OpenVMS Alpha System Analysis Tools Manual

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This manual explains how to use various Alpha system analysis tools to investigate system failures and examine a running Compaq OpenVMS system.

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Contents

3 ANALYZE Usage Summary and Qualifiers

4 SDA Commands

5 SDA CLUE Extension Commands

6 SDA Spinlock Tracing Utility

7 SDA Extended File Cache (XFC) Extension Commands

Part II OpenVMS Alpha System Code Debugger and System Dump Debugger

9 The OpenVMS Alpha System Code Debugger

10 The OpenVMS Alpha System Dump Debugger

Part III OpenVMS Watchpoint Utility

11 The Watchpoint Utility

Index

Examples

Figures

Tables

Preface

Intended Audience

The *OpenVMS Alpha System Analysis Tools Manual* is intended primarily for the system programmer who must investigate the causes of system failures and debug kernel-mode code, such as a device driver. This manual describes the following system analysis tools in detail; it also provides a summary of the dump off system disk (DOSD) feature and DELTA/XDELTA debugger:

- System Dump Analyzer utility (SDA)
- System code debugger (SCD)
- System dump debugger (SDD)
- Watchpoint utility (WP)

This manual also includes such system management information as maintaining the system resources necessary to capture and store system crash dumps, including the use of dump off system disk (DOSD). If you need to determine the cause of a hung process or improve system performance, refer to this manual for instructions on using the appropriate system analysis tool to analyze a running system.

Document Structure

The *OpenVMS Alpha System Analysis Tools Manual* includes the following information:

Chapter 1 presents an overview of all the system analysis tools. It describes the System Dump Analyzer (SDA), System Code Debugger (SCD), System Dump Debugger (SDD), and Watchpoint utility (WP). It also provides a brief description of the dump off system disk (DOSD) feature and the DELTA/XDELTA debugger.

Part I describes the System Dump Analyzer (SDA) commands, SDA CLUE and spinlock tracing extension commands, and SDA extension routines.

Part II describes the system code debugger (SCD) and the system dump debugger (SDD).

Part III describes the Watchpoint utility (WP).

Related Documents

For additional information, refer to the following documents:

- *OpenVMS Alpha Version 7.3–1 Upgrade and Installation Manual*
- *OpenVMS Calling Standard*
- *OpenVMS System Manager's Manual, Volume 1: Essentials*

- *OpenVMS System Manager's Manual, Volume 2: Tuning, Monitoring, and Complex Systems*
- *OpenVMS Programming Concepts Manual, Volume II*
- *Writing OpenVMS Alpha Device Drivers in C*
- *OpenVMS AXP Internals and Data Structures*
- *Alpha Architecture Reference Manual*
- *MACRO–64 Assembler for OpenVMS AXP Systems Reference Manual*

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Conventions

In this manual, any reference to OpenVMS is synonymous with Compaq OpenVMS.

VMScluster systems are now referred to as OpenVMS Cluster systems. Unless otherwise specified, references to OpenVMS Clusters or clusters in this document are synonymous with VMSclusters.

The following conventions are used in this manual:

Ctrl/*x*	A sequence such as Ctrl/*x* indicates that you must hold down the key labeled Ctrl while you press another key or a pointing device button.
PF1 *x*	A sequence such as PF1 *x* indicates that you must first press and release the key labeled PF1 and then press and release another key or a pointing device button.
$\boxed{\text{Return}}$	In examples, a key name enclosed in a box indicates that you press a key on the keyboard. (In text, a key name is not enclosed in a box.) In the HTML version of this document, this convention appears as brackets, rather than a box.

. . .	A horizontal ellipsis in examples indicates one of the following possibilities: • Additional optional arguments in a statement have been omitted. • The preceding item or items can be repeated one or more times. • Additional parameters, values, or other information can be entered.
. . .	A vertical ellipsis indicates the omission of items from a code example or command format; the items are omitted because they are not important to the topic being discussed.
( )	In command format descriptions, parentheses indicate that you must enclose choices in parentheses if you specify more than one.
[ ]	In command format descriptions, brackets indicate optional choices. You can choose one or more items or no items. Do not type the brackets on the command line. However, you must include the brackets in the syntax for OpenVMS directory specifications and for a substring specification in an assignment statement.
|	In command format descriptions, vertical bars separate choices within brackets or braces. Within brackets, the choices are optional; within braces, at least one choice is required. Do not type the vertical bars on the command line.
{ }	In command format descriptions, braces indicate required choices; you must choose at least one of the items listed. Do not type the braces on the command line.
bold text	This typeface represents the introduction of a new term. It also represents the name of an argument, an attribute, or a reason.
italic text	Italic text indicates important information, complete titles of manuals, or variables. Variables include information that varies in system output (Internal error *number*), in command lines (/PRODUCER=*name*), and in command parameters in text (where *dd* represents the predefined code for the device type).
UPPERCASE TEXT	Uppercase text indicates a command, the name of a routine, the name of a file, or the abbreviation for a system privilege.
`Monospace text`	Monospace type indicates code examples and interactive screen displays. In the C programming language, monospace type in text identifies the following elements: keywords, the names of independently compiled external functions and files, syntax summaries, and references to variables or identifiers introduced in an example.
-	A hyphen at the end of a command format description, command line, or code line indicates that the command or statement continues on the following line.
numbers	All numbers in text are assumed to be decimal unless otherwise noted. Nondecimal radixes—binary, octal, or hexadecimal—are explicitly indicated.

1
Overview of System Analysis Tools

This chapter presents an overview of the following system dump analysis tools and features:

- System Dump Analyzer (SDA)
- System Code Debugger (SCD)
- System Dump Debugger (SDD)
- Watchpoint Utility (WP)
- Delta/XDelta Debugger
- Dump Off System Disk (DOSD)

1.1 System Dump Analyzer (SDA)

The OpenVMS Alpha system dump analyzer (SDA) utility allows you to analyze a running system or a system dump after a system failure occurs. With a system failure, the operating system copies the contents of memory to a system dump file or the primary page file. Additionally, it records the hardware context of each processor. With SDA, you can interpret the contents of the dump file, examine the status of each processor at the fime of the system failure, and investigate the possible causes of failure.

See Part I for complete information about SDA, SDA CLUE (Crash Log Utility Extractor), SDA, SPL (Spinlock Tracing Utility), and SDA Extension routines.

1.2 System Code Debugger (SCD)

The OpenVMS Alpha System Code Debugger (SCD) allows you to debug nonpageable system code and device drivers running at any interupt priority level (IPL). You can use the SCD to perform the following tasks:

- Control the system software's execution—-stop at points of interest, resume execution, intercept fatal exceptions, and so on
- Trace the execution path of the system software
- Display the source code where the software is executing, and step by source line
- Monitor exception conditions
- Examine and modify the values of variables
- In some cases, test the effect of modifications without having to edit the source code, recompile, and relink

SCD is a symbolic debugger. You can specify variable names, routine names, and so on, precisely as they appear in your source code.

SCD recognizes the syntax, data typing, operators, expressions, scoping rules, and other constructs of a given language. If your code or driver is written in more than one language, you can change the debugging context from one language to another during a debugging session.

See Part II for complete information about SCD.

1.3 System Dump Debugger (SDD)

The OpenVMS Alpha System Dump Debugger allows you to analyze certain system dumps using the commands and semantics of SCD. You can use SDD to perform the following tasks:

- Display the source code where the software was executing at the time of the system failure
- Examine the values of variables and registers at the time of the system failure

SDD is a symbolic debugger. You can specify variable names, routine names, and so on, precisely as they appear in your source code.

SDD recognizes the syntax, data typing, operators, expressions, scoping rules, and other constructs of a given language. If your code or driver is written in more than one language, you can change the debugging context from one language to another during a debugging session.

See Part II for complete information about SDD.

1.4 Watchpoint Utility

The OpenVMS Watchpoint utility allows you to maintain a history of modifications that are made to a particular location in shared system space. It sets watchpoints on 32-bit and 64-bit addresses, and watches any system addresses whether in S0, S1, or S2 space.

See Part III for complete information about the Watchpoint utility.

1.5 Delta/XDelta Debugger

The OpenVMS Delta/XDelta debugger allows you to monitor the execution of user programs and the OpenVMS operating system. The Delta/XDelta debuggers both use the same commands and expressions, but they are different in how they operate. Delta operates as an exception handler in a process context; whereas XDelta is invoked directly from the hardware system control block (SCB) vector in a system context.

You use OpenVMS Delta instead of the OpenVMS symbolic debugger to debug programs that run in privileged processor mode at interrupt priority level (IPL) 0. Because Delta operates in a process context, you can use it to debug user-mode programs or programs that execute at interrupt priority level (IPL) 0 in any processor mode—user, supervisor, executive, and kernel. To run Delta in a processor mode other than user mode, your process must have the privilege that allows Delta to change to that mode: change-mode-to-executive (CMEXEC), or change-mode-to-kernel (CMKRNL) privilege. You cannot use Delta to debug code that executes at an elevated IPL. To debug with Delta, you invoke it from within your process by specifying it as the debugger instead of the symbolic debugger.

You use OpenVMS XDelta instead of the System Code Debugger when debugging system code that runs early in booting or when there is no Ethernet adaptor that can be dedicated to SCD. Because XDelta is invoked directly from the hardware system control block (SCB), it can be used to debug programs executing in any processor mode or at any IPL level. To use XDelta, you must have system privileges, and you must include XDelta when you boot the system. Since XDelta is not process specific, it is not invoked from a process. To debug with XDelta, you must boot the system with a command to include XDelta in memory. XDelta's existence terminates when you reboot the system without XDelta.

On OpenVMS Alpha systems, XDelta supports 64-bit addressing. Quadword display mode displays full quadwords of information. The 64-bit address display mode accepts and displays all addresses as 64-bit quantities. XDelta has predefined command strings for displaying the contents of the page frame number (PFN) database.

You can use Delta/XDelta commands to perform the following debugging tasks:

- Open, display, and change the value of a particular location
- Set, clear, and display breakpoints
- Set, display modes in byte, word, longword, or ASCII
- Display instructions
- Execute the program in a single step with the option to step over a subroutine
- Set base registers
- List the names and locations of all loaded modules of the executive
- Map an address to an executive module

See the *OpenVMS Delta/XDelta Debugger Manual* for complete information about using the Delta/XDelta debugging utility.

1.6 Dump Off System Disk (DOSD)

The OpenVMS Alpha system allows you to write the system dump file to a device other than the system disk. This is useful in large memory systems and in clusters with common system disks where sufficient disk space, on one disk, is not always available to support your dump file requirements. To perform this activity, you must correctly enable the DUMPSTYLE system parameter to allow the bugcheck code to write the system dump file to an alternative device.

See the *OpenVMS System Manager's Manual, Volume 2: Tuning, Monitoring, and Complex Systems* for complete information about how to write the system dump file to a disk other than the system disk.

Part I

OpenVMS Alpha System Dump Analyzer (SDA)

Part 1 describes the capabilities and system management of SDA. It provides how to use SDA by doing the following:

- Analyzing a system dump and a running system
- Understanding SDA context and commands
- Investigating system failures
- Inducing system failures
- Understanding the ANALYZE command and qualifiers
- Invoking SDA commands, SDA CLUE extension commands, SDA Spinlock Tracing commands, and SDA extension routines

2

SDA Description

This chapter describes the functions and the system management of SDA. It describes initialization, operation, and procedures in analyzing a system dump and analyzing a running system. This chapter also describes the SDA context, the command format, and the way both to investigate system failures and induce system failures.

2.1 Capabilities of SDA

When a system failure occurs, the operating system copies the contents of memory to a system dump file or the primary page file, recording the hardware context of each processor in the system as well. The System Dump Analyzer (SDA) is a utility that allows you to interpret the contents of this file, examine the status of each processor at the time of the system failure, and investigate the probable causes of the failure.

You can invoke SDA to analyze a system dump, using the DCL command ANALYZE/CRASH_DUMP. You can then use SDA commands to perform the following operations:

- Direct (or echo) the output of an SDA session to a file or device (SET OUTPUT or SET LOG).
- Display the condition of the operating system and the hardware context of each processor in the system at the time of the system failure (SHOW CRASH or CLUE CRASH).
- Select a specific processor in a multiprocessing system as the subject of analysis (SET CPU).
- Select the default size of address data manipulated by the EXAMINE and EVALUATE commands (SET FETCH).
- Enable or disable the sign extension of 32-bit addresses (SET SIGN_EXTEND).
- Display the contents of a specific process stack (SHOW STACK or CLUE STACK).
- Format a call frame from a stack location (SHOW CALL_FRAME).
- Read a set of global symbols into the SDA symbol table (READ).
- Define symbols to represent values or locations in memory and add them to the SDA symbol table (DEFINE).
- Delete symbols not required from the SDA symbol table (UNDEFINE).
- Evaluate an expression in hexadecimal and decimal, interpreting its value as a symbol, a condition value, a page table entry (PTE), a processor status (PS) quadword, or date and time (EVALUATE).

- Examine the contents of memory locations, optionally interpreting them as Alpha assembler instructions, a PTE, a PS, or date and time (EXAMINE).
- Display device status as reflected in system data structures (SHOW DEVICE).
- Display the contents of the stored machine check frame (SHOW MACHINE_CHECK or CLUE MCHK) for selected Compaq computers.
- Format system data structures (FORMAT).
- Validate the integrity of the links in a queue (VALIDATE QUEUE).
- Display a summary of all processes on the system (SHOW SUMMARY).
- Show the hardware or software context of a process (SHOW PROCESS or CLUE PROCESS).
- Display the OpenVMS RMS data structures of a process (SHOW PROCESS with the /RMS qualifier).
- Display memory management data structures (SHOW POOL, SHOW PFN_DATA, SHOW PAGE_TABLE, or CLUE MEMORY).
- Display lock management data structures (SHOW RESOURCES or SHOW LOCKS).
- Display OpenVMS Cluster management data structures (SHOW CLUSTER, SHOW CONNECTIONS, SHOW RSPID, or SHOW PORTS).
- Display multiprocessor synchronization information (SHOW SPINLOCKS).
- Display the layout of the executive images (SHOW EXECUTIVE).
- Capture and archive a summary of dump file information in a list file (CLUE HISTORY).
- Copy the system dump file (COPY).
- Define keys to invoke SDA commands (DEFINE/KEY).
- Search memory for a given value (SEARCH).

Although SDA provides a great deal of information, it does not automatically analyze all the control blocks and data contained in memory. For this reason, in the event of system failure, it is extremely important that you save not only the output provided by SDA commands, but also a copy of the system dump file written at the time of the failure.

You can also invoke SDA to analyze a running system, using the DCL command ANALYZE/SYSTEM. Most SDA commands generate useful output when entered on a running system.

Caution:

Although analyzing a running system may be instructive, you should undertake such an operation with caution. System context, process context, and a processor’s hardware context can change during any given display.

In a multiprocessing environment, it is very possible that, during analysis, a process running SDA could be rescheduled to a different processor frequently. Therefore, avoid examining the hardware context of processors in a running system.

2.2 System Management and SDA

The system manager must ensure that the system writes a dump file whenever the system fails. The manager must also see that the dump file is large enough to contain all the information to be saved, and that the dump file is saved for analysis. The following sections describe these tasks.

2.2.1 Writing System Dumps

The operating system attempts to write information into the system dump file only if the system parameter DUMPBUG is set. (The DUMPBUG parameter is set by default. To examine and change its value, consult the *OpenVMS System Manager's Manual, Volume 2: Tuning, Monitoring, and Complex Systems*.) If DUMPBUG is set and the operating system fails, the system manager has the following choices for writing system dumps:

- Have the system dump file written to either SYSDUMP.DMP (the system dump file) or to PAGEFILE.SYS (the primary system page file).
- Set the DUMPSTYLE system parameter to an even number (for dumps containing all physical memory) or to an odd number (for dumps containing only selected virtual addresses). See Section 2.2.1.1 for more information about the DUMPSTYLE parameter values.

2.2.1.1 Dump File Style

There are two types of dump files—a full memory dump (also known as a physical dump), and a dump of selected virtual addresses (also known as a selective dump). Both full and selective dumps may be produced in either compressed or uncompressed form. Compressed dumps save disk space and time taken to write the dump at the expense of a slight increase in time to access the dump with SDA. The SDA commands COPY/COMPRESS and COPY/DECOMPRESS can be used to convert an existing dump.

A dump can be written to the system disk, or to another disk set aside for dumps. When using a disk other than a system disk, the disk name is set in the console environment variable DUMP_DEV. This disk is also known as the “dump off system disk” (DOSD) disk.

When writing a system dump, information about the crash is displayed at the system console. This can be either minimal output (for example, bug check code, process name, and image name), or verbose output (for example, executive layout, stack and register contents).

In an OpenVMS Alpha Galaxy system, shared memory is dumped by default. It is sometimes necessary to disable the dumping of shared memory. For more information about shared memory, see *OpenVMS Alpha Galaxy Guide*.

DUMPSTYLE, which specifies the method of writing system dumps, is a 32-bit mask. Table 2–1 shows how the bits are defined. Each bit can be set independently. The value of the SYSGEN parameter is the sum of the values of the bits that have been set. Remaining or undefined values are reserved to Compaq.

Table 2–1 Definitions of Bits in DUMPSTYLE

Bit	Value	Description
0	1	0= Full dump. The entire contents of physical memory will be written to the dump file. 1= Selective dump. The contents of memory will be written to the dump file selectively to maximize the usefulness of the dump file while conserving disk space. (Only pages that are in use are written).
1	2	0= Minimal console output. This consists of the bugcheck code; the identity of the CPU, process, and image where the crash occurred; the system date and time; plus a series of dots indicating progress writing the dump. 1= Full console output. This includes the minimal output previously described plus stack and register contents, system layout, and additional progress information such as the names of processes as they are dumped.
2	4	0= Dump to system disk. The dump will be written to SYS$SYSDEVICE:[SYSn.SYSEXE]SYSDUMP.DMP, or in its absence, SYS$SYSDEVICE:[SYSn.SYSEXE]PAGEFILE.SYS. 1= Dump to alternate disk. The dump will be written to dump_dev:[SYSn.SYSEXE]SYSDUMP.DMP, where dump_dev is the value of the console environment variable DUMP_DEV.
3	8	0= Uncompressed dump. Pages are written directly to the dump file. 1= Compressed dump. Each page is compressed before it is written, providing a saving in space and in the time taken to write the dump, at the expense of a slight increase in time taken to access the dump.
4	16	0= Dump shared memory. 1= Do not dump shared memory.
5–31		Reserved to Compaq

The default setting for DUMPSTYLE is 0 (an uncompressed full dump, including shared memory, written to the system disk). Unless a value for DUMPSTYLE is specified in MODPARAMS.DAT, AUTOGEN.COM will set DUMPSTYLE either to 1 (an uncompressed selective dump, including shared memory, written to the system disk) if there is less than 128 megabytes of memory on the system, or to 9 (a compressed selective dump, including shared memory, written to the system disk).

2.2.1.2 Comparison of Full and Selective Dumps

A full dump requires that all physical memory be written to the dump file. This ensures the presence of all the page table pages required for SDA to emulate translation of system virtual addresses. Any even-numbered value in the DUMPSTYLE system parameter generates a full dump.

In certain system configurations, it may be impossible to preserve the entire contents of memory in a disk file. For instance, a large memory system or a system with small disk capacity may not be able to supply enough disk space for a full memory dump. If the system dump file cannot accommodate all of memory, information essential to determining the cause of the system failure may be lost.

To preserve those portions of memory that contain information most useful in determining the causes of system failures, a system manager sets the value of the DUMPSTYLE system parameter to specify a dump of selected virtual address spaces. In a selective dump, related pages of virtual address space are written to the dump file as units called logical memory blocks (LMBs). For example, one LMB consists of the page tables for system space; another is the address space of a particular process. Those LMBs most likely to be useful in crash dump analysis are written first. Any odd-numbered value in the DUMPSTYLE system parameter generates a selective dump.

Table 2–2 compares full and selective style dumps.

Table 2–2 Comparison of Full and Selective Dumps

Item	Full	Selective
Available Information	Complete contents of physical memory in use, stored in order of increasing physical address.	System page table, global page table, system space memory, and process and control regions (plus global pages) for all saved processes.
Unavailable Information	Contents of paged-out memory at the time of the system failure.	Contents of paged-out memory at the time of the system failure, process and control regions of unsaved processes, and memory not mapped by a page table.
SDA Command Limitations	None.	The following commands are not useful for unsaved processes: SHOW PROCESS/CHANNELS, SHOW PROCESS/IMAGE, SHOW PROCESS/RMS, SHOW STACK, and SHOW SUMMARY/IMAGE.

2.2.1.3 Controlling the Size of Page Files and Dump Files

You can adjust the size of the system page file and dump file using AUTOGEN (the recommended method) or by using SYSGEN.

AUTOGEN automatically calculates the appropriate sizes for page and dump files. AUTOGEN invokes the System Generation utility (SYSGEN) to create or change the files. However, you can control sizes calculated by AUTOGEN by defining symbols in the MODPARAMS.DAT file. The file sizes specified in MODPARAMS.DAT are copied into the PARAMS.DAT file during AUTOGEN's GETDATA phase. AUTOGEN then makes appropriate adjustments in its calculations.

Although Compaq recommends using AUTOGEN to create and modify page and dump file sizes, you can use SYSGEN to directly create and change the sizes of those files.

The sections that follow discuss how you can calculate the size of a dump file.

See the *OpenVMS System Manager's Manual* for detailed information about using AUTOGEN and SYSGEN to create and modify page and dump file sizes.

2.2.1.4 Writing to the System Dump File

OpenVMS Alpha writes the contents of the error-log buffers, processor registers, and memory into the system dump file, overwriting its previous contents. If the system dump file is too small, OpenVMS Alpha cannot copy all memory to the file when a system failure occurs.

SYS$SYSTEM:SYSDUMP.DMP (SYS$SPECIFIC:[SYSEXE]SYSDUMP.DMP) is created during installation. To successfully store a crash dump, SYS$SYSTEM:SYSDUMP.DMP must be enlarged to hold all of memory (full dump) or all of system space and the key processes (selective dump).

To calculate the correct size for an uncompressed full dump to SYS$SYSTEM:SYSDUMP.DMP, use the following formula:

```
size-in-blocks(SYS$SYSTEM:SYSDUMP.DMP)
        = size-in-pages(physical-memory) * blocks-per-page
        + number-of-error-log-buffers * blocks-per-buffer
        + 10
```

Use the DCL command SHOW MEMORY to determine the total size of physical memory on your system. There is a variable number of error log buffers in any given system, depending on the setting of the ERRORLOGBUFFERS system parameter. The size of each buffer depends on the setting of the ERLBUFFERPAGES parameter. (See the *OpenVMS System Manager's Manual* for additional information about these parameters.)

2.2.1.5 Writing to the Dump File off the System Disk

OpenVMS Alpha allows you to write the system dump file to a device other than the system disk. This is useful in large memory systems and in clusters with common system disks where sufficient disk space, on one disk, is not always available to support customer dump file requirements. To perform this activity, the DUMPSTYLE system parameter must be correctly enabled to allow the bugcheck code to write the system dump file to an alternative device.

The requirements for writing the system dump file off the system disk are the following:

- The dump device directory structure must resemble the current system disk structure. The [SYSn.SYSEXE]SYSDUMP.DMP file will reside there, with the same boot time system root.

  You can use AUTOGEN to create this file. In the MODPARAMS.DAT file, the following symbol prompts AUTOGEN to create the file:

  ```
  DUMPFILE_DEVICE = $nnn$ddcuuuu
  ```

- The dump device cannot be part of a volume set or a member of a shadow set.
- You must set up DOSD for SDA CLUE as described in Chapter 5.
- The DUMP_DEV environment variable must exist on your system. You specify the dump device at the console prompt, using the following format:
  `>>>SET DUMP_DEV device-name[,...]`

  On some CPU types, you can enter a list of devices. The list can include various alternate paths to the system disk and the dump disk.

  By specifying alternate paths in DUMP_DEV, a dump can still be written if the disk fails over to an alternate path while the system is running. When the system crashes, the bugcheck code can use the alternate path by referring to the contents of DUMP_DEV.

  When you enter a list of devices, however, the system disk must come last.

For information on how to write the system dump file to an alternative device to the system disk, see the *OpenVMS System Manager's Manual, Volume 2: Tuning, Monitoring, and Complex Systems*.

2.2.1.6 Writing to the System Page File

If SYS$SYSTEM:SYSDUMP.DMP does not exist, and there is no DOSD device or dump file, the operating system writes the dump of physical memory into SYS$SYSTEM:PAGEFILE.SYS, the primary system page file, overwriting the contents of that file.

If the SAVEDUMP system parameter is set, the dump file is retained in PAGEFILE.SYS when the system is booted after a system failure. If the SAVEDUMP parameter is not set, which is the default, OpenVMS Alpha uses the entire page file for paging and any dump written to the page file is lost. (To examine or change the value of the SAVEDUMP parameter, consult the *OpenVMS System Manager's Manual, Volume 2: Tuning, Monitoring, and Complex Systems*.)

To calculate the minimum size for a full memory dump to SYS$SYSTEM:PAGEFILE.SYS, use the following formula:

```
size-in-blocks(SYS$SYSTEM:PAGEFILE.SYS)
        = size-in-pages(physical-memory) * blocks-per-page
        + number-of-error-log-buffers  * blocks-per-buffer
        + 10
        + value of the system parameter RSRVPAGCNT * blocks-per-page
```

Note that this formula calculates the minimum size requirement for saving a physical dump in the system's page file. Compaq recommends that the page file be a bit larger than this minimum to avoid hanging the system. Also note that you can only write the system dump into the primary page file (SYS$SYSTEM:PAGEFILE.SYS). Secondary page files cannot be used to save dump file information.

Note also that OpenVMS will not fill the page file completely when writing a system dump, since the system might hang when rebooting after a system crash. RSRVPAGCNT pages are kept unavailable for dumps. This applies to both full dumps and selective dumps.

Writing crash dumps to SYS$SYSTEM:PAGEFILE.SYS presumes that you will later free the space occupied by the dump for use by the pager. Otherwise, your system may hang during the startup procedure. To free this space, you can do one of the following:

- Include SDA commands that free dump space in the site-specific startup command procedure (described in Section 2.2.3).
- Use the SDA COPY command to copy the dump from SYS$SYSTEM:PAGEFILE.SYS to another file. Use the SDA COPY command instead of the DCL COPY command because the SDA COPY command only copies the blocks used by the dump and causes the pages occupied by the dump to be freed from the system's page file.
- If you do not need to copy the dump elsewhere, issue an ANALYZE/CRASH_DUMP/RELEASE command. When you issue this command, SDA immediately releases the pages to be used for system paging, effectively deleting the dump. Note that this command does not allow you to analyze the dump before deleting it.

2.2.2 Saving System Dumps

Every time the operating system writes information to the system dump file, it writes over whatever was previously stored in the file. The system writes information to the dump file whenever the system fails. For this reason, the system manager must save the contents of the file after a system failure has occurred.

The system manager can use the SDA COPY command or the DCL COPY command. Either command can be used in a site-specific startup procedure, but the SDA COPY command is preferred because it marks the dump file as copied. As mentioned earlier, this is particularly important if the dump was written into the page file, SYS$SYSTEM:PAGEFILE.SYS, because it releases those pages occupied by the dump to the pager. Another advantage of using the SDA COPY command is that this command copies only the saved number of blocks and not necessarily the whole allotted dump file. For instance, if the size of the SYSDUMP.DMP file is 100,000 blocks and the bugcheck wrote only 60,000 blocks to the dump file, then DCL COPY would create a file of 100,000 blocks. However, SDA COPY would generate a file of only 60,000 blocks.

Because system dump files are set to NOBACKUP, the Backup utility (BACKUP) does not copy them to tape unless you use the qualifier /IGNORE=NOBACKUP when invoking BACKUP. When you use the SDA COPY command to copy the system dump file to another file, OpenVMS Alpha does not set the new file to NOBACKUP.

As created during installation, the file SYS$SYSTEM:SYSDUMP.DMP is protected against world access. Because a dump file can contain privileged information, Compaq recommends that the system manager does not change this default protection.

2.2.3 Invoking SDA When Rebooting the System

When the system reboots after a system failure, SDA is automatically invoked by default. SDA archives information from the dump in a history file. In addition, a listing file with more detailed information about the system failure is created in the directory pointed to by the logical name CLUE$COLLECT. (Note that the default directory is SYS$ERRORLOG unless you redefine the logical name CLUE$COLLECT in the procedure SYS$MANAGER:SYLOGICALS.COM.) The file name is in the form CLUE$*node_ddmmyy_hhmm*.LIS where the timestamp (*hhmm*) corresponds to the system failure time and not the time when the file was created.

Directed by commands in a site-specific file, SDA can take additional steps to record information about the system failure. They include the following:

- Copying the contents of the dump file to another file. This information is otherwise lost at the next system failure when the system saves information only about that failure.
- Supplementing the contents of the list file containing the output of specific SDA commands.

  If the logical name CLUE$SITE_PROC points to a valid and existing command file, it will be executed as part of the CLUE HISTORY command when you reboot. If used, this file should contain only valid SDA commands.

Generated by a set sequence of commands, the CLUE list file contains only an overview of the failure and is unlikely to provide enough information to determine the cause of the failure. Compaq, therefore, recommends that you always copy the dump file.

The following example shows SDA commands that can make up your site-specific command file to produce a more complete SDA listing after each system failure, and to save a copy of the dump file:

```
!
! SDA command file, to be executed as part of the system
! bootstrap from within CLUE. Commands in this file can
! be used to save the dump file after a system bugcheck, and
! to execute any additional SDA commands.
!
! Note that the logical name DMP$ must have been defined
! within SYS$MANAGER:SYLOGICALS.COM
!
READ/EXEC                    ! read in the executive images' symbol tables
SHOW STACK                   ! display the stack
COPY DMP$:SAVEDUMP.DMP       ! copy and save dump file
!
```

The CLUE HISTORY command is executed first, followed by the SDA commands in this site-specific command file. See the reference section on CLUE HISTORY for details on the summary information that is generated and stored in the CLUE list file by the CLUE HISTORY command. Note that the SDA COPY command is final command. If the dump has been written to PAGEFILE.SYS, then the space used by the dump will be automatically returned for use for paging as soon as the COPY is complete and no more analysis is possible.

To point to your site-specific file, add a line such as the following to the file SYS$MANAGER:SYLOGICALS.COM:

```
$ DEFINE/SYSTEM CLUE$SITE_PROC SYS$MANAGER:SAVEDUMP.COM
```

In this example, the site-specific file is named SAVEDUMP.COM.

The CLUE list file can be printed immediately or saved for later examination.

SDA is invoked and executes the specified commands only when the system boots for the first time after a system failure. If the system is booting for any other reason (such as a normal system shutdown and reboot), SDA exits.

If CLUE files occupy more space than the threshold allows (the default is 5000 blocks), the oldest files will be deleted until the threshold limit is reached. The threshold limit can be customized with the CLUE$MAX_BLOCK logical name.

To prevent the running of CLUE at system startup, define the logical CLUE$INHIBIT in the SYLOGICALS.COM file as TRUE in the system logical name table.

2.3 Analyzing a System Dump

SDA performs certain tasks before bringing a dump into memory, presenting its initial displays, and accepting command input. These tasks include the following:

- Verifying that the process invoking it is suitably privileged to read the dump file
- Using RMS to read in pages from the dump file

- Building the SDA symbol table from the files SDA$READ_DIR:SYS$BASE_IMAGE.EXE and SDA$READ_DIR:REQSYSDEF.STB
- Executing the commands in the SDA initialization file

For detailed information on investigating system failures, see Section 2.7.

2.3.1 Requirements

To analyze a dump file, your process must have read access both to the file that contains the dump and to copies of SDA$READ_DIR:SYS$BASE_IMAGE.EXE and SDA$READ_DIR:REQSYSDEF.STB (the required subset of the symbols in the file SYSDEF.STB). SDA reads these tables by default.

2.3.2 Invoking SDA

If your process can access the files listed in Section 2.3.1, you can issue the DCL command ANALYZE/CRASH_DUMP to invoke SDA. If you do not specify the name of a dump file in the command, SDA prompts you:

```
$ ANALYZE/CRASH_DUMP
_Dump File:
```

The default file specification is as follows:

SYS$DISK:[default-dir]SYSDUMP.DMP

SYS$DISK and [default-dir] represent the disk and directory specified in your last SET DEFAULT command.

If you are rebooting after a system failure, SDA is automatically invoked. See Section 2.2.3.

2.3.3 Mapping the Contents of the Dump File

SDA first attempts to map the contents of memory as stored in the specified dump file. To do this, it must first locate the page tables for system space among its contents. The system page tables contain one entry for each page of system virtual address space.

- If SDA cannot find the system page tables in the dump file, it displays the following message:

  ```
  %SDA-E-SPTNOTFND, system page table not found in dump file
  ```

  If that error message is displayed, you cannot analyze the crash dump, but must take steps to ensure that any subsequent dump can be analyzed. To do this, you must either adjust the DUMPSTYLE system parameter as discussed in Section 2.2.1.1 or increase the size of the dump file as indicated in Section 2.2.1.3.

- If SDA finds the system page tables in an incomplete dump, the following message is displayed:

  ```
  %SDA-W-SHORTDUMP, dump file was n blocks too small when dump written;
                    analysis may not be possible
  ```

Under certain conditions, some memory locations might not be saved in the system dump file. Additionally, if a bugcheck occurs during system initialization, the contents of the register display may be unreliable. The symptom of such a bugcheck is a SHOW SUMMARY display that shows no processes or only the swapper process.

If you use an SDA command to access a virtual address that has no corresponding physical address, SDA generates the following error message:

```
%SDA-E-NOTINPHYS, 'location': virtual data not in physical memory
```

When analyzing a selective dump file, if you use an SDA command to access a virtual address that has a corresponding physical address not saved in the dump file, SDA generates one of the following error messages:

```
%SDA-E-MEMNOTSVD, memory not saved in the dump file
```

```
%SDA-E-NOREAD, unable to access location n
```

2.3.4 Building the SDA Symbol Table

After locating and reading the system dump file, SDA attempts to read the system symbol table file into the SDA symbol table. If SDA cannot find SDA$READ_DIR:SYS$BASE_IMAGE.EXE—or is given a file that is not a system symbol table in the /SYMBOL qualifier to the ANALYZE command—it displays a fatal error and exits. SDA also reads into its symbol table a subset of SDA$READ_DIR:SYSDEF.STB, called SDA$READ_DIR:REQSYSDEF.STB. This subset provides SDA with the information needed to access some of the data structures in the dump.

When SDA finishes building its symbol table, SDA displays a message identifying itself and the immediate cause of the system failure. In the following example, the cause of the system failure was the deallocation of a bad page file address.

```
OpenVMS Alpha System Dump Analyzer

Dump taken on 27-MAR-1993  11:22:33.92
BADPAGFILD, Bad page file address deallocated
```

2.3.5 Executing the SDA Initialization File (SDA$INIT)

After displaying the system failure summary, SDA executes the commands in the SDA initialization file, if you have established one. SDA refers to its initialization file by using the logical name SDA$INIT. If SDA cannot find the file defined as SDA$INIT, it searches for the file SYS$LOGIN:SDA.INIT.

This initialization file can contain SDA commands that read symbols into SDA's symbol table, define keys, establish a log of SDA commands and output, or perform other tasks. For instance, you may want to use an SDA initialization file to augment SDA's symbol table with definitions helpful in locating system code. If you issue the following command, SDA includes those symbols that define many of the system's data structures, including those in the I/O database:

```
READ SDA$READ_DIR:filename
```

You may also find it helpful to define those symbols that identify the modules in the images that make up the executive by issuing the following command:

```
READ/EXECUTIVE SDA$READ_DIR:
```

After SDA has executed the commands in the initialization file, it displays its prompt as follows:

```
SDA>
```

This prompt indicates that you can use SDA interactively and enter SDA commands.

An SDA initialization file may invoke a command procedure with the @ command. However, such command procedures cannot invoke other command procedures.

2.4 Analyzing a Running System

Occasionally, OpenVMS Alpha encounters an internal problem that hinders system performance without causing a system failure. By allowing you to examine the running system, SDA enables you to search for the solution without disturbing the operating system. For example, you may be able to use SDA to examine the stack and memory of a process that is stalled in a scheduler state, such as a miscellaneous wait (MWAIT) or a suspended (SUSP) state.

If your process has change-mode-to-kernel (CMKRNL) privilege, you can invoke SDA to examine the system. Use the following DCL command:

```
$ ANALYZE/SYSTEM
```

SDA attempts to load SDA$READ_DIR:SYS$BASE_IMAGE.EXE and SDA$READ_DIR:REQSYSDEF.STB. It then executes the contents of any existing SDA initialization file, as it does when invoked to analyze a crash dump (see Sections 2.3.4 and 2.3.5, respectively). SDA subsequently displays its identification message and prompt, as follows:

```
OpenVMS Alpha System Analyzer

SDA>
```

This prompt indicates that you can use SDA interactively and enter SDA commands. When analyzing a running system, SDA sets its process context to that of the process running SDA.

If you are analyzing a running system, consider the following:

- When used in this mode, SDA does not map the entire system, but instead retrieves only the information it needs to process each individual command. To update any given display, you must reissue the previous command.

  Caution:

  When using SDA to analyze a running system, carefully interpret its displays. Because system states change frequently, it is possible that the information SDA displays may be inconsistent with the current state of the system.

- Certain SDA commands are illegal in this mode, such as SHOW CPU and SET CPU. Use of these commands results in the following error message:

  ```
  %SDA-E-CMDNOTVLD, command not valid on the running system
  ```

- The SHOW CRASH command, although valid, does not display the contents of any of the processor's set of hardware registers.

2.5 SDA Context

When you invoke SDA to analyze either a crash dump or a running system, SDA establishes a default context for itself from which it interprets certain commands.

When you are analyzing a uniprocessor system, SDA's context is solely **process context**, which means SDA can interpret its process-specific commands in the context of either the process current on the uniprocessor or some other process in another scheduling state. When SDA is initially invoked to analyze a crash dump, SDA's process context defaults to that of the process that was current at the time of the system failure. When you invoke SDA to analyze a running system, SDA's process context defaults to that of the current process, that is, the one executing SDA. To change SDA's process context, issue any of the following commands:

SET PROCESS **process-name**
SET PROCESS/ADDRESS=**pcb-address**
SET PROCESS/INDEX=**nn**
SET PROCESS/SYSTEM
SHOW PROCESS **process-name**
SHOW PROCESS/ADDRESS=**pcb-address**
SHOW PROCESS/INDEX=**nn**
SHOW PROCESS/SYSTEM

When you invoke SDA to analyze a crash dump from a multiprocessing system with more than one active CPU, SDA maintains a second dimension of context—its **CPU context—**that allows it to display certain processor-specific information. This information includes the reason for the bugcheck exception, the currently executing process, the current IPL, and the spin locks owned by the processor. When you invoke SDA to analyze a multiprocessor's crash dump, its CPU context defaults to that of the processor that induced the system failure. When you are analyzing a running system, CPU context is not accessible to SDA. Therefore, the SET CPU and SHOW CPU commands are not permitted.

You can change the SDA CPU context by using any of the following commands:

SET CPU **cpu-id**
SHOW CPU **cpu-id**
SHOW CRASH
SHOW MACHINE_CHECK **cpu-id**

Changing CPU context involves an implicit change in process context in either of the following ways:

- If there is a current process on the CPU made current, SDA process context is changed to that of that CPU's current process.
- If there is no current process on the CPU made current, SDA process context is undefined and no process-specific information is available until SDA process context is set to that of a specific process.

Changing process context can require a switch of CPU context as well. For instance, if you issue a SET PROCESS command for a process that was current at the time of a system failure on another CPU, SDA will automatically change its CPU context to that of the CPU on which that process was current. The following commands can have this effect if the **process-name**, **pcb-address**, or index number (**nn**) refers to a current process:

SET PROCESS **process-name**
SET PROCESS/ADDRESS=**pcb-address**
SET PROCESS/INDEX=**nn**
SHOW PROCESS **process-name**
SHOW PROCESS/ADDRESS=**pcb-address**
SHOW PROCESS/INDEX=**nn**

2.6 SDA Command Format

The following sections describe the format of SDA commands and the expressions you can use with SDA commands.

2.6.1 General Command Format

SDA uses a command format similar to that used by the DCL interpreter. Issue commands in the following format:

command-name[/qualifier...] [parameter][/qualifier...] [!comment]

The **command-name** is an SDA command. Each command tells the utility to perform a function. Commands can consist of one or more words, and can be abbreviated to the number of characters that make the command unique. For example, SH stands for SHOW.

The **parameter** is the target of the command. For example, SHOW PROCESS RUSKIN tells SDA to display the context of the process RUSKIN. The command EXAMINE 80104CD0;40 displays the contents of 40 bytes of memory, beginning with location 80104CD0.

When you supply part of a file specification as a parameter, SDA assumes default values for the omitted portions of the specification. The default device is SYS$DISK, the device specified in your most recent SET DEFAULT command. The default directory is the directory specified in the most recent SET DEFAULT command. See the *OpenVMS DCL Dictionary* for a description of the DCL command SET DEFAULT.

The **qualifier** modifies the action of an SDA command. A qualifier is always preceded by a slash (/). Several qualifiers can follow a single parameter or command name, but each must be preceded by a slash. Qualifiers can be abbreviated to the shortest string of characters that uniquely identifies the qualifier.

The **comment** consists of text that describes the command; this comment is not actually part of the command. Comments are useful for documenting SDA command procedures. When executing a command, SDA ignores the exclamation point and all characters that follow it on the same line.

2.6.2 Expressions

You can use expressions as parameters for some SDA commands, such as SEARCH and EXAMINE. To create expressions, use any of the following elements:

- Numerals
- Radix operators
- Arithmetic and logical operators
- Precedence operators
- Symbols

Numerals are one possible component of an expression. The following sections describe the use of the other components.

2.6.2.1 Radix Operators

Radix operators determine which numeric base SDA uses to evaluate expressions. You can use one of the three radix operators to specify the radix of the numeric expression that follows the operator:

- ^X (hexadecimal)
- ^O (octal)
- ^D (decimal)

The default radix is hexadecimal. SDA displays hexadecimal numbers with leading zeros and decimal numbers with leading spaces.

2.6.2.2 Arithmetic and Logical Operators

There are two types of arithmetic and logical operators, both of which are listed in Table 2–3.

- **Unary operators** affect the value of the expression that follows them.
- **Binary operators** combine the operands that precede and follow them.

In evaluating expressions containing binary operators, SDA performs logical AND, OR, and XOR operations, and multiplication, division, and arithmetic shifting before addition and subtraction. Note that the SDA arithmetic operators perform integer arithmetic on 64-bit operands.

Table 2–3 SDA Operators

Operator	Action
Unary Operators	
#	Performs a logical NOT of the expression
+	Makes the value of the expression positive
–	Makes the value of the expression negative
@	Evaluates the following expression as an address, then uses the contents of that address as value
^Q	Specifies that the size of field to be used as an address is a quadword when used with the unary operator @[1]
^L	Specifies that the size of field to be used as an address is a longword when used with the unary operator @[1]
^W	Specifies that the size of field to be used as an address is a word when used with the unary operator @[1]
^B	Specifies that the size of field to be used as an address is a byte when used with the unary operator @[1]
^P	Specifies a physical address when used with the unary operator @[1]
^V	Specifies a virtual address when used with the unary operator @[1]
G	Adds FFFFFFFF 80000000_{16} to the value of the expression[2].

[1]The command SET FETCH can be used to change the default FETCH size and/or access method. See the SET FETCH command description in Chapter 4 for more details and examples.

[2]The unary operator G corresponds to the first virtual address in S0 system space. For example, the expression GD40 can be used to represent the address FFFFFFFF $80000D40_{16}$.

(continued on next page)

Table 2–3 (Cont.) SDA Operators

Operator	Action
Unary Operators	
H	Adds $7FFE0000_{16}$ to the value of the expression[3].

I	Fills the leading digits of the following hexadecimal number with hex value of F. For example:
	`SDA> eval i80000000`
	`Hex = FFFFFFFF.80000000 Decimal = -2147483648 G`
	`SYS$PUBLIC_VECTORS_NPRO`

Binary Operators	
+	Addition
–	Subtraction
*	Multiplication
&	Logical AND
|	Logical OR
\	Logical XOR
/	Division[4]
@	Arithmetic shifting

"."	Catenates two 32-bit values into a 64-bit value. For example:
	`SDA> eval fe.50000`
	`Hex = 000000FE00050000   Decimal = 1090922020864`

[3]The unary operator H corresponds to a convenient base address in P1 space ($7FFE0000_{16}$). You can therefore refer to an address such as $7FFE2A64_{16}$ as H2A64.

[4]In division, SDA truncates the quotient to an integer, if necessary, and does not retain a remainder.

2.6.2.3 Precedence Operators

SDA uses parentheses as **precedence operators**. Expressions enclosed in parentheses are evaluated first. SDA evaluates nested parenthetical expressions from the innermost to the outermost pairs of parentheses.

2.6.2.4 Symbols

A **symbol** can represent a few different types of values. It can represent a constant, a data address, a procedure descriptor address, or a routine address. Constants are usually offsets of a particular field in a data structure; however, they can also represent constant values such as the BUG$_*xxx* symbols.

All address symbols identify memory locations. SDA generally does not distinguish among different types of address symbols. However, for a symbol identified as the name of a procedure descriptor, SDA takes an additional step of creating an associated symbol to name the code entry point address of the procedure. It forms the code entry point symbol name by appending _C to the name of the procedure descriptor.

Also, SDA substitutes the code entry point symbol name for the procedure descriptor symbol when you enter the following command:

```
SDA> EXAMINE/INSTRUCTION procedure descriptor
```

For example, enter the following command:

```
SDA> EXAMINE/INSTRUCTION SCH$QAST
```

SDA displays the following information:

```
SCH$QAST_C:     SUBQ    SP,#X40,SP
```

Now enter the EXAMINE command but do not specify the /INSTRUCTION qualifier, as follows:

```
SDA> EXAMINE SCH$QAST
```

SDA displays the following information:

```
SCH$QAST:  0000002C.00003009   ".0..,..."
```

This display shows the contents of the first two longwords of the procedure descriptor.

Note that there are no routine address symbols on Alpha systems, except for those in MACRO-64 assembly language modules. Therefore, SDA creates a routine address symbol for every procedure descriptor it has in its symbol table. The new symbol name is the same as for the procedure descriptor except that it has an _C appended to the end of the name.

Sources for SDA Symbols

SDA can get its information from the following places:

- Images (.EXE files)
- Image symbol table files (.STB files)
- Object files

SDA also defines symbols to access registers and to access common data structures.

The only images with symbols are shareable images and executive images. These images contain only universal symbols, such as constants and addresses.

The image symbol table files are produced by the linker with the /SYMBOLS qualifier. These files normally only contain universal symbols, as do the executable images. However, if the SYMBOL_TABLE=GLOBALS linker option is specified, the .STB file also contains all global symbols defined in the image. See the *OpenVMS Linker Utility Manual* for more information.

Object files can contain global constant values. An object file used with SDA typically contains symbol definitions for data structure fields. Such an object file can be generated by compiling a MACRO-32 source module that invokes specific macros. The macros, which are typically defined in SYS$LIBRARY:LIB.MLB or STARLET.MLB, define symbols that correspond to data structure field offsets. The macro $UCBDEF, for example, defines offsets for fields within a unit control block (UCB). OpenVMS Alpha provides a number of such object modules in SDA$READ_DIR, as listed in Table 2–4. For compatibility with OpenVMS VAX, the modules' file types have been renamed to .STB.

Table 2–4 Modules Containing Global Symbols and Data Structures Used by SDA

File	Contents
DCLDEF.STB	Symbols for the DCL interpreter
DECDTMDEF.STB	Symbols for transaction processing
GLXDEF.STB	Symbols for OpenVMS Galaxy data structures
IMGDEF.STB	Symbols for the image activator
IODEF.STB	I/O database structure symbols
NETDEF.STB	Symbols for DECnet data structures
REQSYSDEF.STB	Required symbols for SDA
RMSDEF.STB	Symbols that define RMS internal and user data structures and RMS$_*xxx* completion codes
SCSDEF.STB	Symbols that define data structures for system communications services
SYSDEF.STB	Symbols that define system data structures, including the I/O database
TCPIP$NET_GLOBALS.STB[1]	Data structure definitions for TCP/IP internet driver, execlet, and ACP data structures
TCPIP$NFS_GLOBALS.STB[1]	Data structure definitions for TCP/IP NFS server
TCPIP$PROXY_GLOBALS.STB[1]	Data structure definitions for TCP/IP proxy execlet
TCPIP$PWIP_GLOBALS.STB[1]	Data structure definitions for TCP/IP PWIP driver, and ACP data structures
TCPIP$TN_GLOBALS.STB[1]	Data structure definitions for TCP/IP TELNET/RLOGIN server driver data structures

[1]Only available if TCP/IP has been installed. These are found in SYS$SYSTEM, so that all files are not automatically read in when you issue a READ/EXEC command.

Table 2–5 lists symbols that SDA defines automatically on initialization.

Table 2–5 SDA Symbols Defined on Initialization

ASN	Address space number
AST	Both the asynchronous system trap status and enable registers: AST<3:0> = AST enable; AST<7:4> = AST status
ESP	Executive stack pointer
FEN	Floating-point enable
FP	Frame pointer (R29)
FP0 through FP30	Floating-point registers 0-30
FPCR	Floating-point control register
G	$FFFFFFFF.80000000_{16}$, the base address of system space
H	$00000000.7FFE0000_{16}$, a base address in P1 space

(continued on next page)

Table 2–5 (Cont.) SDA Symbols Defined on Initialization

I	$FFFFFFFF.FFFFFFFF_{16}$, also fills the leading digits of a hexadecimal number with the value of F
KSP	Kernel stack pointer
PC	Program counter
PCC	Process cycle counter
PS	Processor status
PTBR	Page table base register
R0 through R29	Integer registers
SCC	System cycle counter
SP	Current stack pointer of a process
SSP	Supervisor stack pointer
USP	User stack pointer

After a SET CPU command is issued (for analyzing a crash dump only), the symbols defined in Table 2–6 are set for that CPU.

Table 2–6 SDA Symbols Defined by SET CPU Command

CPUDB	Address of CPU database
IPL	Interrupt priority level register
MCES	Machine check error summary register
PCBB	Process context block base register
PRBR	Processor base register (CPU database address)
RAD	Address of RAD database
SCBB	System control block base register
SISR	Software interrupt status register
VPTB	Virtual Page Table Base register

After a SET PROCESS command is issued, the symbols listed in Table 2–7 are defined for that process.

Table 2–7 SDA Symbols Defined by SET PROCESS Command

ARB	Address of access rights block
FRED	Address of floating-point register and execution data block
JIB	Address of job information block
KTB	Address of the kernel thread block
ORB	Address of object rights block
PCB	Address of process control block
PHD	Address of process header
PSB	Address of persona security block

Other SDA commands, such as SHOW DEVICE and SHOW CLUSTER, predefine additional symbols.

SDA Symbol Initialization

On initialization, SDA reads the universal symbols defined by SYS$BASE_IMAGE.EXE. For every procedure descriptor address symbol found, a routine address symbol is created (with _C appended to the symbol name).

SDA then reads the object file REQSYSDEF.STB. This file contains data structure definitions that are required for SDA to run correctly. It uses these symbols to access some of the data structures in the crash dump file or on the running system.

Finally, SDA initializes the process registers defined in Table 2–7 and executes a SET CPU command, defining the symbols as well.

Use of SDA Symbols

There are two major uses of the address type symbols. First, the EXAMINE command employs them to find the value of a known symbol. For example, EXAMINE CTL$GL_PCB finds the PCB for the current process. Then, certain SDA commands (such as EXAMINE, SHOW STACK, and FORMAT) use them to symbolize addresses when generating output.

When the code for one of these commands needs a symbol for an address, it calls the SDA symbolize routine. The symbolize routine tries to find the symbol in the symbol table whose address is closest to, but not greater than the requested address. This means, for any given address, the routine may return a symbol of the form symbol_name+offset. If, however, the offset is greater than $0FFF_{16}$, it fails to find a symbol for the address.

As a last resort, the symbolize routine checks to see if this address falls within a known memory range. Currently, the only known memory ranges are those used by the OpenVMS Alpha executive images and those used by active images in a process. SDA searches through the executive loaded image list (LDRIMG data structure) to see if the address falls within any of the image sections. If SDA does find a match, it returns one of the following types of symbols:

executive_image_name+offset
activated_image_name+offset

The offset is the same as the image offset as defined in the map file.

The constants in the SDA symbol table are usually used to display a data structure with the FORMAT command. For example, the PHD offsets are defined in SYSDEF.STB; you can display all the fields of the PHD by entering the following commands:

```
SDA> READ SDA$READ_DIR:SYSDEF.STB
SDA> FORMAT/TYPE=PHD phd_address
```

Symbols and Address Resolution

In OpenVMS Alpha, executive and user images are loaded into dynamically assigned address space. To help you associate a particular virtual address with the image whose code has been loaded at that address, SDA provides several features:

- The SHOW EXECUTIVE command
- The symbolization of addresses, described in the previous section
- The READ command
- The SHOW PROCESS command with the /IMAGES qualifier

- The MAP command

The OpenVMS Alpha executive consists of two base images, SYS$BASE_IMAGE.EXE and SYS$PUBLIC_VECTORS.EXE, and a number of other separately loadable images. Some of these images are loaded on all systems, while others support features unique to particular system configurations. Executive images are mapped into system space during system initialization.

By default, a typical executive image is not mapped at contiguous virtual addresses. Instead, its nonpageable image sections are loaded into a reserved set of pages with other executive images' nonpageable sections. The pageable sections of a typical executive image are mapped contiguously into a different part of system space. An image mapped in this manner is said to be **sliced**. A particular system may have system parameters defined that disable executive image slicing altogether.

Each executive image is described by a data structure called a **loadable image data block** (LDRIMG). The LDRIMG specifies whether the image has been sliced. If the image is sliced, the LDRIMG indicates the beginning of each image section and the size of each section. All the LDRIMGs are linked together in a list that SDA scans to determine what images have been loaded and into what addresses they have been mapped. The SHOW EXECUTIVE command displays a list of all images that are included in the OpenVMS Alpha executive.

Each executive image is a shareable image whose universal symbols are defined in the SYS$BASE_IMAGE.EXE symbol vector. On initialization, SDA reads this symbol vector and adds its universal symbols to the SDA symbol table.

Executive image .STB files define additional symbols within an executive image that are not defined as universal symbols and thus are not in the SYS$BASE_IMAGE.EXE symbol vector (see *Sources for SDA Symbols* in this section). You can enter a READ/EXECUTIVE command to read symbols defined in all executive image .STB files into the SDA symbol table, or a READ/IMAGE filespec command to read the .STB for a specified image only.

To obtain a display of all images mapped within a process, execute a SHOW PROCESS/IMAGE command. See the description of the SHOW PROCESS command for additional information about displaying the hardware and software context of a process.

You can also identify the image name and offset that correspond to a specified address with the MAP command. With the information obtained from the MAP command, you can then examine the image map to locate the source module and program section offset corresponding to an address.

2.6.3 SDA Display Mode

Some SDA commands produce more output than will fit on one screen. In this situation, SDA enters **display mode**, and outputs the **screen overflow prompt** at the bottom of the screen:

```
Press RETURN for more.
SDA>
```

If the RETURN key is pressed, SDA will continue the output of the command it was processing. If an EXIT command is entered, SDA will leave display mode, abort the command it was processing and output a regular SDA prompt. If any other command is entered, SDA will leave display mode, abort the command it was processing, and begin processing the new command.

SDA will leave display mode once a continued command completes.

2.7 Investigating System Failures

This section discusses how the operating system handles internal errors, and suggests procedures that can help you determine the causes of these errors. It illustrates, through detailed analysis of a sample system failure, how SDA helps you find the causes of operating system problems.

For a complete description of the commands discussed in the sections that follow, refer to Chapter 4 and Chapter 5 of this document, where all the SDA and CLUE commands are presented in alphabetical order.

2.7.1 General Procedure for Analyzing System Failures

When the operating system detects an internal error so severe that normal operation cannot continue, it signals a condition known as a fatal bugcheck and shuts itself down. A specific bugcheck code describes each fatal bugcheck.

To resolve the problem, you must find the reason for the bugcheck. Many failures are caused by errors in user-written device drivers or other privileged code not supplied by Compaq. To identify and correct these errors, you need a listing of the code in question.

Occasionally, a system failure is the result of a hardware failure or an error in code supplied by Compaq. A hardware failure requires the attention of Compaq Services. To diagnose an error in code supplied by Compaq, you need listings of that code, which are available from Compaq.

Start the search for the error by analyzing the CLUE list file that was created by default when the system failed. This file contains an overview of the system failure, which can assist you in finding the line of code that signaled the bugcheck. CLUE CRASH displays the content of the program counter (PC) in the list file. The content of the PC is the address of the next instruction after the instruction that signaled the bugcheck.

However, some bugchecks are caused by unexpected exceptions. In such cases, the address of the instruction that *caused* the exception is more informative than the address of the instruction that signaled the bugcheck. The address of the instruction that caused the exception is located on the stack. You can obtain this address either by using the SHOW STACK command to display the contents of the stack or by using the CLUE CRASH command to display the system state at time of exception. See Section 2.7.2 for information on how to proceed for several types of bugchecks.

Once you have found the address of the instruction that caused the bugcheck or exception, find the module in which the failing instruction resides. Use the MAP command to determine whether the instruction is part of a device driver or another executive image. Alternatively, the SHOW EXECUTIVE command shows the location and size of each of the images that make up the OpenVMS Alpha executive.

If the instruction that caused the bugcheck is not part of a driver or executive image, examine the linker's map of the module or modules you are debugging to determine whether the instruction that caused the bugcheck is in your program.

To determine the general cause of the system failure, examine the code that signaled the bugcheck or the instruction that caused the exception.

2.7.2 Fatal Bugcheck Conditions

There are many possible conditions that can cause OpenVMS Alpha to issue a bugcheck. Normally, these occasions are rare. When they do occur, they are often fatal exceptions or illegal page faults occurring within privileged code. This section describes the symptoms of several common bugchecks. A discussion of other exceptions and condition handling in general appears in the *OpenVMS Programming Concepts Manual*.

An exception is fatal when it occurs while either of the following conditions exists:

- The process is executing above IPL 2 (IPL$_ASTDEL).
- The process is executing in a privileged (kernel or executive) processor access mode and has not declared a condition handler to deal with the exception.

When the system fails, the operating system reports the approximate cause of the system failure on the console terminal. SDA displays a similar message when you issue a SHOW CRASH command. For instance, for a fatal exception, SDA can display one of these messages:

```
FATALEXCPT, Fatal executive or kernel mode exception
```

```
INVEXCEPTN, Exception while above ASTDEL
```

```
SSRVEXCEPT, Unexpected system service exception
```

```
UNXSIGNAL, Unexpected signal name in ACP
```

When a FATALEXCPT, INVEXCEPTN, SSRVEXCEPT, or UNXSIGNAL bugcheck occurs, two argument lists, known as the mechanism and signal arrays, are placed on the stack.

Section 2.7.2.1 to Section 2.7.2.4 describe these arrays and related data structures, and Section 2.7.2.5 shows example output from SDA for an SSRVEXCEPT bugcheck.

A page fault is illegal when it occurs while the interrupt priority level (IPL) is greater than 2 (IPL$_ASTDEL). When OpenVMS Alpha fails because of an illegal page fault, it displays the following message on the console terminal:

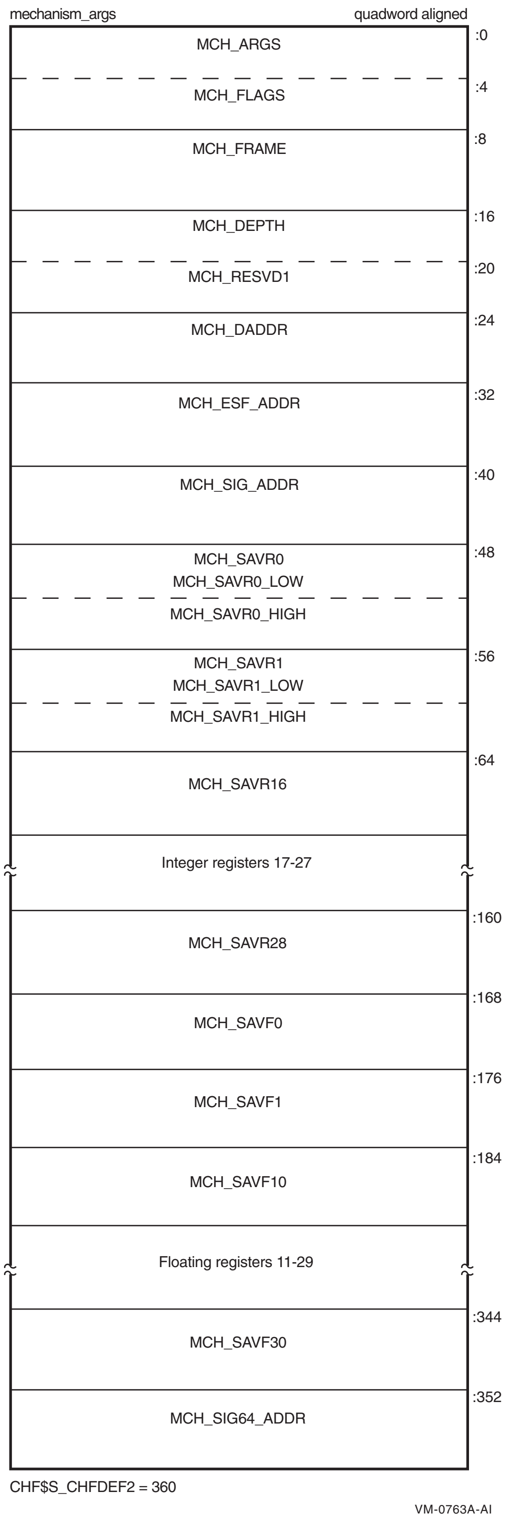
```
PGFIPLHI, Page fault with IPL too high
```

Section 2.7.2.6 describes the stack contents when an illegal page fault occurs.

2.7.2.1 Mechanism Array

Figure 2–1 illustrates the **mechanism array**, which is made up entirely of quadwords. The first quadword of this array indicates the number of quadwords in this array; this value is always $2C_{16}$. These quadwords are used by the procedures that search for a condition handler and report exceptions.

Figure 2–1 Mechanism Array



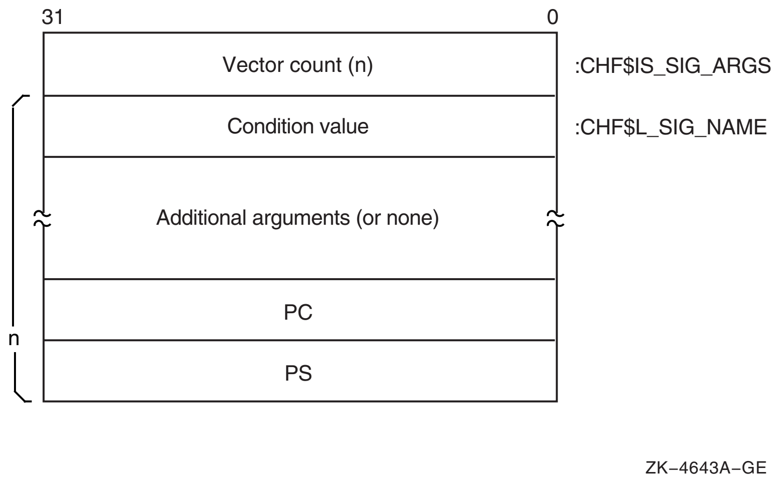
Symbolic offsets into the mechanism array are defined as follows. The SDA SHOW STACK command identifies the elements of the mechanism array on the stack using these symbols.

Offset	Meaning
CHF$IS_MCH_ARGS	Number of quadwords that follow. In a mechanism array, this value is always $2C_{16}$.
CHF$IS_MCH_FLAGS	Flag bits for related argument mechanism information.
CHF$PH_MCH_FRAME	Address of the FP (frame pointer) of the establisher's call frame.
CHF$IS_MCH_DEPTH	Depth of the OpenVMS Alpha search for a condition handler.
CHF$PH_MCH_DADDR	Address of the handler data quadword, if the exception handler data field is present.
CHF$PH_MCH_ESF_ADDR	Address of the exception stack frame (see Figure 2–4).
CHF$PH_MCH_SIG_ADDR	Address of the signal array (see Figure 2–2).
CHF$IH_MCH_SAVRnn	Contents of the saved integer registers at the time of the exception. The following registers are saved: R0, R1, and R16 to R28 inclusive.
CHF$FH_MCH_SAVFnn	If the process was using floating point, contents of the saved floating-point registers at the time of the exception. The following registers are saved: F0, F1, and F10 to F30 inclusive.
CHF$PH_MCH_SIG64_ADDR	Address of the 64-bit signal array (see Figure 2–3).

2.7.2.2 Signal Array

The **signal array** appears somewhat further down the stack. This array comprises all longwords so that the structure is VAX compatible. A signal array describes the exception that occurred. It contains an argument count, the exception code, zero or more exception parameters, the PC, and the PS. Therefore, the size of a signal array can vary from exception to exception. Although there are several possible exception conditions, access violations are most common. Figure 2–2 shows the signal array for an access violation.

Figure 2–2 Signal Array



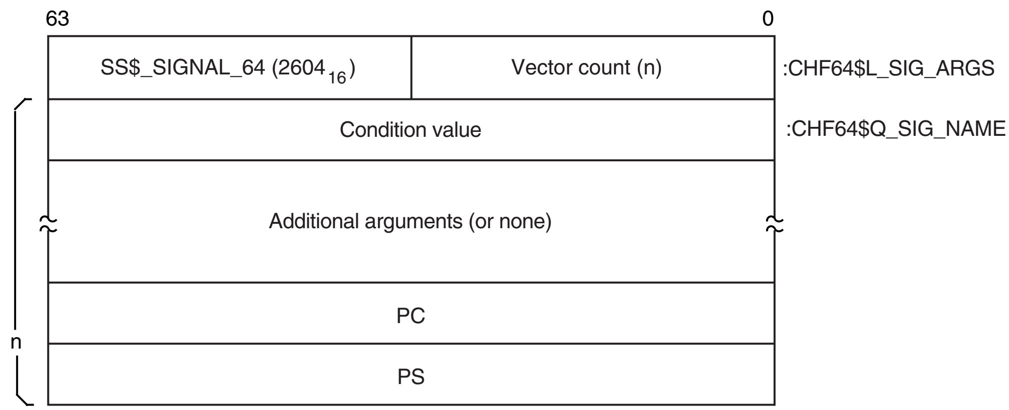
For access violations, the signal array is set up as follows:

Value	Meaning
Vector list length	Number of longwords that follow. For access violations, this value is always 5.
Condition value	Exception code. The value $0C_{16}$ represents an access violation. You can identify the exception code by using the SDA command EVALUATE/CONDITION_VALUE or SHOW CRASH.
Additional arguments	These can include a reason mask and a virtual address. In the longword mask if bit 0 of the longword is set, the failing instruction (at the PC saved below) caused a length violation. If bit 1 is set, it referred to a location whose page table entry is in a “no access” page. Bit 2 indicates the type of access used by the failing instruction: it is set for write and modify operations and clear for read operations. The virtual address represents the low-order 32 bits of the virtual address that the failing instruction tried to reference.
PC	PC whose execution resulted in the exception.
PS	PS at the time of the exception.

2.7.2.3 64-Bit Signal Array

The **64-bit signal array** also appears further down the stack. This array comprises all quadwords and is not VAX compatible. It contains the same data as the signal array, and Figure 2–3 shows the 64-bit signal array for an access violation. The SDA SHOW STACK command uses the CHF64$ symbols listed in the figure to identify the 64-bit signal array on the stack.

Figure 2–3 64-Bit Signal Array



ZK–8960A–GE

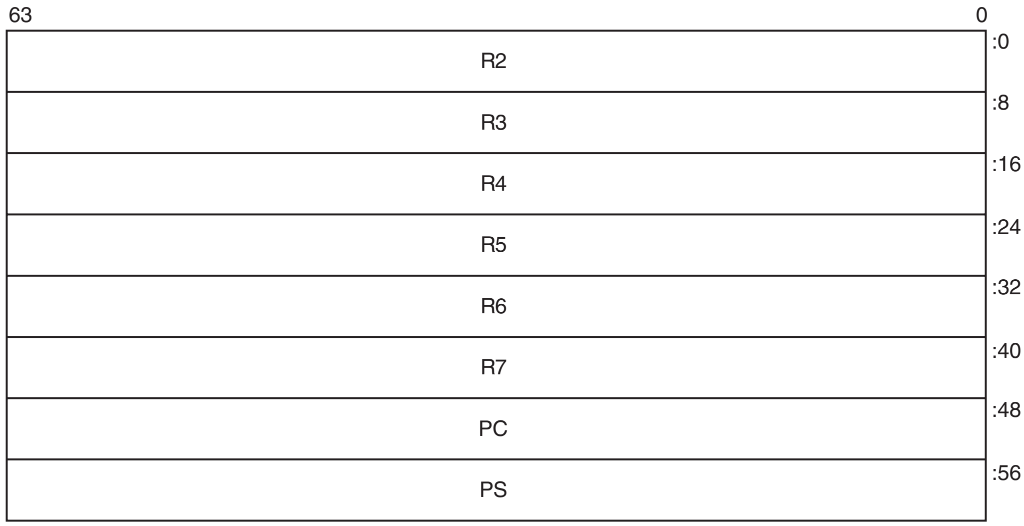
For access violations, the 64-bit signal array is set up as follows:

Value	Meaning
Vector list length	Number of quadwords that follow. For access violations, this value is always 5.
Condition value	Exception code. The value $0C_{16}$ represents an access violation. You can identify the exception code by using the SDA command EVALUATE/CONDITION_VALUE or SHOW CRASH.
Additional arguments	These can include a reason mask and a virtual address. In the quadword mask if bit 0 of the quadword is set, the failing instruction (at the PC saved below) caused a length violation. If bit 1 is set, it referred to a location whose page table entry is in a “no access” page. Bit 2 indicates the type of access used by the failing instruction: it is set for write and modify operations and clear for read operations.
PC	PC whose execution resulted in the exception.
PS	PS at the time of the exception.

2.7.2.4 Exception Stack Frame

Figure 2–4 illustrates the exception stack frame, which comprises all quadwords.

Figure 2–4 Exception Stack Frame



ZK–6788A–GE

The values contained in the exception stack frame are defined as follows:

Table 2–8 Exception Stack Frame Values

Value	Contents
INTSTK$Q_R2	Contents of R2 at the time of the exception
INTSTK$Q_R3	Contents of R3 at the time of the exception
INTSTK$Q_R4	Contents of R4 at the time of the exception
INTSTK$Q_R5	Contents of R5 at the time of the exception
INTSTK$Q_R6	Contents of R6 at the time of the exception
INTSTK$Q_R7	Contents of R7 at the time of the exception
INTSTK$Q_PC	PC whose execution resulted in the exception
INTSTK$Q_PS	PS at the time of the exception (except high-order bits)

The SDA SHOW STACK command identifies the elements of the exception stack frame on the stack using these symbols.

2.7.2.5 SSRVEXCEPT Example

If OpenVMS Alpha encounters a fatal exception, you can find the code that signaled it by examining the PC in the signal array. Use the SHOW CRASH or CLUE CRASH command to display the PC and the instruction stream around the PC to locate the exception.

The following display shows the SDA output in response to the SHOW CRASH and SHOW STACK commands for an SSRVEXCEPT bugcheck. It illustrates the mechanism array, signal arrays, and the exception stack frame previously described.

```
OpenVMS (TM) Alpha system dump analyzer
...analyzing a selective memory dump...

Dump taken on 30-AUG-2000 13:13:46.83
SSRVEXCEPT, Unexpected system service exception

SDA>  SHOW CRASH
Time of system crash: 30-AUG-1996 13:13:46.83

Version of system: OpenVMS (TM) Alpha Operating System, Version V7.3

System Version Major ID/Minor ID: 3/0

System type: DEC 3000 Model 400

Crash CPU ID/Primary CPU ID:  00/00

Bitmask of CPUs active/available:  00000001/00000001

CPU bugcheck codes:
        CPU 00 -- SSRVEXCEPT, Unexpected system service exception

System State at Time of Exception
---------------------------------
Exception Frame:
----------------
        R2  = 00000000.00000003
        R3  = FFFFFFFF.80C63460  EXCEPTION_MON_NPRW+06A60
        R4  = FFFFFFFF.80D12740  PCB
        R5  = 00000000.000000C8
        R6  = 00000000.00030038
        R7  = 00000000.7FFA1FC0
        PC  = 00000000.00030078
        PS  = 00000000.00000003

         00000000.00030068:     STQ             R27,(SP)
         00000000.0003006C:     BIS             R31,SP,FP
         00000000.00030070:     STQ             R26,#X0010(SP)
         00000000.00030074:     LDA             R28,(R31)
   PC => 00000000.00030078:     LDL             R28,(R28)
         00000000.0003007C:     BEQ             R28,#X000007
         00000000.00030080:     LDQ             R26,#XFFE8(R27)
         00000000.00030084:     BIS             R31,R26,R0
         00000000.00030088:     BIS             R31,FP,SP

   PS =>
         MBZ SPAL      MBZ    IPL VMM MBZ CURMOD INT PRVMOD
         0   00   00000000000 00  0   0   KERN   0   USER

Signal Array
------------
        Length = 00000005
        Type   = 0000000C
        Arg    = 00000000.00010000
        Arg    = 00000000.00000000
        Arg    = 00000000.00030078
        Arg    = 00000000.00000003
%SYSTEM-F-ACCVIO, access violation, reason mask=00, virtual address=0000000000000000,
   PC=0000000000030078, PS=00000003
```

```
Saved Scratch Registers in Mechanism Array
------------------------------------------
R0   = 00000000.00020000  R1   = 00000000.00000000  R16  = 00000000.00020004
R17  = 00000000.00010050  R18  = FFFFFFFF.FFFFFFFF  R19  = 00000000.00000000
R20  = 00000000.7FFA1F50  R21  = 00000000.00000000  R22  = 00000000.00010050
R23  = 00000000.00000000  R24  = 00000000.00010051  R25  = 00000000.00000000
R26  = FFFFFFFF.8010ACA4  R27  = 00000000.00010050  R28  = 00000000.00000000

CPU 00 Processor crash information
----------------------------------

CPU 00 reason for Bugcheck: SSRVEXCEPT, Unexpected system service exception

Process currently executing on this CPU: SYSTEM

Current image file: $31$DKB0:[SYS0.][SYSMGR]X.EXE;1

Current IPL: 0  (decimal)

CPU database address:  80D0E000

CPUs Capabilities:    PRIMARY,QUORUM,RUN

General registers:

R0   = 00000000.00000000  R1   = 00000000.7FFA1EB8  R2   = FFFFFFFF.80D0E6C0
R3   = FFFFFFFF.80C63460  R4   = FFFFFFFF.80D12740  R5   = 00000000.000000C8
R6   = 00000000.00030038  R7   = 00000000.7FFA1FC0  R8   = 00000000.7FFAC208
R9   = 00000000.7FFAC410  R10  = 00000000.7FFAD238  R11  = 00000000.7FFCE3E0
R12  = 00000000.00000000  R13  = FFFFFFFF.80C6EB60  R14  = 00000000.00000000
R15  = 00000000.009A79FD  R16  = 00000000.000003C4  R17  = 00000000.7FFA1D40
R18  = FFFFFFFF.80C05C38  R19  = 00000000.00000000  R20  = 00000000.7FFA1F50
R21  = 00000000.00000000  R22  = 00000000.00000001  R23  = 00000000.7FFF03C8
R24  = 00000000.7FFF0040  AI   = 00000000.00000003  RA   = FFFFFFFF.82A21080
PV   = FFFFFFFF.829CF010  R28  = FFFFFFFF.8004B6DC  FP   = 00000000.7FFA1CA0
PC   = FFFFFFFF.82A210B4  PS   = 18000000.00000000


Processor Internal Registers:

ASN  = 00000000.0000002F                    ASTSR/ASTEN =          0000000F
IPL  =          00000000  PCBB = 00000000.003FE080  PRBR = FFFFFFFF.80D0E000
PTBR = 00000000.00001136  SCBB = 00000000.000001DC  SISR = 00000000.00000000
VPTB = FFFFFFFC.00000000  FPCR = 00000000.00000000  MCES = 00000000.00000000

CPU 00 Processor crash information
----------------------------------

        KSP    = 00000000.7FFA1C98
        ESP    = 00000000.7FFA6000
        SSP    = 00000000.7FFAC100
        USP    = 00000000.7AFFBAD0
                No spinlocks currently owned by CPU 00
```

```
SDA> SHOW STACK
Current Operating Stack (KERNEL):
                       00000000.7FFA1C78    18000000.00000000
                       00000000.7FFA1C80    00000000.7FFA1CA0
                       00000000.7FFA1C88    00000000.00000000
                       00000000.7FFA1C90    00000000.7FFA1D40
                SP =>  00000000.7FFA1C98    00000000.00000000
                       00000000.7FFA1CA0    FFFFFFFF.829CF010  EXE$EXCPTN
                       00000000.7FFA1CA8    FFFFFFFF.82A2059C  EXCEPTION_MON_PRO+0259C
                       00000000.7FFA1CB0    00000000.00000000
                       00000000.7FFA1CB8    00000000.7FFA1CD0
                       00000000.7FFA1CC0    FFFFFFFF.829CEDA8  EXE$SET_PAGES_READ_ONLY+00948
                       00000000.7FFA1CC8    00000000.00000000
                       00000000.7FFA1CD0    FFFFFFFF.829CEDA8  EXE$SET_PAGES_READ_ONLY+00948
                       00000000.7FFA1CD8    00000000.00000000
                       00000000.7FFA1CE0    FFFFFFFF.82A1E930  EXE$CONTSIGNAL_C+001D0
                       00000000.7FFA1CE8    00000000.7FFA1F40
                       00000000.7FFA1CF0    FFFFFFFF.80C63780  EXE$ACVIOLAT
                       00000000.7FFA1CF8    00000000.7FFA1EB8
                       00000000.7FFA1D00    00000000.7FFA1D40
                       00000000.7FFA1D08    00000000.7FFA1F00
                       00000000.7FFA1D10    00000000.7FFA1F40
                       00000000.7FFA1D18    00000000.00000000
                       00000000.7FFA1D20    00000000.00000000
                       00000000.7FFA1D28    00000000.00020000  SYS$K_VERSION_04
                       00000000.7FFA1D30    00000005.00000250  BUG$_NETRCVPKT
                       00000000.7FFA1D38    829CE050.000008F8  BUG$_SEQ_NUM_OVF
CHF$IS_MCH_ARGS        00000000.7FFA1D40    00000000.0000002C
CHF$PH_MCH_FRAME       00000000.7FFA1D48    00000000.7AFFBAD0
CHF$IS_MCH_DEPTH       00000000.7FFA1D50    FFFFFFFF.FFFFFFFD
CHF$PH_MCH_DADDR       00000000.7FFA1D58    00000000.00000000
CHF$PH_MCH_ESF_ADDR    00000000.7FFA1D60    00000000.7FFA1F00
CHF$PH_MCH_SIG_ADDR    00000000.7FFA1D68    00000000.7FFA1EB8
CHF$IH_MCH_SAVR0       00000000.7FFA1D70    00000000.00020000  SYS$K_VERSION_04
CHF$IH_MCH_SAVR1       00000000.7FFA1D78    00000000.00000000
CHF$IH_MCH_SAVR16      00000000.7FFA1D80    00000000.00020004  UCB$M_LCL_VALID+00004
CHF$IH_MCH_SAVR17      00000000.7FFA1D88    00000000.00010050  SYS$K_VERSION_16+00010
CHF$IH_MCH_SAVR18      00000000.7FFA1D90    FFFFFFFF.FFFFFFFF
CHF$IH_MCH_SAVR19      00000000.7FFA1D98    00000000.00000000
CHF$IH_MCH_SAVR20      00000000.7FFA1DA0    00000000.7FFA1F50
CHF$IH_MCH_SAVR21      00000000.7FFA1DA8    00000000.00000000
CHF$IH_MCH_SAVR22      00000000.7FFA1DB0    00000000.00010050  SYS$K_VERSION_16+00010
CHF$IH_MCH_SAVR23      00000000.7FFA1DB8    00000000.00000000
CHF$IH_MCH_SAVR24      00000000.7FFA1DC0    00000000.00010051  SYS$K_VERSION_16+00011
CHF$IH_MCH_SAVR25      00000000.7FFA1DC8    00000000.00000000
CHF$IH_MCH_SAVR26      00000000.7FFA1DD0    FFFFFFFF.8010ACA4  AMAC$EMUL_CALL_NATIVE_C+000A4
CHF$IH_MCH_SAVR27      00000000.7FFA1DD8    00000000.00010050  SYS$K_VERSION_16+00010
CHF$IH_MCH_SAVR28      00000000.7FFA1DE0    00000000.00000000
                       00000000.7FFA1DE8    00000000.00000000
                       00000000.7FFA1DF0    00000000.00000000
                       00000000.7FFA1DF8    00000000.00000000
                       00000000.7FFA1E00    00000000.00000000
                       00000000.7FFA1E08    00000000.00000000
                       00000000.7FFA1E10    00000000.00000000
                       00000000.7FFA1E18    00000000.00000000
                       00000000.7FFA1E20    00000000.00000000
                       00000000.7FFA1E28    00000000.00000000
                       00000000.7FFA1E30    00000000.00000000
                       00000000.7FFA1E38    00000000.00000000
                       00000000.7FFA1E40    00000000.00000000
                       00000000.7FFA1E48    00000000.00000000
                       00000000.7FFA1E50    00000000.00000000
                       00000000.7FFA1E58    00000000.00000000
                       00000000.7FFA1E60    00000000.00000000
                       00000000.7FFA1E68    00000000.00000000
```

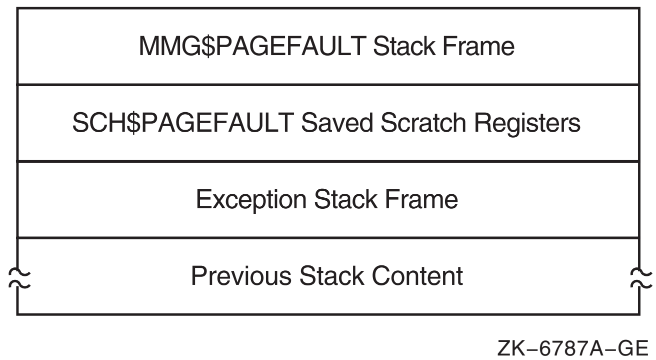
```
                       00000000.7FFA1E70   00000000.00000000
                       00000000.7FFA1E78   00000000.00000000
                       00000000.7FFA1E80   00000000.00000000
                       00000000.7FFA1E88   00000000.00000000
                       00000000.7FFA1E90   00000000.00000000
                       00000000.7FFA1E98   00000000.00000000
CHF$PH_MCH_SIG64_ADDR  00000000.7FFA1EA0   00000000.7FFA1ED0
                       00000000.7FFA1EA8   00000000.00000000
                       00000000.7FFA1EB0   00000000.7FFA1F50
                       00000000.7FFA1EB8   0000000C.00000005
                       00000000.7FFA1EC0   00000000.00010000  SYS$K_VERSION_07
                       00000000.7FFA1EC8   00000003.00030078  SYS$K_VERSION_01+00078
CHF$L_SIG_ARGS         00000000.7FFA1ED0   00002604.00000005  UCB$M_TEMPLATE+00604
CHF$L_SIG_ARG1         00000000.7FFA1ED8   00000000.0000000C
                       00000000.7FFA1EE0   00000000.00010000  SYS$K_VERSION_07
                       00000000.7FFA1EE8   00000000.00000000
                       00000000.7FFA1EF0   00000000.00030078  SYS$K_VERSION_01+00078
                       00000000.7FFA1EF8   00000000.00000003
INTSTK$Q_R2            00000000.7FFA1F00   00000000.00000003
INTSTK$Q_R3            00000000.7FFA1F08   FFFFFFFF.80C63460  EXCEPTION_MON_NPRW+06A60
INTSTK$Q_R4            00000000.7FFA1F10   FFFFFFFF.80D12740  PCB
INTSTK$Q_R5            00000000.7FFA1F18   00000000.000000C8
INTSTK$Q_R6            00000000.7FFA1F20   00000000.00030038  SYS$K_VERSION_01+00038
INTSTK$Q_R7            00000000.7FFA1F28   00000000.7FFA1FC0
INTSTK$Q_PC            00000000.7FFA1F30   00000000.00030078  SYS$K_VERSION_01+00078
INTSTK$Q_PS            00000000.7FFA1F38   00000000.00000003
Prev SP (7FFA1F40) ==> 00000000.7FFA1F40   00000000.00010050  SYS$K_VERSION_16+00010
                       00000000.7FFA1F48   00000000.00010000  SYS$K_VERSION_07
                       00000000.7FFA1F50   FFFFFFFF.8010ACA4  AMAC$EMUL_CALL_NATIVE_C+000A4
                       00000000.7FFA1F58   00000000.7FFA1F70
                       00000000.7FFA1F60   00000000.00000001
                       00000000.7FFA1F68   FFFFFFFF.800EE81C  RM_STD$DIRCACHE_BLKAST_C+005AC
                       00000000.7FFA1F70   FFFFFFFF.80C6EBA0  SCH$CHSEP+001E0
                       00000000.7FFA1F78   00000000.829CEDE8  EXE$SIGTORET
                       00000000.7FFA1F80   00010050.00000002  SYS$K_VERSION_16+00010
                       00000000.7FFA1F88   00000000.00020000  SYS$K_VERSION_04
                       00000000.7FFA1F90   00000000.00030000  SYS$K_VERSION_01
                       00000000.7FFA1F98   FFFFFFFF.800A4D64  EXCEPTION_MON_NPRO+00D64
                       00000000.7FFA1FA0   00000000.00000003
                       00000000.7FFA1FA8   FFFFFFFF.80D12740  PCB
                       00000000.7FFA1FB0   00000000.00010000  SYS$K_VERSION_07
                       00000000.7FFA1FB8   00000000.7AFFBAD0
                       00000000.7FFA1FC0   00000000.7FFCF880  MMG$IMGHDRBUF+00080
                       00000000.7FFA1FC8   00000000.7B0E9851
                       00000000.7FFA1FD0   00000000.7FFCF818  MMG$IMGHDRBUF+00018
                       00000000.7FFA1FD8   00000000.7FFCF938  MMG$IMGHDRBUF+00138
                       00000000.7FFA1FE0   00000000.7FFAC9F0
                       00000000.7FFA1FE8   00000000.7FFAC9F0
                       00000000.7FFA1FF0   FFFFFFFF.80000140  SYS$PUBLIC_VECTORS_NPRO+00140
                       00000000.7FFA1FF8   00000000.0000001B

   .
   .
   .
```

2.7.2.6 Illegal Page Faults

When an illegal page fault occurs, the stack appears as pictured in Figure 2–5.

Figure 2–5 Stack Following an Illegal Page-Fault Error



The stack contents are as follows:

MMG$PAGEFAULT Stack Frame	Stack frame built at entry to MMG$PAGEFAULT, the page fault exception service routine. The frame includes the contents of the following registers at the time of the page fault: R3, R8, R11 to R15, R29 (frame pointer)
SCH$PAGEFAULT Saved Scratch Registers	Contents of the following registers at the time of the page fault: R0, R1, R16 to R28
Exception Stack Frame	Exception stack frame (see Figure 2–4)
Previous Stack Content	Contents of the stack prior to the illegal page-fault error

When you analyze a dump caused by a PGFIPLHI bugcheck, the SHOW STACK command identifies the exception stack frame using the symbols shown in Table 2–8. The SHOW CRASH or CLUE CRASH command displays the instruction that caused the page fault and the instructions around it.

2.8 Inducing a System Failure

If the operating system is not performing well and you want to create a dump you can examine, you must induce a system failure. Occasionally, a device driver or other user-written, kernel-mode code can cause the system to execute a loop of code at a high priority, interfering with normal system operation. This loop can occur even though you have set a breakpoint in the code if the loop is encountered before the breakpoint. To gain control of the system in such circumstances, you must cause the system to fail and then reboot it.

If the system has suspended all noticeable activity and is hung, see the examples of causing system failures in Section 2.8.2.

If you are generating a system failure in response to a system hang, be sure to record the PC and PS as well as the contents of the integer registers at the time of the system halt.

2.8.1 Meeting Crash Dump Requirements

The following requirements must be met before the operating system can write a complete crash dump:

- You must not halt the system until the console dump messages have been printed in their entirety and the memory contents have been written to the crash dump file. Be sure to allow sufficient time for these events to take place or make sure that all disk activity has stopped before using the console to halt the system.
- There must be a crash dump file in SYS$SPECIFIC:[SYSEXE]: named either SYSDUMP.DMP or PAGEFILE.SYS.

  This dump file must be either large enough to hold the entire contents of memory (as discussed in Section 2.2.1.1) or, if the DUMPSTYLE system parameter is set, large enough to accommodate a subset or compressed dump (also discussed in Section 2.2.1.1).

  If SYSDUMP.DMP is not present, the operating system attempts to write crash dumps to PAGEFILE.SYS. In this case, the SAVEDUMP system parameter must be 1 (the default is 0).
- Alternatively, the system must be set up for DOSD. See Section 2.2.1.5, and the *OpenVMS System Manager's Manual, Volume 2: Tuning, Monitoring, and Complex Systems* for details.
- The DUMPBUG system parameter must be 1 (the default is 1).

2.8.2 Procedure for Causing a System Failure

This section tells you how to enter the XDelta utility (XDELTA) to force a system failure.

Before you can use XDelta, it must be loaded at system startup. To load XDelta during system bootstrap, you must set bit 1 in the boot flags. See the *OpenVMS Alpha Version 7.1 Upgrade and Installation Manual* for information about booting with the XDelta utility.

Put the system in console mode by pressing Ctrl/P or the Halt push button. Enter the following commands at the console prompt to enter XDelta:

```
>>> DEPOSIT SIRR E
>>> CONTINUE
```

Once you have entered XDelta, use any valid XDelta commands to examine register or memory locations, step through code, or force a system failure (by entering ;C under XDelta). See the *OpenVMS Delta/XDelta Debugger Manual* for more information about using XDelta.

If you did not load XDelta, you can force a system crash by entering console commands that make the system incur an exception at high IPL. At the console prompt, enter commands to set the program counter (PC) to an invalid address and the PS to kernel mode at IPL 31 before continuing. This results in a forced INVEXCEPTN-type bugcheck. Some Compaq computers employ the console command CRASH (which will force a system failure) while other systems require that you manually enter the commands.

Enter the following commands at the console prompt to force a system failure:

```
>>> DEPOSIT PC FFFFFFFFFFFFFF00
>>> DEPOSIT PS 1F00
>>> CONTINUE
```

For more information, refer to the hardware manuals that accompanied your computer.

3

ANALYZE Usage Summary and Qualifiers

This chapter describes the format, usage, and qualifiers of the System Dump Analyzer (SDA) utility.

3.1 ANALYZE Usage Summary

The System Dump Analyzer (SDA) utility helps determine the causes of system failures. This utility is also useful for examining the running system.

Format

```
ANALYZE   {/CRASH_DUMP
           [/OVERRIDE]
           [/RELEASE]
           [/SHADOW_MEMBER [= device-name]]
           filespec | /SYSTEM}
           [/SYMBOL = system-symbols-table]
```

Command Parameter

filespec

Name of the file that contains the dump you want to analyze. At least one field of the **filespec** is required, and it can be any field. The default **filespec** is the highest version of SYSDUMP.DMP in your default directory. The **filespec** is required for ANALYZE/CRASH_DUMP, but cannot be specified for ANALYZE/SYSTEM.

Description

By default, the System Dump Analyzer is automatically invoked when you reboot the system after a system failure.

To analyze a system dump interactively, invoke SDA by issuing the following command:

```
$ ANALYZE/CRASH_DUMP filespec
```

If you do not specify **filespec**, SDA prompts you for it.

To analyze a crash dump, your process must have the privileges necessary for reading the dump file. This usually requires system privilege (SYSPRV), but your system manager can, if necessary, allow less privileged processes to read the dump files. Your process needs change-mode-to-kernel (CMKRNL) privilege to release page file dump blocks, whether you use the /RELEASE qualifier or the SDA COPY command.

Invoke SDA to analyze a running system by issuing the following command:

```
$ANALYZE/SYSTEM
```

To examine a running system, your process must have change-mode-to-kernel (CMKRNL) privilege. Your process must also have the map-by-PFN privilege (PFNMAP) to access memory by physical address on a running system. You cannot specify **filespec** when using the /SYSTEM qualifier.

To send all output from SDA to a file, use the SDA command SET OUTPUT, specifying the name of the output file. The file produced is 132 columns wide and is formatted for output to a printer. To later redirect the output to your terminal, use the following command:

```
SDA> SET OUTPUT SYS$OUTPUT
```

To send a copy of all the commands you type and a copy of all the output those commands produce to a file, use the SDA command SET LOG, specifying the name of the log file. The file produced is 132 columns wide and is formatted for output to a printer.

To exit from SDA, use the EXIT command. Note that the EXIT command also causes SDA to exit from display mode. Thus, if SDA is in display mode, you must use the EXIT command twice: once to exit from display mode, and a second time to exit from SDA. See Section 2.6.3 for a description of display mode.

3.2 ANALYZE Qualifiers

The following qualifiers described in this section determine whether the object of an SDA session is a crash dump or a running system. They also help create the environment of an SDA session.

/CRASH_DUMP
/OVERRIDE
/RELEASE
/SHADOW_MEMBER
/SYMBOL
/SYSTEM

/CRASH_DUMP

Invokes SDA to analyze the specified dump file.

Format

/CRASH_DUMP   filespec

Parameter

filespec
Name of the crash dump file to be analyzed. The default file specification is:

SYS$DISK:[default-dir]SYSDUMP.DMP

SYS$DISK and [default-dir] represent the disk and directory specified in your last SET DEFAULT command. If you do not specify **filespec**, SDA prompts you for it.

Description

See Chapter 2, Section 2.3 for additional information on crash dump analysis. You cannot specify the /SYSTEM qualifier when you include the /CRASH_DUMP qualifier in the ANALYZE command.

Examples

1.
```
$ ANALYZE/CRASH_DUMP SYS$SYSTEM:SYSDUMP.DMP
$ ANALYZE/CRASH SYS$SYSTEM
```

These commands invoke SDA to analyze the crash dump stored in SYS$SYSTEM:SYSDUMP.DMP.

2.
```
$ ANALYZE/CRASH SYS$SYSTEM:PAGEFILE.SYS
```

This command invokes SDA to analyze a crash dump stored in the system page file.

/OVERRIDE

When used with the /CRASH_DUMP qualifier, invokes SDA to analyze only the structure of the specified dump file when a corruption or other problem prevents normal invocation of SDA with the ANALYZE/CRASH_DUMP command.

Format

/CRASH_DUMP/OVERRIDE   filespec

Parameter

filespec
Name of the crash dump file to be analyzed. The default file specification is:

SYS$DISK:[default-dir]SYSDUMP.DMP

SYS$DISK and [default-dir] represent the disk and directory specified in your last SET DEFAULT command. If you do not specify **filespec**, SDA prompts you for it.

Description

See Chapter 2, Section 2.3 for additional information on crash dump analysis. Note that when SDA is invoked with /OVERRIDE, not all the commands in Chapter 2, Section 2.3 can be used. Commands that can be used are as follows:

- Output control commands such as SET OUTPUT and SET LOG
- Dump file related commands such as SHOW DUMP and CLUE ERRLOG

Commands that cannot be used are as follows:

- Commands that access memory addresses within the dump file such as EXAMINE and SHOW SUMMARY

Also, the /RELEASE qualifier cannot be used when you include the /OVERRIDE qualifier in the ANALYZE/CRASH_DUMP command

When /OVERRIDE is used, the SDA command prompt is SDA>>.

Example

```
$ ANALYZE/CRASH_DUMP/OVERRIDE SYS$SYSTEM:SYSDUMP.DMP
$ ANALYZE/CRASH/OVERRIDE SYS$SYSTEM
```

These commands invoke SDA to analyze the crash dump stored in SYS$SYSTEM:SYSDUMP.DMP.

/RELEASE

Invokes SDA to release those blocks in the specified system page file occupied by a crash dump.

Requires CMKRNL (change-mode-to-kernel) privilege.

Format

/CRASH_DUMP/RELEASE filespec

Parameter

filespec
Name of the system page file (SYS$SYSTEM:PAGEFILE.SYS). Because the default file specification is SYS$DISK:[default-dir]SYSDUMP.DMP, you must identify the page file explicitly. SYS$DISK and [default-dir] represent the disk and directory specified in your last DCL command SET DEFAULT. If you do not specify **filespec**, SDA prompts you for it.

Description

Use the /RELEASE qualifier to release from the system page file those blocks occupied by a crash dump. When invoked with the /RELEASE qualifier, SDA immediately deletes the dump from the page file and allows no opportunity to analyze its contents.

When you specify the /RELEASE qualifier in the ANALYZE command, do the following:

1. Use the /CRASH_DUMP qualifier.
2. Include the name of the system page file (SYS$SYSTEM:PAGEFILE.SYS) as the **filespec**.

If you do not specify the system page file or the specified page file does not contain a dump, SDA generates the following messages:

```
%SDA-E-BLKSNRLSD, no dump blocks in page file to release, or not page file
%SDA-E-NOTPAGFIL, specified file is not the page file
```

You cannot specify the /OVERRIDE or /SHADOW_MEMBER qualifier when you include the /RELEASE qualifier in the ANALYZE/CRASH_DUMP command.

Example

```
$ ANALYZE/CRASH_DUMP/RELEASE SYS$SYSTEM:PAGEFILE.SYS
$ ANALYZE/CRASH/RELEASE PAGEFILE.SYS
```

These commands invoke SDA to release to the page file those blocks in SYS$SYSTEM:PAGEFILE.SYS occupied by a crash dump.

/SHADOW_MEMBER

Specifies which member of a shadow set contains the system dump to be analyzed, or allows the user to determine what system dumps have been written to the members of the shadow set.

Format

/CRASH_DUMP/SHADOW_MEMBER [=device-name]

Description

If the system disk is a shadow set, a system dump will only be written to one member of the shadow set (usually the master member at the time the dump is written). By default, if the filespec translates to a file on a shadow set, SDA will read the dump only from the master member. If at analysis time, the master member is different from where the dump was written, the /SHADOW_MEMBER qualifier allows the user to choose the member from which the dump is to be read.

If the correct member is not known, the /SHADOW_MEMBER qualifier may be specified without a device name. SDA will display a one-line summary of the most recent dump written to each member and then prompt the user to determine which member to use. The prompt is:

```
Shadow set action?
```

The possible responses are:

Command	Effect
EXIT	Aborts the SDA session without analyzing a dump
HELP	Displays simple help text. See example 3 below.
Use <device_name>	Initiates analysis of the system dump located on the specified shadow set member.

The one-line summary for each member consists of the following fields:

Member device name
Bugcheck name
Date and time of system crash
Node name
VMS Version
Flags—none, one or more of: Bad_Checksum, ErrorLog_Dump, Not_Saved, Old_Dump

If there is no usable dump on a member, SDA output will an explanatory warning message followed by a line giving the member device name and the message "No system or error log dump found."

Note that SDA cannot distinguish a dump on a shadowed system disk from a dump copied to a shadowed data disk. SDA will therefore always read the dump from a single member of a host-based shadow set. (In an OpenVMS Cluster system with multiple shadowed system disks, one system’s system disk will be a data disk on other systems). This does not affect dumps being read directly from a DOSD disk, since DOSD disks cannot be members of a host-based shadow set.

Note

The /SHADOW_MEMBER qualifier is not useful if the system dump has been written to the primary page file on a shadowed system disk. You cannot specify /RELEASE with /SHADOW_MEMBER.

Examples

1.
```
$ ANALYZE/CRASH_DUMP DSA777:[SYS0.SYSEXE]SYSDUMP.DMP
%SDA-I-USEMASTER, accessing dump file via _$31$DKB200:, master member of shadow set _DSA777:

OpenVMS (TM) Alpha system dump analyzer
...analyzing a compressed selective memory dump...

Dump taken on 12-DEC-2001 08:23:07.80
SSRVEXCEPT, Unexpected system service exception

SDA>
```

This command initiates dump analysis using the master member of the shadow set DSA777 (the default action).

2.
```
$ ANALYZE/CRASH_DUMP/SHADOW_MEMBER=DKB0 DSA777:[SYS0.SYSEXE]SYSDUMP.DMP

OpenVMS (TM) Alpha system dump analyzer
...analyzing a compressed selective memory dump...

Dump taken on 12-DEC-2001 08:23:07.80
SSRVEXCEPT, Unexpected system service exception

SDA>
```

This command initiates dump analysis using member device 31DKB0 of the shadow set DSA777.

3.
```
$ ANALYZE/CRASH_DUMP/SHADOW_MEMBER DSA8888:[SYS1.SYSEXE]SYSDUMP.DMP

_$70$DKA303:     INVEXCEPTN          16-NOV-2001 00:00:25.74 MRVP2    X96S-FT1
_$70$DKA202:     INCONSTATE          18-NOV-2001 02:08:45.05 MRVP2    X96S-FT1

Shadow set action? HELP

Shadow set actions:

     EXIT                           exit SDA
     HELP                           this display
     USE <shadow_set_member>        proceed using specified shadow set member

Shadow set action? USE _$70$DKA303:

OpenVMS (TM) Alpha system dump analyzer
...analyzing a compressed selective memory dump...

%SDA-W-NOTSAVED, global pages not saved in the dump file
Dump taken on 16-NOV-2001 00:00:25.74
INVEXCEPTN, Exception while above ASTDEL

SDA> EXIT
```

This command displays the dumps to be found on the members of shadow set DSA8888:[SYS1.SYSEXE]SYSDUMP.DMP and then begins analysis of the dump written to device _70DKA303.

/SYMBOL

Specifies an alternate system symbol table for SDA to use.

Format

/SYMBOL = system-symbol-table

File specification of the OpenVMS Alpha SDA system symbol table required by SDA to analyze a system dump or running system. The specified **system-symbol-table** must contain those symbols required by SDA to find certain locations in the executive image.

If you do not specify the /SYMBOL qualifier, SDA uses SDA$READ_DIR:SYS$BASE_IMAGE.EXE to load system symbols into the SDA symbol table. When you specify the /SYMBOL qualifier, SDA assumes the default disk and directory to be SYS$DISK:[ ], that is, the disk and directory specified in your last DCL command SET DEFAULT. If you specify a file for this parameter that is not a system symbol table, SDA exits with a fatal error.

Description

The /SYMBOL qualifier allows you to specify a system symbol table to load into the SDA symbol table. You can use the /SYMBOL qualifier whether you are analyzing a system dump or a running system. It is not normally necessary to use the /SYMBOL qualifier when analyzing the running system, since the default SYS$BASE_IMAGE.EXE is the one in use in the system. However if SDA$READ_DIR has been redefined during crash dump analysis, then the /SYMBOL qualifier can be used to ensure that the correct base image is found when analyzing the running system.

The /SYMBOL qualifier can be used with the /CRASH_DUMP and /SYSTEM qualifiers. It is ignored when /OVERRIDE or /RELEASE is specified.

Example

```
$ ANALYZE/CRASH_DUMP/SYMBOL=SDA$READ_DIR:SYS$BASE_IMAGE.EXE SYS$SYSTEM
```

This command invokes SDA to analyze the crash dump stored in SYS$SYSTEM:SYSDUMP.DMP, using the base image in SDA$READ_DIR.

/SYSTEM

Invokes SDA to analyze a running system.

Requires CMKRNL (change-mode-to-kernel) privilege. Also requires PFNMAP (map-by-PFN) privilege to access memory by physical address.

Format

/SYSTEM

Parameters

None.

Description

See Chapter 2, Section 2.4 to use SDA to analyze a running system.

You cannot specify the /CRASH_DUMP, /OVERRIDE, /RELEASE, or /SHADOW_MEMBER qualifiers when you include the /SYSTEM qualifier in the ANALYZE command.

Example

```
$  ANALYZE/SYSTEM
```

This command invokes SDA to analyze the running system.

4 SDA Commands

This chapter describes the SDA commands that you can use to analyze a system dump or a running system. SDA CLUE extension commands, which can summarize information provided by certain SDA commands and provide additional detail for some SDA commands, are described in Chapter 5.

The SDA commands are as follows:

@ (Execute Command)
ATTACH
COPY
DEFINE
DEFINE/KEY
DUMP
EVALUATE
EXAMINE
EXIT
FORMAT
HELP
MAP
MODIFY DUMP
READ
REPEAT
SEARCH
SET CPU
SET ERASE_SCREEN
SET FETCH
SET LOG
SET OUTPUT
SET PROCESS
SET RMS
SET SIGN_EXTEND
SET SYMBOLIZE
SHOW ADDRESS
SHOW BUGCHECK
SHOW CALL_FRAME
SHOW CLUSTER
SHOW CONNECTIONS
SHOW CPU
SHOW CRASH
SHOW DEVICE
SHOW DUMP
SHOW EXECUTIVE
SHOW GALAXY
SHOW GCT
SHOW GLOBAL_SECTION_TABLE, SHOW GST

SHOW GLOCK
SHOW GMDB
SHOW GSD
SHOW HEADER
SHOW LAN
SHOW LOCKS
SHOW MACHINE_CHECK
SHOW MEMORY
SHOW PAGE_TABLE
SHOW PARAMETER
SHOW PFN_DATA
SHOW POOL
SHOW PORTS
SHOW PROCESS
SHOW RAD
SHOW RESOURCES
SHOW RMD
SHOW RMS
SHOW RSPID
SHOW SHM_CPP
SHOW SHM_REG
SHOW SPINLOCKS
SHOW STACK
SHOW SUMMARY
SHOW SYMBOL
SHOW TQE
SHOW WORKING_SET_LIST, SHOW WSL
SPAWN
UNDEFINE
VALIDATE PFN_LIST
VALIDATE QUEUE
VALIDATE SHM_CPP
VALIDATE TQE

@(Execute Command)

Causes SDA to execute SDA commands contained in a file. Use this command to execute a set of frequently used SDA commands.

Format

@filespec

Parameter

filespec
Name of a file that contains the SDA commands to be executed. The default file type is .COM.

Example

```
SDA>  @USUAL
```

The execute (@) command executes the following commands, as contained in a file named USUAL.COM:

```
SET OUTPUT LASTCRASH.LIS
SHOW CRASH
SHOW PROCESS
SHOW STACK
SHOW SUMMARY
```

This command procedure first makes the file LASTCRASH.LIS the destination for output generated by subsequent SDA commands. Next, the command procedure sends information to the file about the system failure and its context, including a description of the process executing at the time of the failure, the contents of the stack on which the failure occurred, and a list of the processes active on the system.

An EXIT command within a command procedure terminates the procedure at that point, as would an end-of-file.

Command procedures cannot be nested.

ATTACH

Switches control of your terminal from your current process to another process in your job (for example, one created with the SDA SPAWN command).

Format

ATTACH [/PARENT] process-name

Parameter

process-name
Name of the process to which you want to transfer control.

Qualifier

/PARENT
Transfers control of the terminal to the parent process of the current process. When you specify this qualifier, you cannot specify the **process-name** parameter.

Examples

1. `SDA>  ATTACH/PARENT`

   This ATTACH command attaches the terminal to the parent process of the current process.

2. `SDA>  ATTACH DUMPER`

   This ATTACH command attaches the terminal to a process named DUMPER in the same job as the current process.

COPY

Copies the contents of the dump file to another file.

Format

COPY [/qualifier...] output-filespec

Parameter

output-filespec
Name of the device, directory, and file to which SDA copies the dump file. The default file specification is:

SYS$DISK:[*default-dir*]*filename*.DMP)

SYS$DISK and [*default-dir*] represent the disk and directory specified in your last DCL command SET DEFAULT. You must specify a file name.

Qualifiers

/COMPRESS
Causes SDA to compress dump data as it is writing a copy. If the dump being analyzed is already compressed, then SDA does a direct COPY, and issues an informational message indicating that it is ignoring the /COMPRESS qualifier.

/DECOMPRESS
Causes SDA to decompress dump data as it is writing a copy. If the dump being analyzed is already decompressed, then SDA does a direct COPY, and issues an informational message indicating that it is ignoring the /DECOMPRESS qualifier.

Description

Each time the system fails, the contents of memory and the hardware context of the current process (as directed by the DUMPSTYLE parameter) are copied into the file SYS$SYSTEM:SYSDUMP.DMP (or the page file), overwriting its contents. If you do not save this crash dump elsewhere, it will be overwritten the next time that the system fails.

The COPY command allows you to preserve a crash dump by copying its contents to another file. It is generally useful to invoke SDA during system initialization to execute the COPY command. This ensures that a copy of the dump file is made only after the system has failed. The preferred method for doing this, using the logical name CLUE$SITE_PROC, is described in Section 2.2.3.

The COPY command does not affect the contents of the file containing the dump being analyzed.

If you are using the page file (SYS$SYSTEM:PAGEFILE.SYS) as the dump file instead of SYSDUMP.DMP, successful completion of the COPY command will automatically cause the blocks of the page file containing the dump to be released, thus making them available for paging. Even if the copy operation succeeds, the release operation requires that your process have change-mode-to-kernel (CMKRNL) privilege. When the dump pages have been released from the page file, the dump information in these pages will be lost and SDA will immediately exit. You must perform subsequent analysis upon the copy of the dump created by the COPY command.

If you press Ctrl/T while using the COPY command, the system displays how much of the file has been copied.

Example

```
SDA>  COPY SYS$CRASH:SAVEDUMP
```

The COPY command copies the dump file into the file SYS$CRASH:SAVEDUMP.DMP.

DEFINE

Assigns a value to a symbol.

Format

DEFINE [/qualifier...] symbol-name [=] expression

Parameters

symbol-name
Name, containing from 1 to 31 alphanumeric characters, that identifies the symbol. See Section 2.6.2.4 for a description of SDA symbol syntax and a list of default symbols.

expression
Definition of the symbol's value. See Section 2.6.2 for a discussion of the components of SDA expressions.

Qualifier

/PD
Defines a symbol as a procedure descriptor (PD). It also defines the routine address symbol corresponding to the defined symbol (the routine address symbol has the same name as the defined symbol, only with _C appended to the symbol name). See Section 2.6.2.4 for more information about symbols.

Description

The DEFINE command causes SDA to evaluate an expression and then assign its value to a symbol. Both the DEFINE and EVALUATE commands perform computations to evaluate expressions. DEFINE adds symbols to the SDA symbol table but does not display the results of the computation. EVALUATE displays the result of the computation but does not add symbols to the SDA symbol table.

Examples

1.
```
SDA>  DEFINE BEGIN = 80058E00
SDA>  DEFINE END = 80058E60
SDA>  EXAMINE BEGIN:END
```

   In this example, DEFINE defines two addresses, called BEGIN and END. These symbols serve as reference points in memory, defining a range of memory locations for the EXAMINE command to inspect.

2.
```
SDA>  DEFINE NEXT = @PC
SDA>  EXAMINE/INSTRUCTION NEXT
NEXT:   HALT
```

   The symbol NEXT defines the address contained in the program counter, so that the symbol can be used in an EXAMINE/INSTRUCTION command.

3.
```
SDA>  DEFINE VEC SCH$GL_PCBVEC
SDA>  EXAMINE VEC
SCH$GL_PCBVEC:  00000000.8060F2CC   "Ìò‘....."
SDA>
```

After the value of global symbol SCH$GL_PCBVEC has been assigned to the symbol VEC, the symbol VEC is used to examine the memory location or value represented by the global symbol.

4.
```
SDA>  DEFINE/PD VEC SCH$QAST
SDA>  EXAMINE VEC
SCH$QAST:  0000002C.00003008   ".0..,..."
SDA>  EXAMINE VEC_C
SCH$QAST_C:  B75E0008.43C8153E   ">.ÈC..^•"
SDA>
```

In this example, the DEFINE/PD command defines not only the symbol VEC, but also the corresponding routine address symbol (VEC_C).

DEFINE/KEY

Associates an SDA command with a terminal key.

Format

DEFINE/KEY [/qualifier...] key-name command

Parameters

key-name
Name of the key to be defined. You can define the following keys under SDA:

Key Name	Key Designation
PF1	LK201, VT100
PF2	LK201, VT100
PF3	LK201, VT100
PF4	LK201, VT100
KP0 . . . KP9	Keypad 0–9
PERIOD	Keypad period
COMMA	Keypad comma
MINUS	Keypad minus
ENTER	Keypad ENTER
UP	Up arrow
DOWN	Down arrow
LEFT	Left arrow
RIGHT	Right arrow
E1	LK201 Find
E2	LK201 Insert Here
E3	LK201 Remove
E4	LK201 Select
E5	LK201 Prev Screen
E6	LK201 Next Screen
HELP	LK201 Help
DO	LK201 Do
F7 . . . F20	LK201 Function keys

command
SDA command to define a key. You must enclose the command in quotation marks (" ").

Qualifiers

/IF_STATE=*state_list*
/NOIF_STATE
Specifies a list of one or more states, one of which must be in effect for the key definition to work. The /NOIF_STATE qualifier has the same meaning as /IF_STATE=current_state. The state name is an alphanumeric string. States are

established with the /SET_STATE qualifier. If you specify only one state name, you can omit the parentheses. By including several state names, you can define a key to have the same function in all the specified states.

/KEY

Defines a key as an SDA command. To issue the command, press the defined key and the Return key. If you use the /TERMINATE qualifier as well, you do not have to press the Return key. You must specify the /KEY qualifier.

/LOCK_STATE
/NOLOCK_STATE

Specifies that the state set by the /SET_STATE qualifier remains in effect until explicitly changed. By default, the /SET_STATE qualifier is in effect only for the next definable key you press or the next read-terminating character that you type. You can specify this qualifier only with the /SET_STATE qualifier.

The default is /NOLOCK_STATE.

/SET_STATE=*state-name*
/NOSET_STATE

Causes the key being defined to create a key state change instead of or in addition to issuing an SDA command. When you use the /SET_STATE qualifier, you supply the name of a key state to be used with the /IF_STATE qualifier in other key definitions.

For example, you can define the PF1 key as the GOLD key and use the /IF_STATE=GOLD qualifier to allow two definitions for the other keys, one in the GOLD state and one in the non-GOLD state. For more information on using the /IF_STATE qualifier, see the DEFINE/KEY command in the *OpenVMS DCL Dictionary: A–M*.

The default is /NOSET_STATE.

/TERMINATE
/NOTERMINATE

Causes the key definition to include termination of the command, which causes SDA to execute the command when the defined key is pressed. Therefore, you do not have to press the Return key after you press the defined key if you specify the /TERMINATE qualifier.

Description

The DEFINE/KEY command causes an SDA command to be associated with the specified key, in accordance with any of the specified qualifiers described previously.

If the symbol or key is already defined, SDA replaces the old definition with the new one. Symbols and keys remain defined until you exit from SDA.

Examples

1.
```
SDA>  DEFINE/KEY PF1 "SHOW STACK"
SDA>  PF1 SHOW STACK RETURN
Process stacks (on CPU 00)
-------------------------
Current operating stack (KERNEL):
   .
   .
   .
```

The DEFINE/KEY command defines PF1 as the SHOW STACK command. When you press the PF1 key, SDA displays the command and waits for you to press the Return key.

2.
```
SDA>  DEFINE/KEY/TERMINATE PF1 "SHOW STACK"
SDA>  PF1 SHOW STACK
Process stacks (on CPU 00)
-------------------------
Current operating stack (KERNEL):
      00000000.7FF95D00  00000000.0000000B
      00000000.7FF95D08  FFFFFFFF.804395C8  MMG$TBI_DATA_64+000B8
      00000000.7FF95D10  00000000.00000000
      00000000.7FF95D18  0000FE00.00007E04
SP => 00000000.7FF95D20  00000000.00000800  IRP$M_EXTEND
      00000000.7FF95D28  00000001.000002F7  UCB$B_PI_FKB+0000B
      00000000.7FF95D30  FFFFFFFF.804395C8  MMG$TBI_DATA_64+000B8
      00000000.7FF95D38  00000002.00000000
   .
   .
   .
```

The DEFINE/KEY command defines PF1 as the SDA SHOW STACK command. The /TERMINATE qualifier causes SDA to execute the SHOW STACK command without waiting for you to press the Return key.

3.
```
SDA>  DEFINE/KEY/SET_STATE="GREEN" PF1 ""
SDA>  DEFINE/KEY/TERMINATE/IF_STATE=GREEN PF3 "SHOW STACK"
SDA>  PF1  PF3 SHOW STACK
Process stacks (on CPU 00)
-------------------------
Current operating stack (KERNEL):
   .
   .
   .
```

The first DEFINE/KEY command defines PF1 as a key that sets a command state GREEN. The trailing pair of quotation marks is required syntax, indicating that no command is to be executed when this key is pressed.

The second DEFINE command defines PF3 as the SHOW STACK command, but using the /IF_STATE qualifier makes the definition valid only when the command state is GREEN. Thus, you must press PF1 before pressing PF3 to issue the SHOW STACK command. The /TERMINATE qualifier causes the command to execute as soon as you press the PF3 key.

DUMP

Displays the contents of a range of memory formatted as a comma-separated variable (CSV) list, suitable for inclusion in a spreadsheet.

Format

DUMP range
[/LONGWORD (default) | /QUADWORD]
[/DECIMAL | /HEXADECIMAL (default)]
[/FORWARD (default) | /REVERSE]
[/RECORD_SIZE=*size*] (default = 512)
[/INDEX_ARRAY [={ LONGWORD (default) | QUADWORD}]]
[/INITIAL_POSITION={ ADDRESS=*address* | RECO RD=*number*}]
[/COUNT = {ALL | *records*}] (default = all records)
[/PHYSICAL]

Parameter

range
The range of locations to be displayed. The range is specified in one of the following formats:

m:n	Range from address *m* to address *n* inclusive
m;n	Range from address *m* for *n* bytes

Qualifiers

/COUNT=[{ ALL | *records*}]
Gives the number of records to be displayed. The default is to display all records.

/DECIMAL
Outputs data as decimal values.

/FORWARD
Causes SDA to display the records in the history buffer in ascending address order. This is the default.

/HEXADECIMAL
Outputs data as hexadecimal values. This is the default.

/INDEX_ARRAY [={ LONGWORD (default) | QUADWORD}]
Indicates to SDA that the range of addresses given is a vector of pointers to the records to be displayed. The vector can be a list of longwords (default) or quadwords. The size of the range must be an exact number of longwords or quadwords as appropriate.

/INITIAL_POSITION = { ADDRESS=*address* | RECORD=*number*}
Indicates to SDA which record is to be displayed first. The default is the lowest addressed record if /FORWARD is used, and the highest addressed record if /REVERSE is used. The initial position may be given as a record number within the range, or the address at which the record is located.

/LONGWORD
Outputs each data item as a longword. This is the default.

/PHYSICAL

Indicates to SDA that all addresses (range and/or start position) are physical addresses. By default, virtual addresses are assumed.

/QUADWORD

Outputs each data item as a quadword.

/RECORD_SIZE=*size*

Indicates the size of each record within the history buffer, the default being 512 bytes. This size must exactly divide into the total size of the address range to be displayed, unless /INDEX_ARRAY is specified.

/REVERSE

Causes SDA to display the records in the history buffer in descending address order.

Description

The DUMP command displays the contents of a range of memory formatted as a comma-separated variable (CSV) list, suitable for inclusion in a spreadsheet. It is intended for use with a history buffer containing records of information of which the most recently written entry is in the middle of the memory range.

Note

See SET OUTPUT/NOHEADER for related information.

Examples

1.
```
SDA> DUMP dump g;200/initial_position=record=5/record_size=20/reverse
05,A77B0010,A79B0008,6B9C4001,47FF041F,A03E0000,47DF041C,201F0016,083
04,A03E0000,47DF041C,201F0058,083,A77B0010,A79B0008,6B9C4001,47FF041F
03,A03E0000,47DF041C,201F0075,083,A03E0000,47DF041C,201F001B,083
02,A77B0010,A79B0008,6B9C4001,47FF041F,A03E0000,47DF041C,201F0074,083
01,43E05120,083,6BFA8001,47FF041F,A77B0010,A79B0008,6B9C4001,47FF041F
0,201F0104,6BFA8001,47FF041F,47FF041F,201F0001,6BFA8001,47FF041F,47FF041F
0F,A03E0000,47DF041C,201F0065,083,A03E0000,47DF041C,201F0006,083
0E,A03E0000,47DF041C,201F001C,083,A03E0000,47DF041C,201F001A,083
0D,A03E0000,47DF041C,201F0077,083,A03E0000,47DF041C,201F0057,083
0C,A03E0000,47DF041C,201F002B,083,A03E0000,47DF041C,201F003A,083
0B,A03E0000,47DF041C,201F007D,083,A77B0010,A79B0008,6B9C4001,47FF041F
0A,A03E0000,47DF041C,201F005A,083,A03E0000,47DF041C,201F0078,083
09,A03E0000,47DF041C,201F0002,082,A03E0000,47DF041C,201F0037,083
08,A03E0000,47DF041C,201F0035,083,A03E0000,47DF041C,201F007A,083
07,A03E0000,47DF041C,201F0019,083,A03E0000,47DF041C,201F0034,083
06,A77B0010,A79B0008,6B9C4001,47FF041F,A03E0000,47DF041C,201F0018,083
```

This example shows the dump of an area of memory treated as 16 records of 32 bytes each, beginning at record 5, and dumped in reverse order. Note the record number in the first field, and that the dump wraps to the end of the memory area after the first record has been output.

2.
```
SDA> EXAMINE SMP$GL_CPU_DATA;80
00000000 00000000 8FE26000 8FE14000 00000000 00000000 8FE02000 811FE000  ...
00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  ...
00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  ...
00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  ...

SDA> DUMP SMP$GL_CPU_DATA;80/index_array/record_size=20/count=5
0,810C17C0,8EC7C180,026A09C0,02,0,FFFFFFFF,0,0
01,810C17C0,8EC7C400,026A09C0,02,0,FFFFFFFF,0,01
04,810C17C0,8EC7CB80,026A09C0,02,0,FFFFFFFF,0,04
```

This example shows the contents of the CPU database vector, then dumps the first 32 bytes of each CPU database entry. Only the first five entries in the array are requested, and those containing zero are ignored.

EVALUATE

Computes and displays the value of the specified expression in both hexadecimal and decimal. Alternative evaluations of the expression are available with the use of the qualifiers defined for this command.

Format

EVALUATE [{/CONDITION_VALUE | /PS | /PTE
| /[NO]SYMBOLS | /TIME}] expression

Parameter

expression
SDA expression to be evaluated. Section 2.6.2 describes the components of SDA expressions.

Qualifiers

/CONDITION_VALUE
Displays the message that the $GETMSG system service obtains for the value of the expression.

/PS
Evaluates the specified expression in the format of a processor status.

/PTE
Interprets and displays the expression as a page table entry (PTE). The individual fields of the PTE are separated and an overall description of the PTE's type is provided.

/SYMBOLS
/NOSYMBOLS
Specifies that all symbols known to be equal to the evaluated expression are to be listed in alphabetical order. The default behavior of the EVALUATE command displays only the first five symbols. If /NOSYMBOLS is specified, only the hexadecimal and decimal values are displayed.

/TIME
Interprets and displays the expression as a 64-bit time value. Positive values are interpreted as absolute time; negative values are interpreted as delta time.

Description

If you do not specify a qualifier, the EVALUATE command interprets and displays the expression as hexadecimal and decimal values. In addition, if the expression is equal to the value of a symbol in the SDA symbol table, that symbol is displayed. If no symbol with this value is known, the next lower valued symbol is displayed with an appropriate offset unless the offset is extremely large. (See Section 2.6.2.4 for a description of how SDA displays symbols and offsets.) The DEFINE command adds symbols to the SDA symbol table but does not display the results of the computation. EVALUATE displays the result of the computation but does not add symbols to the SDA symbol table.

Examples

1.

```
SDA>  EVALUATE -1
Hex = FFFFFFFF.FFFFFFFF   Decimal = -1          I
```

The EVALUATE command evaluates a numeric expression, displays the value of that expression in hexadecimal and decimal notation, and displays a symbol that has been defined to have an equivalent value.

2.

```
SDA>  EVALUATE 1
Hex = 00000000.00000001   Decimal = 1  CHF$M_CALEXT_CANCEL
                                              CHF$M_FPREGS_VALID
                                              CHF$V_CALEXT_LAST
                                              IRP$M_BUFIO
                                              IRP$M_CLN_READY
                                                |
                           (remaining symbols suppressed by default)
```

The EVALUATE command evaluates a numeric expression and displays the value of that expression in hexadecimal and decimal notation. This example also shows the symbols that have the displayed value. A maximum of five symbols are displayed by default.

3.

```
SDA>  DEFINE TEN = A
SDA>  EVALUATE TEN
Hex = 00000000.0000000A   Decimal = 10  IRP$B_TYPE
                                             IRP$S_FMOD
                                             IRP$V_MBXIO
                                             TEN
                                             UCB$B_TYPE
                                             |
                           (remaining symbols suppressed by default)
```

This example shows the definition of a symbol named TEN. The EVALUATE command then shows the value of the symbol.

Note that A, the value assigned to the symbol by the DEFINE command, could be a symbol. When SDA evaluates a string that can be either a symbol or a hexadecimal numeral, it first searches its symbol table for a definition of the symbol. If SDA finds no definition for the string, it evaluates the string as a hexadecimal number.

4.

```
SDA>  EVALUATE (((TEN * 6) + (-1/4)) + 6)
Hex = 00000000.00000042      Decimal = 66
```

This example shows how SDA evaluates an expression of several terms, including symbols and rational fractions. SDA evaluates the symbol, substitutes its value in the expression, and then evaluates the expression. The fraction -1/4 is truncated to 0.

5.

```
SDA>  EVALUATE/CONDITION 80000018
%SYSTEM-W-EXQUOTA, exceeded quota
```

This example shows the output of an EVALUATE/CONDITION command.

6.
```
SDA>  EVALUATE/PS  0B03
         MBZ SPAL      MBZ    IPL VMM MBZ CURMOD INT PRVMOD
         0   00   00000000000 0B  0   0   KERN   0   USER
```

SDA interprets the entered value 0B03 as though it were a processor status (PS) and displays the resulting field values.

7.
```
SDA>  EVALUATE/PTE 0BCDFFEE



3 3 2  2              2   1   1 1
1 0 9  7              0   8   6 5              7 6          0
+-+-+--+--------------+-+-+---+-+---------------+-+-----------+-+
|0|0|00|     005E     |0|X| 02|1|      FF       |X|    37     |0|
+-+-+--+--------------+-+-+---+-+---------------+-+-----------+-+
|                            00000000                           |
+---------------------------------------------------------------+
Global PTE:  Owner = S, Read Prot = KESU, Write Prot = KESU, CPY = 0
                     GPT Index  = 00000000
```

The EVALUATE/PTE command displays the expression 0BCDFFEE as a page table entry (PTE) and labels the fields. It also describes the status of the page.

8.
```
SDA> EVALUATE/TIME 009A9A4C.843DBA9F
10-OCT-1996 15:59:44.02
```

This example shows the use of the EVALUATE/TIME command.

EXAMINE

Displays either the contents of a location or range of locations in physical memory, or the contents of a register. Use location parameters to display specific locations or use qualifiers to display the entire process and system regions of memory.

Format

EXAMINE [/qualifier[,...]] [location]

Parameter

location
Location in memory to be examined. A location can be represented by any valid SDA expression. (See Section 2.6.2 for additional information about expressions.) To examine a range of locations, use the following syntax:

m:n Range of locations to be examined, from *m* to *n*

m;n Range of locations to be examined, starting at *m* and continuing for *n* bytes

The default location that SDA uses is initially 0 in the program region (P0) of the process that was executing at the time the system failed (if you are examining a crash dump) or your process (if you are examining the running system). Subsequent uses of the EXAMINE command with no parameter specified increase the last address examined by eight. Use of the /INSTRUCTION qualifier increases the default address by four. To examine memory locations of other processes, you must use the SET PROCESS command.

Qualifiers

/ALL
Examines all the locations in the program, and control regions and system space, displaying the contents of memory in hexadecimal longwords and ASCII characters. Do not specify parameters when you use this qualifier.

/CONDITION_VALUE
Examines the specified longword, displaying the message that the $GETMSG system service obtains for the value in the longword.

/INSTRUCTION
Translates the specified range of memory locations into assembly instruction format. Each symbol in the EXAMINE expression that is defined as a procedure descriptor is replaced with the code entry point address of that procedure, unless you also specify the /NOPD qualifier.

/NOPD
Can be used with the /INSTRUCTION qualifier to override treating symbols as procedure descriptors. You can place the qualifier immediately after the /INSTRUCTION qualifier, or following a symbol name.

For more details on using the /NOPD qualifier, see the description for the /PD qualifier.

/NOSUPPRESS

Inhibits the suppression of zeros when displaying memory with one of the following qualifiers: /ALL, /P0, /P1, /SYSTEM, or when a range is specified.

/P0

Displays the entire program region for the default process. Do not specify parameters when you use this qualifier.

/P1

Displays the entire control region for the default process. Do not specify parameters when you use this qualifier.

/PD

Causes the EXAMINE command to treat the location specified in the EXAMINE command as a procedure descriptor (PD). PD can also be used to qualify symbols.

You can use the /PD and /NOPD qualifiers with the /INSTRUCTION qualifier to override treating symbols as procedure descriptors. Placing the qualifier right after a symbol will override how the symbol is treated. /PD will force it to be a procedure descriptor, and /NOPD will force it to not be a procedure descriptor.

Only the /PD qualifier can be placed right after the /INSTRUCTION qualifier. It treats the calculated value as a procedure descriptor.

In the following examples, TEST_ROUTINE is a PD symbol. Its value is 500 and the code address in this procedure descriptor is 1000. The first example displays intructions starting at 520.

```
EXAMINE/INSTRUCTION TEST_ROUTINE/NOPD+20
```

The next example fetches code address from TEST_ROUTINE PD, adds 20 and displays instructions at that address. In other words, it displays code starting at location 1020.

```
EXAMINE/INSTRUCTION TEST_ROUTINE+20
```

The final example treates the address TEST_ROUTINE+20 as a procedure descriptor, so it fetches the code address out of a procedure descriptor at address 520. It then uses that address to display instructions.

```
EXAMINE/INSTRUCTION/PD TEST_ROUTINE/NOPD+20
```

/PHYSICAL

Examines physical addresses. You cannot use the /PHYSICAL qualifier in combination with the /P0, /P1, or /SYSTEM qualifiers.

/PS

Examines the specified quadword, displaying its contents in the format of a processor status. This qualifier must precede any parameters used in the command line.

/PTE

Interprets and displays the specified quadword as a page table entry (PTE). The display separates individual fields of the PTE and provides an overall description of the PTE's type.

/SYSTEM

Displays portions of the writable system region. Do not specify parameters when you use this qualifier.

/TIME

Examines the specified quadword, displaying its contents in the format of a system-date-and-time quadword.

Description

The following sections describe how to use the EXAMINE command.

Examining Locations

When you use the EXAMINE command to look at a location, SDA displays the location in symbolic notation (symbolic name plus offset), if possible, and its contents in hexadecimal and ASCII formats:

```
SDA> EXAMINE G6605C0
806605C0:  64646464.64646464  "dddddddd"
```

If the ASCII character that corresponds to the value contained in a byte is not printable, SDA displays a period (.). If the specified location does not exist in memory, SDA displays this message:

```
%SDA-E-NOTINPHYS, address : virtual data not in physical memory
```

To examine a range of locations, you can designate starting and ending locations separated by a colon. For example:

```
SDA> EXAMINE G40:G200
```

Alternatively, you can specify a location and a length, in bytes, separated by a semicolon. For example:

```
SDA> EXAMINE G400;16
```

When used to display the contents of a range of locations, the EXAMINE command displays six or ten columns of information. Ten columns are used if the terminal width is 132 or greater, or if a SET OUTPUT has been entered; six columns are used otherwise. An explanation of the columns is as follows:

- Each of the first four or eight columns represents a longword of memory, the contents of which are displayed in hexadecimal format.
- The fifth or ninth column lists the ASCII value of each byte in each longword displayed in the previous four or eight columns.
- The sixth or tenth column contains the address of the first, or rightmost, longword in each line. This address is also the address of the first, or leftmost, character in the ASCII representation of the longwords. Thus, you read the hexadecimal dump display from right to left, and the ASCII display from left to right.

If a series of virtual addresses does not exist in physical memory, SDA displays a message specifying the range of addresses that were not translated.

If a range of virtual locations contains only zeros, SDA displays this message:

```
Zeros suppressed from 'loc1' to 'loc2'
```

Decoding Locations

You can translate the contents of memory locations into instruction format by using the /INSTRUCTION qualifier. This qualifier causes SDA to display the location in symbolic notation (if possible) and its contents in instruction format. The operands of decoded instructions are also displayed in symbolic notation. The location must be longword aligned.

Examining Memory Regions

You can display an entire region of virtual memory by using one or more of the qualifiers /ALL, /SYSTEM, /P0, and /P1 with the EXAMINE command.

Other Uses

Other uses of the EXAMINE command appear in the following examples.

Note

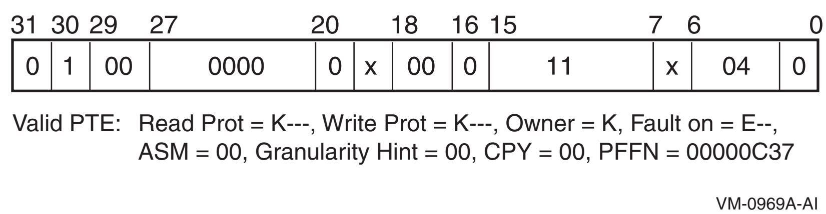
When examining individual locations, addresses are usually symbolized, as described previously. If the SET SYMBOLIZE OFF command is issued, addresses are not symbolized. See the SET SYMBOLIZE command for further details.

Examples

1.
```
SDA> EXAMINE/PS 7FF95E78
          MBZ SPAL      MBZ     IPL VMM MBZ CURMOD INT PRVMOD
          0   00   00000000000 08  0   0   KERN   0   EXEC
```

   This example shows the display produced by the EXAMINE/PS command.

2.
```
SDA> EXAMINE/PTE @^QMMG$GQ_L1_BASE
```



   The EXAMINE/PTE command displays and formats the level 1 page table entry at FFFFFFFF.FF7FC000.

3.
```
SDA> EXAMINE/CONDITION_VALUE R0
%SYSTEM-F-NOPRIV, insufficient privilege or object protection violation
```

   This example shows the text associated with the condition code in R0.

4.
```
SDA> EXAMINE/TIME EXE$GQ_SYSTIME
12-DEC-2001 08:23:07.80
```

   This example displays the current system as an ASCII absolute time.

EXIT

Exits from an SDA display or exits from the SDA utility.

Format

EXIT

Parameters

None.

Qualifiers

None.

Description

If SDA is displaying information on a video display terminal—and if that information extends beyond one screen—SDA enters display mode and displays a **screen overflow prompt** at the bottom of the screen:

```
Press RETURN for more.
SDA>
```

If you want to discontinue the current display at this point, enter the EXIT command. If you want SDA to execute another command, enter that command. SDA discontinues the display as if you entered EXIT, and then executes the command you entered.

When the SDA> prompt is not immediately preceded by the screen overflow prompt, entering EXIT causes your process to cease executing the SDA utility. When issued within a command procedure (either the SDA initialization file or a command procedure invoked with the execute (@) command), EXIT causes SDA to terminate execution of the procedure and return to the SDA prompt.

See Section 2.6.3 for a description of SDA display mode.

FORMAT

Displays a formatted list of the contents of a block of memory.

Format

FORMAT [/TYPE=*block-type*] location [/PHYSICAL] [/POSITIVE]

Parameter

location
Location of the beginning of the data block. The location can be given as any valid SDA expression.

Qualifiers

/TYPE=block-type
Forces SDA to characterize and format a data block at **location** as the specified type of data structure. The /TYPE qualifier thus overrides the default behavior of the FORMAT command in determining the type and/or subtype of a data block, as described in the Description section. The *block-type* can be the symbolic prefix of any data structure defined by the operating system.

/PHYSICAL
Specifies that the location given is a physical address.

/POSITIVE
Symbols that describe negative offsets from the start of the structure are ignored. By default, all symbols for the block type are processed.

Description

The FORMAT command performs the following actions:

- Characterizes a range of locations as a system data block
- Assigns, if possible, a symbol to each item of data within the block
- Displays all the data within the block

Most OpenVMS Alpha control blocks include two bytes that indicate the block type and/or subtype at offsets $0A_{16}$ and $0B_{16}$, respectively. The type and/or subtype associate the block with a set of symbols that have a common prefix. Each symbol's name describes a field within the block, and the value of the symbol represents the offset of the field within the block.

If the type and/or subtype bytes contain a valid block type/subtype combination, SDA retrieves the symbols associated with that type of block (see $DYNDEF) and uses their values to format the block.

For a given block type, all associated symbols have the folloiwng form:

```
<block_type>$<field>_<name>
```

where field is one of the following:

```
B  Byte
W  Word
L  Longword
Q  Quadword
O  Octaword
A  Address
C  Constant
G  Global Longword
P  Pointer
R  Structure (variable size)
T  Counted ASCII string (up to 31 characters)
```

If SDA cannot find the symbols associated with the block type specified in the block-type byte or by the /TYPE qualifier, it issues the following message:

```
%SDA-E-NOSYMBOLS, no <block type> symbols found to format this block
```

If you receive this message, you may want to read additional symbols into the SDA symbol table and retry the FORMAT command. Many symbols that define OpenVMS Alpha data structures are contained within SDA$READ_DIR:SYSDEF.STB. Thus, you would issue the following command:

```
SDA> READ SDA$READ_DIR:SYSDEF.STB
```

If SDA issues the same message again, try reading additional symbols. Table 2–4 lists additional modules provided by the OpenVMS operating system. Alternatively, you can create your own object modules with the MACRO-32 Compiler for OpenVMS Alpha. See the READ command description for instructions on creating such an object module.

Certain OpenVMS Alpha data structures do not contain a block type and/or subtype. If bytes contain information other than a block type/subtype—or do not contain a valid block type/subtype—SDA either formats the block in a totally inappropriate way, based on the contents of offsets $0A_{16}$ and $0B_{16}$, or displays the following message:

```
%SDA-E-INVBLKTYP, invalid block type in specified block
```

To format such a block, you must reissue the FORMAT command, using the /TYPE qualifier to designate a *block-type*.

The FORMAT command produces a three-column display containing the following information:

- The first column shows the virtual address of each item within the block.
- The second column lists each symbolic name associated with a location within the block.
- The third column shows the contents of each item in hexadecimal format, including symbolization if a suitable symbol exists.

Example

```
SDA> READ SDA$READ_DIR:SYSDEF.STB
%SDA-I-READSYM, 913 symbols read from SYS$COMMON:[SYS$LDR]SYSDEF.STB
SDA> FORMAT G41F818
FFFFFFFF.8041F818   UCB$L_FQFL                    8041F818       UCB
                    UCB$L_MB_MSGQFL
                    UCB$L_RQFL
                    UCB$W_MB_SEED
                    UCB$W_UNIT_SEED
FFFFFFFF.8041F81C   UCB$L_FQBL                    8041F818       UCB
                    UCB$L_MB_MSGQBL
                    UCB$L_RQBL
FFFFFFFF.8041F820   UCB$W_SIZE                        0110
FFFFFFFF.8041F822   UCB$B_TYPE                      10
FFFFFFFF.8041F823   UCB$B_FLCK                    2C
FFFFFFFF.8041F824   UCB$L_ASTQFL                  00000000
                    UCB$L_FPC
                    UCB$L_MB_W_AST
                    UCB$T_PARTNER
    .
    .
    .
```

The READ command loads the symbols from SDA$READ_DIR:SYSDEF.STB into SDA's symbol table. The FORMAT command displays the data structure that begins at $G41F818_{16}$, a unit control block (UCB). If a field has more than one symbolic name, all such names are displayed. Thus, the field that starts at $8041F824_{16}$ has four designations: UCBL_ASTQFL, UCBL_FPC, UCB$L_MB_W_AST, and UCB$T_PARTNER.

The contents of each field appear to the right of the symbolic name of the field. Thus, the contents of UCB$L_FQBL are $8041F818_{16}$.

HELP

Displays information about the SDA utility, its operation, and the format of its commands.

Format

HELP [topic-name]

Parameter

topic-name
Topic for which you need information. A topic can be a command name or one of the following keywords:

Keyword	Function
ANALYZE_USAGE_ SUMMARY	Describes the parameters and qualifiers for the ANALYZE/CRASH_DUMP and ANALYZE/SYSTEM DCL commands
CPU_CONTEXT	Describes the concept of CPU context as it governs the behavior of SDA
EXECUTE_COMMAND	Describes the use of @ file to execute SDA commands contained in a file
EXPRESSIONS	Prints a description of SDA expressions
INITIALIZATION	Describes the circumstances under which SDA executes an initialization file when first invoked
OPERATION	Describes how to operate SDA at your terminal and by means of the site-specific startup procedure
PROCESS_CONTEXT	Describes the concept of process context as it governs the behavior of SDA
SDA_CLUE_ EXTENSION_ COMMANDS	Provides an overview of SDA CLUE (Crash Log Utility Extractor)
SDA_EXTENSION_ ROUTINES	Describes how to write, debug, and invoke an SDA extension and provides details of all callable routines
SDA_SPINLOCK_ TRACING_COMMANDS	Provides an overview of SDA SPL (Spinlock Tracing utility)
SYMBOLS	Describes the symbols used by SDA

Qualifiers

None.

Description

The HELP command displays brief descriptions of SDA commands and concepts on the terminal screen (or sends these descriptions to the file designated in a SET OUTPUT command). You can request additional information by specifying the name of a topic in response to the Topic? prompt.

If you do not specify a parameter in the HELP command, it lists the features of SDA and those commands and topics for which you can request help, as follows:

Example

```
SDA> HELP

HELP

     The System Dump Analyzer (SDA) allows you to inspect the contents
     of memory as saved in the dump taken at crash time or as exists
     in a running system. You can use SDA interactively or in batch
     mode. You can send the output from SDA to a listing file. You can
     use SDA to perform the following operations:

                      Assign a value to a symbol
                      Examine memory of any process
                      Format instructions and blocks of data
                      Display device data structures
                      Display memory management data structures
                      Display a summary of all processes on the system
                      Display the SDA symbol table
                      Copy the system dump file
                      Send output to a file or device
                      Read global symbols from any object module
                      Send output to a file or device
                      Search memory for a given value

     For help on performing these functions, use the HELP command and
     specify a topic.

     Format

       HELP  [topic-name]


  Additional information available:

  ANALYZE_Usage_Summary ATTACH     CLUE       COPY       CPU_Context
  DEFINE     DUMP       EVALUATE   EXAMINE    Execute_Command       EXIT
  Expressions           FORMAT     HELP       Initialization        MAP
  MODIFY     Operation  Process_Context       READ       REPEAT
  SDA_CLUE_Extension_Commands      SDA_Extension_Routines
  SDA_Spinlock_Tracing_Commands    SEARCH     SET        SHOW       SPAWN
  SPL        Symbols    UNDEFINE   VALIDATE

Topic?
```

MAP

Transforms an address into an offset in a particular image.

Format

MAP address

Parameter

address
Address to be identified.

Qualifiers

None.

Description

The MAP command identifies the image name and offset corresponding to an address. With this information, you can examine the image map to locate the source module and program section offset corresponding to an address. MAP searches for the specified address in executive images first. It then checks activated images in process space to include those images installed using the /RESIDENT qualifier of the Install utility. Finally, it checks all image-resident sections in system space.

If the address cannot be found, MAP displays the following message:

```
%SDA-E-NOTINIMAGE, Address not within a system/installed image
```

Examples

1.
```
SDA> MAP G90308
Image                                  Base      End       Image Offset
SYS$VM
Nonpaged read only                     80090000  800ABA00  00000308
```

Examining the image map identified by this MAP command (SYS$VM.MAP) shows that image offset 308 falls within psect EXEC$HI_USE_PAGEABLE_CODE because the psect goes from offset 0 to offset 45D3:

```
   .
   .
   .
EXEC$HI_USE_PAGEABLE_CODE       00000000 000045D3 000045D4 ( 17876.) 2 **  5 . . .
                SYSCREDEL       00000000 0000149B 0000149C (  5276.) 2 **  5
                SYSCRMPSC       000014A0 000045D3 00003134 ( 12596.) 2 **  5

EXEC$NONPAGED_CODE              000045E0 0001B8B3 000172D4 ( 94932.) 2 **  5 . . .
                EXECUTE_FAULT   000045E0 0000483B 0000025C (   604.) 2 **  5
                IOLOCK          00004840 000052E7 00000AA8 (  2728.) 2 **  5
                LOCK_SYSTEM_PAGES
   .
   .
   .
```

Specifically, image offset 308 is located within source module SYSCREDEL. Therefore, to locate the corresponding code, you would look in SYSCREDEL for offset 308 in psect EXEC$HI_USE_PAGEABLE_CODE.

2.
```
SDA> MAP G550000
Image                             Base         End        Image Offset
SYS$DKDRIVER                      80548000     80558000   00008000
```

In this example, the MAP command identifies the address as an offset into an executive image that is not sliced. The base and end addresses are the boundaries of the image.

3.
```
SDA> MAP G550034
Image                             Base         End        Image Offset
SYS$DUDRIVER
      Nonpaged read/write         80550000     80551400   00008034
```

In this example, the MAP command identifies the address as an offset into an executive image that is sliced. The base and end addresses are the boundaries of the image section that contains the address of interest.

4.
```
SDA> MAP GF0040
Image Resident Section            Base         End        Image Offset
MAILSHR                           800F0000     80119000   00000040
```

The MAP command identifies the address as an offset into an image-resident section residing in system space.

5.
```
SDA> MAP 12000
Activated Image                   Base         End        Image Offset
MAIL                              00010000     000809FF   00002000
```

The MAP command identifies the address as an offset into an activated image residing in process-private space.

6.
```
SDA> MAP B2340
Compressed Data Section           Base         End        Image Offset
LIBRTL                            000B2000     000B6400   00080340
```

The MAP command identifies the address as being within a compressed data section. When an image is installed with the Install utility using the /RESIDENT qualifier, the code sections are mapped in system space. The data sections are compressed into process-private space to reduce null pages or holes in the address space left by the absence of the code section. The SHOW PROCESS/IMAGE=ALL display shows how the data has been compressed; the MAP command searches this information to map an address in a compressed data section to an offset in an image.

7.
```
SDA> MAP 7FC06000
Shareable Address Data Section           Base      End       Image Offset
LIBRTL                                   7FC06000  7FC16800  00090000
```

The MAP command identifies the address as an offset into a shareable address data section residing in P1 space.

8.
```
SDA> MAP 7FC26000
Read-Write Data Section                  Base      End       Image Offset
LIBRTL                                   7FC26000  7FC27000  000B0000
```

The MAP command identifies the address as an offset into a read-write data section residing in P1 space.

9.
```
SDA> MAP 7FC36000
Shareable Read-Only Data Section        Base      End       Image Offset
LIBRTL                                  7FC36000  7FC3F600  000C0000
```

The MAP command identifies the address as an offset into a shareable read-only data section residing in P1 space.

10.
```
SDA> MAP 7FC56000
Demand Zero Data Section                Base      End       Image Offset
LIBRTL                                  7FC56000  7FC57000  000E0000
```

The MAP command identifies the address as an offset into a demand zero data section residing in P1 space.

MODIFY DUMP

Allows a given byte, word, longword, or quadword in the dump to be modified.

Format

MODIFY DUMP {/BLOCK=*n*/OFFSET=*n* | /NEXT} [/CONFIRM=*n*]
{/BYTE | /WORD | /LONGWORD (d) | /QUADWORD} value

Parameter

value
New value deposited in the specified location in the dump file.

Qualifiers

/BLOCK=*n*
Indicates block number to be modified. Required unless the /NEXT qualifier is given.

/OFFSET=*n*
Indicates byte offset within block to be modified. Required unless the /NEXT qualifier is given.

/NEXT
Indicates that the byte or bytes immediately following the location altered by the previous MODIFY DUMP command are to be modified. Used instead of the /BLOCK=*n* and /OFFSET=*n* qualifiers.

/CONFIRM=*n*
Checks existing contents of location to be modified.

/BYTE
Indicates that only a single byte is to be replaced.

/WORD
Indicates that a word is to be replaced.

/LONGWORD
Indicates that a longword is to be replaced. This is the default.

/QUADWORD
Indicates that a quadword is to be replaced.

Description

The MODIFY DUMP command is used on a dump file that cannot be analyzed without specifying the /OVERRIDE qualifier on the ANALYZE/CRASH_DUMP command. You can use the MODIFY DUMP command to correct the problem that prevents normal analysis of a dump file. You can only use the MODIFY DUMP command when you have invoked SDA with the ANALYZE/CRASH_DUMP/OVERRIDE command.

Important

This command is not intended for general use. It is provided for the benefit of Compaq support personnel when investigating crash dumps that cannot be analyzed in other ways.

If the block being modified is part of either the dump header, the error log buffers, or the compression map, the changes made are not seen when you issue the appropriate SHOW DUMP command, unless you first exit from SDA and then reissue the ANALYZE/CRASH_DUMP command.

The MODIFY DUMP command sets a bit in the dump header to indicate that the dump has been modified. Subsequent ANALYZE/CRASH_DUMP commands issued to that file produce the following warning message:

```
%SDA-W-DUMPMOD, dump has been modified
```

Examples

1. `SDA>> MODIFY DUMP/BLOCK=10/OFFSET=100/WORD FF`

   This example shows the dump file modified with the word at offset 100 in block 00000010 replaced by 00FF.

2. `SDA>> MODIFY DUMP/BLOCK=10/OFFSET=100/WORD 0/CONFIRM=EE`

   This example shows that the actual word value of 00FF at offset 100 in block 00000010 does not match the given value of 00EE. The following message is displayed:

3. `%SDA-E-NOMATCH, expected value does not match value in dump; dump not updated`

4. `SDA>> MODIFY DUMP/BLOCK=10/OFFSET=100/WORD 0/CONFIRM=FF`

   This example shows the dump file modified with a word value of 00FF at offset 100 in block 00000010 replaced by 0000.

READ

Loads the global symbols contained in the specified file into the SDA symbol table.

Format

READ [/[NO]LOG | /RELOCATE =*expression* | /SYMVA=*expression*]
{/EXECUTIVE [directory spec] | /FORCE filespec
| /IMAGE filespec | filespec}

Parameters

directory-spec
Name of the directory containing the loadable images of the executive. This parameter defaults to SDA$READ_DIR, which is a search list of SYS$LOADABLE_IMAGES and SYS$LIBRARY.

filespec
Name of the device, directory, and file that contains the file from which you want to read global symbols. The **filespec** defaults to SYS$DISK:[default-dir]filename.type, where SYS$DISK and [default-dir] represent the disk and directory specified in your last DCL command SET DEFAULT. If no type has been given in **filespec**, SDA first tries .STB and then .EXE.

If no device or directory is given in the file specification, and the file specification is not found in SYS$DISK:[default_dir], then SDA attempts to open the file SDA$READ_DIR:filename.type. If no type has been given in **filespec**, SDA first tries .STB and then .EXE.

If the file name is the same as that of an execlet or image, but the symbols in the file are not those of the execlet or image, then you must use the /FORCE qualifier, and optionally /RELOCATE and /SYMVA qualifiers, to tell SDA how to interpret the symbols in the file.

Qualifiers

/EXECUTIVE directory-spec
Reads into the SDA symbol table all global symbols and global entry points defined within all loadable images that make up the executive. For all the execlets in the system, SDA reads the .STB or .EXE files in the requested directory.

/FORCE filespec
Forces SDA to read the symbols file, regardless of what other information or qualifiers are specified. If you do not specify the /FORCE qualifier, SDA may not read the symbols file if the specified **filespec** matches the image name in either the executive loaded images or the current processes activated image list, and one of the following conditions is true:

- The image has a symbols vector (is a shareable image), and a symbols vector was not specified with the /SYMVA or /IMAGE qualifier.
- The image is sliced, and slicing information was not provided with the /IMAGE qualifier.

- The shareable or executive image is not loaded at the same address it was linked at, and the relocation information was not provided with either the /IMAGE or /RELOCATE qualifier.

The use of /FORCE [/SYMVA=*addr*][/RELOCATE=*addr*] **filespec** is a variant of the /IMAGE qualifier and avoids fixing up the symbols to match an image of the same name.

/IMAGE filespec

Searches the executive loaded image list and the current process activated image list for the image specified by **filespec**. If the image is found, the symbols are read in using the image symbol vector (if there is one) and either slicing or relocation information.

This is the preferred way to read in the .STB files produced by the linker. These .STB files contain all universal symbols, unless SYMBOL_TABLE=GLOBAL is in the linker options file, in which case the .STB file contains all universal and global symbols.

/LOG
/NOLOG

The /LOG qualifier causes SDA to output the %SDA-I-READSYM message for each symbol table file it reads. This is the default. You can specify the /LOG qualifier with any other combination of parameters and qualifiers.

The /NOLOG qualifier suppresses the output of the %SDA-I-READSYM messages. You can specify the /NOLOG qualifier with any other combination of parameters and qualifiers.

/RELOCATE=*expression*

Changes the relative addresses of the symbols to absolute addresses by adding the value of **expression** to the value of each symbol in the symbol table file to be read. This qualifier changes those addresses to absolute addresses in the address space into which the dump is mapped.

The relocation only applies to symbols with the relocate flag set. All universal symbols must be found in the symbol vector for the image. All constants are read in without any relocation.

If the image is sliced (image sections are placed in memory at different relative offsets than how the image is linked), then the /RELOCATE qualifier does not work. SDA compares the file name used as a parameter to the READ command against all the image names in the executive loaded image list and the current processes activated image list. If a match is found, and that image contains a symbol vector, an error results. At this point you can either use the /FORCE qualifier or the /IMAGE qualifier to override the error.

/SYMVA=*expression*

Informs SDA whether the absolute symbol vector address is for a shareable image (SYS$PUBLIC_VECTORS.EXE) or base system image (SYS$BASE_IMAGE.EXE). All symbols found in the file with the universal flag are found by referencing the symbol vector (that is, the symbol value is a symbol vector offset).

Description

The READ command symbolically identifies locations in memory and the definitions used by SDA for which the default files (SDA$READ_DIR:SYS$BASE_IMAGE.EXE and SDA$READ_DIR:REQSYSDEF.STB) provide no definition. In other words, the required global symbols are located in modules and symbol tables that have been compiled and/or linked separately from the executive. SDA extracts no local symbols from the files.

The file specified in the READ command can be the output of a compiler or assembler (for example, an .OBJ file).

Note

The READ command can read both OpenVMS VAX and OpenVMS Alpha format files. Do not use READ to read OpenVMS VAX format files that contain VAX specific symbols, as this might change the behavior of other OpenVMS Alpha SDA commands.

Most often the file is provided in SYS$LOADABLE_IMAGES. Many SDA applications, for instance, need to load the definitions of system data structures by issuing a READ command specifying SYSDEF.STB. Others require the definitions of specific global entry points within the executive image.

The files in SYS$LOADABLE_IMAGES define global locations within executive images, including those listed in Table 4–1. The actual list of executive images used varies, depending on platform type, devices, and the settings of several system parameters.

Table 4–1 Modules Defining Global Locations Within Executive Images

File	Contents
ACME.EXE	$ACM system service
CNX$DEBUG.EXE	Connection Manager trace routines
DDIF$RMS_EXTENSION.EXE	Support for Digital Document Interchange Format (DDIF) file operations
ERRORLOG.STB	Error-logging routines and system services
EXCEPTION.STB[1]	Bugcheck and exception-handling routines and those system services that declare condition and exit handlers
EXEC_INIT.STB	Initialization code
F11BXQP.STB	File system support
FC$GLOGALS.STB	Fibrechannel symbols

[1]Variations of these files also exist, for example, where the file name ends in "_MON." System parameters such as SYSTEM_CHECK determine which image is loaded.

(continued on next page)

Table 4–1 (Cont.) Modules Defining Global Locations Within Executive Images

File	Contents
IMAGE_MANAGEMENT.STB	Image activator and the related system services
IO_ROUTINES.STB[1]	$QIO system service, related system services (for example, $CANCEL and $ASSIGN), and supporting routines
LAT$RATING.EXE	CPU load-balancing routines for LAT
LCK$DEBUG.EXE	Lock manager trace routines
LMF$GROUP_TABLE.EXE	Data structures for licensed product groups
LOCKING.STB	Lock management routines and system services
LOGICAL_NAMES.STB	Logical name routines and system services
MESSAGE_ROUTINES.STB	System message routines and system services (including $SNDJBC and $GETTIM)
MSCP.EXE	Disk MSCP server
MULTIPATH.STB[1]	Fibrechannel multipath support routines
NET$CSMACD.EXE	CSMA/CD LAN management module
NET$FDDI.EXE	FDDI LAN management module
NT_EXTENSION.EXE	NT extensions for persona system services
PROCESS_MANAGEMENT.STB[1]	Scheduler, report system event, and supporting routines and system services
RECOVERY_UNIT_SERVICES.STB	Recovery unit system services
RMS.EXE	Global symbols and entry points for RMS
SECURITY.STB[1]	Security management routines and system services
SHELL*xx*K.STB	Process shell
SPL$DEBUG.EXE	Spinlock trace routines
SSPI.EXE	Security Support Provider Interface
SYS$*xx*DRIVER.EXE	Run-time device drivers
SYS$ATMWORKS351.EXE	PCI-ATM driver

[1]Variations of these files also exist, for example, where the file name ends in "_MON." System parameters such as SYSTEM_CHECK determine which image is loaded.

(continued on next page)

Table 4–1 (Cont.) Modules Defining Global Locations Within Executive Images

File	Contents
SYS$CLUSTER.EXE	OpenVMS Cluster support routines
SYS$CPU_ROUTINES_*xxxx*.EXE	Processor-specific data and initialization routines
SYS$EW1000A.EXE	Gigabit Ethernet driver
SYS$GALAXY.STB	OpenVMS Galaxy support routines
SYS$IPC_SERVICES.EXE	Interprocess communication for DECdtm and Batch/Print
SYS$LAN.EXE	Common LAN routines
SYS$LAN_ATM.EXE	LAN routines for ATM
SYS$LAN_ATM4.EXE	LAN routines for ATM (ForeThought)
SYS$LAN_CSMACD.EXE	LAN routines for CSMA/CD
SYS$LAN_FDDI.EXE	LAN routines for FDDI
SYS$LAN_TR.EXE	LAN routines for Token Ring
SYS$MME_SERVICES.STB	Media Management Extensions
SYS$NETWORK_SERVICES.EXE	DECnet support
SYS$NTA.STB	NT affinity routines and services
SYS$PUBLIC_VECTORS.EXE[2]	System service vector base image
SYS$SCS.EXE	System Communication Services
SYS$TRANSACTION_SERVICES.EXE	DECdtm services
SYS$UTC_SERVICES.EXE	Universal Coordinated Time services
SYS$VCC.STB[1]	Virtual I/O cache
SYS$VM.STB	System pager and swapper, along with their supporting routines, and management system services
SYS$XFCACHE.STB[1]	Extented File Cache
SYSDEVICE.STB	Mailbox driver and null driver
SYSGETSYI.STB	Get System Information system service ($GETSYI)
SYSLDR_DYN.STB	Dynamic executive image loader
SYSLICENSE.STB	Licensing system service ($LICENSE)
SYSTEM_DEBUG.EXE	XDelta and SCD routines

[1]Variations of these files also exist, for example, where the file name ends in "_MON." System parameters such as SYSTEM_CHECK determine which image is loaded.

[2]This file is located in SYS$LIBRARY.

(continued on next page)

Table 4–1 (Cont.) Modules Defining Global Locations Within Executive Images

File	Contents
SYSTEM_PRIMITIVES.STB[1]	Miscellaneous basic system routines, including those that allocate system memory, maintain system time, create fork processes, and control mutex acquisition
SYSTEM_SYNCHRONIZATION.STB[1]	Routines that enforce synchronization
TCPIP$BGDRIVER.STB[3]	TCP/IP internet driver
TCPIP$INETACP.STB[3]	TCP/IP internet ACP
TCPIP$INETDRIVER.STB[3]	TCP/IP internet driver
TCPIP$INTERNET_SERVICES.STB[3]	TCP/IP internet execlet
TCPIP$NFS_SERVICES.STB[3]	Symbols for the TCP/IP NFS server
TCPIP$PROXY_SERVICES.STB[3]	Symbols for the TCP/IP proxy execlet
TCPIP$PWIPACP.STB[3]	TCP/IP PWIP ACP
TCPIP$PWIPDRIVER.STB[3]	TCP/IP PWIP driver
TCPIP$TNDRIVER.STB[3]	TCP/IP TELNET/RLOGIN server driver
TMSCP.EXE	Tape MSCP server
VMS_EXTENSION.EXE	VMS extensions for persona system services

[1]Variations of these files also exist, for example, where the file name ends in "_MON." System parameters such as SYSTEM_CHECK determine which image is loaded.

[3]Only available if TCP/IP has been installed. These are found in SYS$SYSTEM, and are not automatically read in when you issue a READ/EXEC command.

SDA can also read symbols from an image .EXE or .STB produced by the linker. The STB and EXE files only contain universal symbols. The STB file, however, can be forced to have global symbols for the image if you use the SYMBOL_ TABLE=GLOBAL option in the linker options file.

A number of ready-built symbol table files ship with OpenVMS Alpha. They can be found in the directory SYS$LOADABLE_IMAGES, and all have names of the form xyzDEF.STB. Of these files, SDA automatically reads REQSYSDEF.STB on activation. You can add the symbols in the other files to SDA's symbol table using the READ command. Table 2–4 lists the files that OpenVMS Alpha provides in SYS$LOADABLE_IMAGES that define data structure offsets.

The following MACRO program, GLOBALS.MAR, shows how to obtain symbols in addition to those in SYS$BASE_IMAGE.EXE, other executive images listed in Table 4–1, and the symbol table files that are listed in Table 2–4:

```
.TITLE GLOBALS
; n.b. on following lines GLOBAL must be capitalized
$PHDDEF GLOBAL         ; Process header definitions
$DDBDEF GLOBAL         ; Device data block
$UCBDEF GLOBAL         ; Unit control block
$VCBDEF GLOBAL         ; Volume control block
$ACBDEF GLOBAL         ; AST control block
$IRPDEF GLOBAL         ; I/O request packet
; more can be inserted here
.END
```

Use the following command to generate an object module file containing the globals defined in the program:

```
$MACRO GLOBALS+SYS$LIBRARY:LIB/LIBRARY /OBJECT=GLOBALS.STB
```

Examples

1.
```
SDA>  READ SDA$READ_DIR:SYSDEF.STB
%SDA-I-READSYM, 10010 symbols read from SYS$COMMON:[SYSEXE]SYSDEF.STB;1
```

The READ command causes SDA to add all the global symbols in SDA$READ_DIR:SYSDEF.STB to the SDA symbol table. Such symbols are useful when you are formatting an I/O data structure, such as a unit control block or an I/O request packet.

2.
```
SDA> SHOW STACK
Process stacks (on CPU 00)
--------------------------
Current operating stack (KERNEL):

        00000000.7FF95CD0  FFFFFFFF.80430CE0  SCH$STATE_TO_COM+00040
        00000000.7FF95CD8  00000000.00000000
        00000000.7FF95CE0  FFFFFFFF.81E9CB04  LNM$SEARCH_ONE_C+000E4
        00000000.7FF95CE8  FFFFFFFF.8007A988  PROCESS_MANAGEMENT_NPRO+0E988
   SP =>00000000.7FF95CF0  00000000.00000000
        00000000.7FF95CF8  00000000.006080C1
        00000000.7FF95D00  FFFFFFFF.80501FDC
        00000000.7FF95D08  FFFFFFFF.81A5B720
   .
   .
   .
SDA>  READ/IMAGE SYS$LOADABLE_IMAGES:PROCESS_MANAGEMENT
%SDA-I-READSYM, 767 symbols read from SYS$COMMON:[SYS$LDR]PROCESS_MANAGEMENT.STB;1
SDA>  SHOW STACK
Process stacks (on CPU 00)
--------------------------
Current operating stack (KERNEL):

        00000000.7FF95CD0  FFFFFFFF.80430CE0  SCH$FIND_NEXT_PROC
        00000000.7FF95CD8  00000000.00000000
        00000000.7FF95CE0  FFFFFFFF.81E9CB04  LNM$SEARCH_ONE_C+000E4
        00000000.7FF95CE8  FFFFFFFF.8007A988  SCH$INTERRUPT+00068
   SP =>00000000.7FF95CF0  00000000.00000000
        00000000.7FF95CF8  00000000.006080C1
        00000000.7FF95D00  FFFFFFFF.80501FDC
        00000000.7FF95D08  FFFFFFFF.81A5B720
   .
   .
   .
```

The initial SHOW STACK command contains an address that SDA resolves into an offset from the PROCESS_MANAGEMENT executive image. The READ command loads the corresponding symbols into the SDA symbol table such that the reissue of the SHOW STACK command subsequently identifies the same location as an offset within a specific process management routine.

REPEAT

Repeats execution of the last command issued. On terminal devices, the KP0 key performs the same function as the REPEAT command with no parameter or qualifier.

Format

REPEAT [count|/UNTIL=condition]

Parameter

count
Number of times the previous command is to be repeated. The default is a single repeat.

Qualifier

/UNTIL=condition
Defines a condition that terminates the REPEAT command. By default, there is no terminating condition.

Description

The REPEAT command is useful for stepping through a linked list of data structures, or for examining a sequence of memory locations. When used with ANALYZE/SYSTEM, it allows the changing state of a system location or data structure to be monitored.

Examples

1.
```
SDA> SPAWN CREATE SDATEMP.COM
        SEARCH  0:3FFFFFFF   12345678
        SET PROCESS/NEXT
        ^Z
SDA> SET PROCESS NULL
SDA> @SDATEMP
SDA> REPEAT/UNTIL = BADPROC
```

This example demonstrates how to search the address space of each process in a system or dump a given pattern.

2.
```
SDA> SHOW CALL_FRAME
Call Frame Information
----------------------
        Stack Frame Procedure Descriptor
Flags:  Base Register = FP, Jacket, Native
        Procedure Entry: FFFFFFFF.80080CE0          MMG$RETRANGE_C+00180
        Return address on stack = FFFFFFFF.8004CF30  EXCEPTION_NPRO+00F30
```

```
Registers saved on stack
------------------------
7FF95E80 FFFFFFFF.FFFFFFFD  Saved R2
7FF95E88 FFFFFFFF.8042DBC0  Saved R3      EXCEPTION_NPRW+03DC0
7FF95E90 FFFFFFFF.80537240  Saved R4
7FF95E98 00000000.00000000  Saved R5
7FF95EA0 FFFFFFFF.80030960  Saved R6      MMG$IMGRESET_C+00200
7FF95EA8 00000000.7FF95EC0  Saved R7
7FF95EB0 FFFFFFFF.80420E68  Saved R13     MMG$ULKGBLWSL E
7FF95EB8 00000000.7FF95F70  Saved R29
.
.
.
SDA> SHOW CALL_FRAME/NEXT_FP

Call Frame Information
----------------------
        Stack Frame Procedure Descriptor
Flags:  Base Register = FP, Jacket, Native
        Procedure Entry: FFFFFFFF.80F018D0             IMAGE_MANAGEMENT_PRO+078D0
        Return address on stack = FFFFFFFF.8004CF30    EXCEPTION_NPRO+00F30

Registers saved on stack
------------------------
7FF95F90 FFFFFFFF.FFFFFFFB  Saved R2
7FF95F98 FFFFFFFF.8042DBC0  Saved R3      EXCEPTION_ NPRW+03DC0
7FF95FA0 00000000.00000000  Saved R5
7FF95FA8 00000000.7FF95FC0  Saved R7
7FF95FB0 FFFFFFFF.80EF8D20  Saved R13     ERL$DEVINF O+00C20
7FF95FB8 00000000.7FFA0450  Saved R29
.
.
.
SDA> REPEAT
Call Frame Information
----------------------
        Stack Frame Procedure Descriptor
Flags:  Base Register = FP, Jacket, Native
        Procedure Entry: FFFFFFFF.80F016A0             IMAGE_MANAGEMENT_PRO+076A0
        Return address on stack = 00000000.7FF2451C

        Registers saved on stack
        ------------------------
 7FFA0470 00000000.7FEEA890  Saved R13
 7FFA0478 00000000.7FFA0480  Saved R29
 .
 .
 .
```

The first SHOW CALL_FRAME displays the call frame indicated by the current FP value. Because the /NEXT_FP qualifier to the instruction displays the call frame indicated by the saved FP in the current call frame, you can use the REPEAT command to repeat the SHOW CALL_FRAME/NEXT_FP command and follow a chain of call frames.

SEARCH

Scans a range of memory locations for all occurrences of a specified value.

Format

SEARCH [/qualifier] range [=] expression

Parameters

range
Location in memory to be searched. A location can be represented by any valid SDA expression. To search a range of locations, use the following syntax:

m:n	Range of locations to be searched, from *m* to *n*
m;n	Range of locations to be searched, starting at *m* and continuing for *n* bytes

expression
Value for which SDA is to search. SDA evaluates the **expression** and searches the specified **range** of memory for the resulting value. For a description of SDA expressions, see Section 2.6.2.

If you do not use an equals sign to separate **range** and **expression**, then you must insert a space between them.

Qualifiers

/LENGTH={*QUADWORD*| *LONGWORD*| *WORD* | *BYTE* }
Specifies the size of the **expression** value that the SEARCH command uses for matching. If you do not specify the /LENGTH qualifier, the SEARCH command uses a longword length by default.

/MASK=*n*
Allows the SEARCH command finer qranularity in its matches. It compares only the given bits of a byte, word, longword, or quadword. To compare bits when matching, you set the bits in the mask; to ignore bits when matching, you clear the bits in the mask.

/PHYSICAL
Specifies that the addresses used to define the range of locations to be searched are physical addresses.

/STEPS={*QUADWORD*| *LONGWORD*| *WORD* | *BYTE*| *value* }
Specifies the step factor of the search through the specified memory **range**. After the SEARCH command has performed the comparison between the value of **expression** and memory location, it adds the specified step factor to the address of the memory location. The resulting location is the next location to undergo the comparison. If you do not specify the /STEPS qualifier, the SEARCH command uses a step factor of a longword.

Description

SEARCH displays each location as each value is found. If you press Ctrl/T while using the SEARCH command, the system displays how far the search has progressed. The progress display is always output to the terminal even if a SET OUTPUT <file> command has previously been entered.

Examples

1.
```
SDA> SEARCH GB81F0;500 B41B0000
Searching from FFFFFFFF.800B81F0 to FFFFFFFF.800B86EF in LONGWORD steps for B41B0000...
Match at FFFFFFFF.800B86E4    B41B0000
```

This SEARCH command finds the value B41B0000 in the longword at FFFFFFFF.800B86E4.

2.
```
SDA> SEARCH 80000000;200/STEPS=BYTE 82
Searching from FFFFFFFF.80000000 to FFFFFFFF.800001FF in BYTE steps for 00000082...
Match at FFFFFFFF.8000012C    00000082
```

This SEARCH command finds the value 00000082 in the longword at FFFFFFFF.8000012C.

3.
```
SDA> SEARCH/LENGTH=WORD 80000000;100 10
Match at FFFFFFFF.80000030    0010
Match at FFFFFFFF.80000040    0010
Match at FFFFFFFF.80000090    0010
Match at FFFFFFFF.800000A0    0010
Match at FFFFFFFF.800000C0    0010
5 matches found
```

This SEARCH command finds the value 0010 in the words at FFFFFFFF.80000030, FFFFFFFF.80000040, FFFFFFFF.80000090, FFFFFFFF.800000A0, FFFFFFFF.800000C0.

4.
```
SDA> SEARCH/MASK=FF000000 80000000;40 20000000
Searching from FFFFFFFF.80000000 to FFFFFFFF.8000003F in LONGWORD steps for 20000000...
(Using search mask of FF000000)
Match at FFFFFFFF.80000000    201F0104
Match at FFFFFFFF.80000010    201F0001
2 matches found
```

This SEARCH command finds the value 20 in the upper byte of the longwords at FFFFFFFF.80000000 and FFFFFFFF.80000010, regardless of the contents of the lower 3 bytes.

SET CPU

When analyzing a system dump, selects a processor to become the current CPU for SDA. (You cannot use this command when analyzing the running system.)

Format

SET CPU cpu-id

Parameter

cpu-id
Numeric value from 00_{16} to $1F_{16}$ indicating the identity of the processor to be made the current CPU. If you specify a value outside this range or a **cpu-id** of a processor that was not active at the time of the system failure, SDA displays the following message:

```
%SDA-E-CPUNOTVLD, CPU not booted or CPU number out of range
```

Qualifiers

None.

Description

When you invoke SDA to examine a system dump, the current CPU context for SDA defaults to that of the processor that caused the system to fail. When analyzing a system failure from a multiprocessing system, you may find it useful to examine the context of another processor in the configuration.

The SET CPU command changes the current CPU context for SDA to that of the processor indicated by **cpu-id**. The CPU specified by this command becomes the current CPU for SDA until you either exit from SDA or change the CPU context for SDA by issuing one of the following commands:

SET CPU **cpu-id**
SHOW CPU **cpu-id**
SHOW CRASH
SHOW MACHINE_CHECK **cpu-id**

The following commands also change the CPU context for SDA if the **process-name**, **pcb-address**, or index number (**nn**) refers to a current process:

SET PROCESS **process-name**
SET PROCESS/ADDRESS=**pcb-address**
SET PROCESS/INDEX=**nn**
SHOW PROCESS **process-name**
SHOW PROCESS/ADDRESS=**pcb-address**
SHOW PROCESS/INDEX=**nn**

Changing CPU context can cause an implicit change in process context under the following circumstances:

- If there is a current process on the CPU made current, SDA changes its process context to that of that CPU's current process.
- If there is no current process on the CPU made current, the SDA process context is undefined and no process-specific information is available until you set the SDA process context to that of a specific process.

See Section 2.5 for further discussion of the way in which SDA maintains its context information.

SET ERASE_SCREEN

Enables or disables the automatic clearing of the screen before each new page of SDA output.

Format

SET ERASE_SCREEN {ON|OFF}

Parameters

ON
Enables the screen to be erased before SDA outputs a new heading. This setting is the default.

OFF
Disables the erasing of the screen.

Qualifiers

None.

Description

SDA's usual behavior is to erase the screen and then show the data. By setting the **OFF** parameter, the clear screen action is replaced by a blank line. This action does not affect what is written to a file when the SET LOG or SET OUTPUT commands are used.

Examples

1. `SDA>  SET ERASE_SCREEN ON`

   The clear screen action is now enabled.

2. `SDA> SET ERASE_SCREEN OFF`

   The clear screen action is disabled.

SET FETCH

Sets the default size and access method of address data used when SDA evaluates an expression that includes the @ unary operator.

Format

SET FETCH [{QUADWORD | LONGWORD | WORD | BYTE}][,][{PHYSICAL | VIRTUAL}]

Parameters

QUADWORD
Sets the default size to 8 bytes.

LONGWORD
Sets the default size to 4 bytes.

WORD
Sets the default size to 2 bytes.

BYTE
Sets the default size to 1 byte.

PHYSICAL
Sets the default access method to physical addresses.

VIRTUAL
Sets the default access method to virtual addresses.

You can specify only one parameter out of each group. If you are changing both size and access method, separate the two parameters by spaces or a comma. Include a comma only if you are specifying a parameter from both groups. See examples 5 and 6.

Qualifiers

None.

Description

Sets the default size and/or default access method of address data used by the @ unary operator in commands such as EXAMINE and EVALUATE. SDA uses the current default size unless it is overridden by the ^Q, ^L, ^W, or ^B qualifier on the @ unary operator in an expression. SDA uses the current default access method unless it is overridden by the ^P or ^V qualifier on the @ unary operator in an expression.

Examples

1.
```
SDA>  EXAMINE MMG$GQ_SHARED_VA_PTES
MMG$GQ_SHARED_VA_PTES:  FFFFFFFD.FF7FE000   ".‘a....."
```

This example shows the location’s contents of a 64-bit virtual address.

2.
```
SDA> SET FETCH LONG
SDA> EXAMINE @MMG$GQ_SHARED_VA_PTES
%SDA-E-NOTINPHYS, FFFFFFFF.FF7FE000 : virtual data not in physical memory
```

This example shows a failure because the SET FETCH LONG causes SDA to assume that it should take the lower 32 bits of the location's contents as a longword value, sign-extend them, and use that value as an address.

3.
```
SDA> EXAMINE @^QMMG$GQ_SHARED_VA_PTES
FFFFFFFD.FF7FE000:  000001D0.40001119   "...@..."
```

This example shows the correct results by overriding the SET FETCH LONG with the ^Q qualifier on the @ operator. SDA takes the full 64 bits of the location's contents and uses that value as an address.

4.
```
SDA> SET FETCH QUAD
SDA> EXAMINE @MMG$GQ_SHARED_VA_PTES
FFFFFFFD.FF7FE000:  000001D0.40001119   "...@..."
```

This example shows the correct results by changing the default fetch size to a quadword.

5.
```
SDA> SET FETCH PHYSICAL
SDA> EXAMINE /PHYSICAL @0
```

This command uses the contents of the physical location 0 as the physical address of the location to be examined.

6.
```
SDA> SET FETCH QUADWORD, PHYSICAL
```

This command sets the default fetch size and default access method at the same time.

SET LOG

Initiates or discontinues the recording of an SDA session in a text file.

Format

SET [NO]LOG filespec

Parameter

filespec
Name of the file in which you want SDA to log your commands and their output. The default **filespec** is SYS$DISK:[*default_dir]filename*.LOG, where SYS$DISK and [*default-dir*] represent the disk and directory specified in your last DCL command SET DEFAULT. You must specify a file name.

Qualifiers

None.

Description

The SET LOG command echoes the commands and output of an SDA session to a log file. The SET NOLOG command terminates this behavior.

The following differences exist between the SET LOG command and the SET OUTPUT command:

- When logging is in effect, your commands and their results are still displayed on your terminal. The SET OUTPUT command causes the displays to be redirected to the output file and they no longer appear on the screen.
- If an SDA command requires that you press Return to produce successive screens of display, the log file produced by SET LOG will record only those screens that are actually displayed. SET OUTPUT, however, sends the entire output of any SDA commands to its listing file.
- The SET LOG command produces a log file with a default file type of .LOG; the SET OUTPUT command produces a listing file whose default file type is .LIS.
- The SET OUTPUT command can generate a table of contents, each item of which refers to a display written to its listing file. SET OUTPUT also produces running heads for each page of output. The SET LOG command does not produce these items in its log file.

If you use the SET OUTPUT command to redirect output to a listing file, a SET LOG command to direct the same output to a log file is ineffective until output is restored to the terminal.

SET OUTPUT

Redirects output from SDA to the specified file or device.

Format

SET OUTPUT [/[NO]INDEX | /[NO]HEADER | /SINGLE_COMMAND] filespec

Parameter

filespec
Name of the file to which SDA is to send the output generated by its commands. The default **filespec** is SYS$DISK:[*default_dir*] *filename*.LIS, where SYS$DISK and [*default-dir*] represent the disk and directory specified in your last DCL command SET DEFAULT. You must specify a file name.

Qualifiers

/INDEX
/NOINDEX
The /INDEX qualifer causes SDA to include an index page at the beginning of the output file. This is the default, unless you specify /NOHEADER See the /NOHEADER description. The /NOINDEX qualifier causes SDA to omit the index page from the output file.

/HEADER
/NOHEADER
The /HEADER qualifier causes SDA to include a heading at the top of each page of the output file. This is the default. The /NOHEADER qualifier causes SDA to omit the page headings. Use of /NOHEADER implies /NOINDEX.

/SINGLE_COMMAND
Indicates to SDA that the output for a single command is to be written to the specified file and that subsequent output should be written to the terminal.

Description

When you use the SET OUTPUT command to send the SDA output to a file or device, SDA continues displaying the SDA commands that you enter but sends the output generated by those commands to the file or device you specify. (See the description of the SET LOG command for a list of differences between the SET LOG and SET OUTPUT commands.)

When you finish directing SDA commands to an output file and want to return to interactive display, issue the following command:

```
SDA> SET OUTPUT SYS$OUTPUT
```

You do not need this command when you specify the /SINGLE_COMMAND qualifier on the original SET OUTPUT command.

If you use the SET OUTPUT command to send the SDA output to a listing file and do not specify /NOINDEX or /NOHEADER, SDA builds a table of contents that identifies the displays you selected and places the table of contents at the beginning of the output file. The SET OUTPUT command formats the output into pages and produces a running head at the top of each page, unless you specify /NOHEADER.

Note

See the description of the DUMP command for use of SET OUTPUT/NOHEADER.

SET PROCESS

Selects a process to become the SDA current process.

Format

SET PROCESS {/ADDRESS=*pcb-address* | process-name | /ID=*nn* | /INDEX=*nn* | /NEXT | /SYSTEM}

Parameter

process-name
Name of the process to become the SDA current process. The **process-name** can contain up to 15 uppercase letters, numerals, the underscore (_), dollar sign ($), colon (:), and some other printable characters. If it contains any other characters (including lowercase letters), you may need to enclose the **process-name** in quotation marks (" ").

Qualifiers

/ADDRESS=*pcb-address*
Specifies the process control block (PCB) address of a process in order to display information about the process.

/ID=*nn*
/INDEX=*nn*
Specifies the process for which information is to be displayed by its index into the system's list of software process control blocks (PCBs), or by its process identification. You can supply the following values for *nn*:

- The process index itself.
- The process identification (PID) or extended PID longword, from which SDA extracts the correct index. The PID or extended PID of any thread of a process with multiple kernel threads may be specified. Any thread-specific data displayed by further commands will be for the given thread.

To obtain these values for any given process, issue the SDA command SHOW SUMMARY/THREADS. The /ID=*nn* and /INDEX=*nn* qualifiers can be used interchangeably.

/NEXT
Causes SDA to locate the next valid process in the process list and select that process. If there are no further valid processes in the process list, SDA returns an error.

/SYSTEM
Specifies the new current process by the system process control block (PCB). The system PCB and process header (PHD) parallel the data structures that describe processes. They contain the system working set list, global section table, and other systemwide data.

Description

When you issue an SDA command such as EXAMINE, SDA displays the contents of memory locations in its current process. To display any information about another process, you must change the current process with the SET PROCESS command.

When you invoke SDA to analyze a crash dump, the process context defaults to that of the process that was current at the time of the system failure. If the failure occurred on a multiprocessing system, SDA sets the CPU context to that of the processor that caused the system to fail. The process context is set to that of the process that was current on that processor.

When you invoke SDA to analyze a running system, its process context defaults to that of the current process, that is, the one executing SDA.

The SET PROCESS command changes the current SDA process context to that of the process indicated by **process-name**, *pcb-address*, or /INDEX=*nn*. The process specified by this command becomes the current process for SDA until you either exit from SDA or change SDA process context by issuing one of the following commands:

SET PROCESS **process-name**
SET PROCESS/ADDRESS=*pcb-address*
SET PROCESS/INDEX=*nn*
SET PROCESS/SYSTEM
SHOW PROCESS **process-name**
SHOW PROCESS/ADDRESS=*pcb-address*
SHOW PROCESS/INDEX=*nn*
SHOW PROCESS/SYSTEM

When you analyze a crash dump from a multiprocessing system, changing process context may require a switch of CPU context as well. For instance, if you issue a SET PROCESS command for a process that is current on another CPU, SDA automatically changes its CPU context to that of the CPU on which that process is current. The following commands can have this effect if **process-name**, *pcb-address*, or index number (*nn*) refers to a current process:

SET PROCESS **process-name**
SET PROCESS/ADDRESS=*pcb-address*
SET PROCESS/INDEX=*nn*
SHOW PROCESS **process-name**
SHOW PROCESS/ADDRESS=*pcb-address*
SHOW PROCESS/INDEX=*nn*

The following commands will also switch process context when analyzing a system dump, if there was a current process on the target CPU at the time of the crash:

SET CPU **cpu-id**
SHOW CPU **cpu-id**
SHOW CRASH
SHOW MACHINE_CHECK **cpu-id**

See Section 2.5 for further discussion of the way in which SDA maintains its context information.

Example

```
SDA> SET PROCESS/ADDRESS=80D772C0
SDA> SHOW PROCESS
Process index: 0012   Name: ERRFMT   Extended PID: 00000052
-----------------------------------------------------------
Process status:  02040001   RES,PHDRES,INTER
        status2: 00000001   QUANTUM_RESCHED

PCB address              80D772C0    JIB address              80556600
PHD address              80477200    Swapfile disk address    01000F01
KTB vector address       80D775AC    HWPCB address            81260080
Callback vector address  00000000    Termination mailbox          0000
Master internal PID      00010004    Subprocess count                0
Creator extended PID     00000000    Creator internal PID     00000000
Previous CPU Id          00000000    Current CPU Id           00000000
Previous ASNSEQ  0000000000000001    Previous ASN     000000000000002E
Initial process priority        4    Delete pending count            0
# open files allowed left     100    Direct I/O count/limit       150/150
UIC                [00001,000004]    Buffered I/O count/limit     149/150
Abs time of last event   0069D34E    BUFIO byte count/limit     99424/99808
ASTs remaining                247    # of threads                    1
Swapped copy of LEFC0    00000000    Timer entries allowed left     63
Swapped copy of LEFC1    00000000    Active page table count         4
Global cluster 2 pointer 00000000    Process WS page count          32
Global cluster 3 pointer 00000000    Global WS page count           31
```

The SET PROCESS command switches SDA's current process context to the process whose PCB is at address 80D772C0. The SHOW PROCESS command shows that the process is ERRFMT, and displays information from its PCB and job information block (JIB).

See the description of the REPEAT command for an example of the use of the SET PROCESS/NEXT command.

SET RMS

Changes the options shown by the SHOW PROCESS/RMS command.

Format

SET RMS =(option[,...])

Parameter

option

Data structure or other information to be displayed by the SHOW PROCESS/RMS command. Table 4–2 lists those keywords that may be used as options.

Table 4–2 SET RMS Command Keywords for Displaying Process RMS Information

Keyword	Meaning
[NO]ALL[:**ifi**][1]	All control blocks (default)
[NO]ASB	Asynchronous save block
[NO]BDB	Buffer descriptor block
[NO]BDBSUM	BDB summary page
[NO]BLB	Buffer lock block
[NO]BLBSUM	Buffer lock summary page
[NO]CCB	Channel control block
[NO]DRC	Directory cache
[NO]FAB	File access block
[NO]FCB	File control block
NO]FSB	File statistics block
[NO]FWA	File work area
[NO]GBD	Global buffer descriptor
[NO]GBDSUM	GBD summary page
[NO]GBH	Global buffer header
[NO]GBHSH	Global buffer hash table
[NO]GBSB	Global buffer synchronization block
[NO]IDX	Index descriptor
[NO]IFAB[:**ifi**][1]	Internal FAB
[NO]IFB[:**ifi**][1]	Internal FAB
[NO]IRAB	Internal RAB
[NO]IRB	Internal RAB
[NO]JFB	Journaling file block
[NO]KLTB	Key-less-than block

[1]The optional parameter **ifi** is an internal file identifier. The default **ifi** (**ALL**) is all the files the current process has opened.

(continued on next page)

Table 4–2 (Cont.) SET RMS Command Keywords for Displaying Process RMS Information

Keyword	Meaning
[NO]NAM	Name block
[NO]NWA	Network work area
[NO]PIO	Process-permanent I/O data structures used instead of process image data structures
[NO]RAB	Record access block
[NO]RLB	Record lock block
[NO]RU	Recovery unit structures, including the recovery unit block (RUB), recovery unit stream block (RUSB), and recovery unit file block (RUFB)
[NO]SFSB	Shared file synchronization block
[NO]WCB	Window control block
[NO]XAB	Extended attribute block
[NO]*	Current list of options displayed by the SHOW RMS command

The default **option** is **option=(ALL,NOPIO)**, designating for display by the SHOW PROCESS/RMS command all structures for all files related to the process image I/O.

To list more than one option, enclose the list in parentheses and separate options by commas. You can add a given data structure to those displayed by ensuring that the list of keywords begins with the asterisk (*) symbol. You can delete a given data structure from the current display by preceding its keyword with NO.

Qualifiers

None.

Description

The SET RMS command determines the data structures to be displayed by the SHOW PROCESS/RMS command. (See the examples included in the discussion of the SHOW PROCESS command for information provided by various displays.) You can examine the options that are currently selected by issuing a SHOW RMS command.

Examples

1.
```
SDA>  SHOW RMS
RMS Display Options:  IFB,IRB,IDX,BDB,BDBSUM,ASB,CCB,WCB,FCB,FAB,RAB,NAM,XAB,RLB,
BLB,BLBSUM,GBD,GBH,FWA,GBDSUM,JFB,NWA,RU,DRC,SFSB,GBSB

Display RMS structures for all IFI values.

SDA>  SET RMS=IFB
SDA>  SHOW RMS

RMS Display Options:  IFB

Display RMS structures for all IFI values.
```

The first SHOW RMS command shows the default selection of data structures that are displayed in response to a SHOW PROCESS/RMS command. The SET RMS command selects only the IFB to be displayed by subsequent SET/PROCESS commands.

2.
```
SDA>  SET RMS=(*,BLB,BLBSUM,RLB)
SDA>  SHOW RMS

RMS Display Options:  IFB,RLB,BLB,BLBSUM

Display RMS structures for all IFI values.
```

The SET RMS command adds the BLB, BLBSUM, and RLB to the list of data structures currently displayed by the SHOW PROCESS/RMS command.

3.
```
SDA>  SET RMS=(*,NORLB,IFB:05)
SDA>  SHOW RMS

RMS Display Options:  IFB,BLB,BLBSUM
Display RMS structures only for IFI=5.
```

The SET RMS command removes the RLB from those data structures displayed by the SHOW PROCESS/RMS command and causes only information about the file with the **ifi** of 5 to be displayed.

4.
```
SDA> SET RMS=(*,PIO)
```

The SET RMS command indicates that the data structures designated for display by SHOW PROCESS/RMS be associated with process-permanent I/O instead of image I/O.

SET SIGN_EXTEND

Enables or disables the sign extension of 32-bit addresses.

Format

SET SIGN_EXTEND {ON|OFF}

Parameters

ON
Enables automatic sign extension of 32-bit addresses with bit 31 set. This is the default.

OFF
Disables automatic sign extension of 32-bit addresses with bit 31 set.

Qualifiers

None.

Description

The 32-bit S0/S1 addresses need to be sign-extended to access 64-bit S0/S1 space. To do this, specify explicitly sign-extended addresses, or set the sign-extend command to **ON**, which is the default.

However, to access addresses in P2 space, addresses must not be sign-extended. To do this, specify a zero in front of the address, or set the sign-extend command to **OFF**.

Examples

1.

```
SDA> SET SIGN_EXTEND ON
SDA>  examine 80400000
FFFFFFFF.80400000: 23DEFF90.4A607621
```

This shows the SET SIGN_EXTEND command as ON.

2.

```
SDA> SET SIGN_EXTEND OFF
SDA>  EXAMINE 80400000
%SDA-E-NOTINPHYS, 00000000.80400000: virtual data not in physical memory
```

This shows the SET SIGN_EXTEND command as OFF.

SET SYMBOLIZE

Enables or disables symbolization of addresses in the display from an EXAMINE command.

Format

SET SYMBOLIZE {ON|OFF}

Parameters

ON
Enables symbolization of addresses.

OFF
Disables symbolization of addresses.

Qualifiers

None.

Examples

1.
```
SDA> SET SYMBOLIZE ON
SDA> examine g1234
SYS$PUBLIC_VECTORS+01234:  47DF041C   "..ßG"
```

2.
```
SDA> SET SYMBOLIZE OFF
SDA> examine g1234
FFFFFFFF.80001234:  47DF041C   "..ßG"
```

These examples show the effect of enabling (default) or disabling symbolization of addresses.

SHOW ADDRESS

Displays the page table related information about a memory address.

Format

SHOW ADDRESS address [/PHYSICAL]

Parameter

address
The requested address.

Qualifier

/PHYSICAL
Indicates that a physical address has been given. The SHOW ADDRESS command displays the virtual address that maps to the given physical address.

Description

The SHOW ADDRESS command displays the region of memory that contains the memory address. It also shows all the page table entries (PTEs) that map the page and can show the range of addresses mapped by the given address if it is the address of a PTE.

When the /PHYSICAL qualifier is given, the SHOW ADDRESS command displays the virtual address that maps to the given physical address. This provides you with a way to use SDA commands that do not have a /PHYSICAL qualifier when only the physical address of a memory location is known.

Examples

1.
```
SDA> SHOW ADDRESS 80000000

FFFFFFFF.80000000 is an S0/S1 address

Mapped by Level-3 PTE at: FFFFFFFD.FFE00000
Mapped by Level-2 PTE at: FFFFFFFD.FF7FF800
Mapped by Level-1 PTE at: FFFFFFFD.FF7FDFF0
Mapped by Selfmap PTE at: FFFFFFFD.FF7FDFF0

Also mapped in SPT window at: FFFFFFFF.FFDF0000
```

   The SHOW ADDRESS command in this example shows where the address 80000000 is mapped at different page table entry levels.

2.
```
SDA> SHOW ADDRESS 0

00000000.00000000 is a P0 address

Mapped by Level-3 PTE at: FFFFFFFC.00000000
Mapped by Level-2 PTE at: FFFFFFFD.FF000000
Mapped by Level-1 PTE at: FFFFFFFD.FF7FC000
Mapped by Selfmap PTE at: FFFFFFFD.FF7FDFF0
```

   The SHOW ADDRESS command in this example shows where the address 0 is mapped at different page table entry levels.

3.
```
SDA> SHOW ADDRESS FFFFFFFD.FF000000

FFFFFFFD.FF000000 is the address of a process-private Level-2 PTE

Mapped by Level-1 PTE at: FFFFFFFD.FF7FC000
Mapped by Selfmap PTE at: FFFFFFFD.FF7FDFF0

Range mapped at level 2: FFFFFFFC.00000000 to FFFFFFFC.00001FFF (1 page)
Range mapped at level 3: 00000000.00000000 to 00000000.007FFFFF (1024 pages)
```

   The SHOW ADDRESS command in this example shows where the address FFFFFFFD.FF7FC000 is mapped at page table entry and the range mapped by the PTE at this address.

4.
```
SDA> SHOW ADDRESS/PHYSICAL 0

Physical address 00000000.00000000 is mapped to system-space address FFFFFFFF.828FC000
```

   The SHOW ADDRESS command in this example shows physical address 00000000.00000000 mapped to system-space address FFFFFFFF.828FC000.

5.
```
SDA> SHOW ADDRESS/PHYSICAL 029A6000

Physical address 00000000.029A6000 is mapped to process-space address 00000000.00030000
(process index 0024)
```

   The SHOW ADDRESS command in this example shows physical address 00000000.029A6000 mapped to process-space address 00000000.00030000 (process index 0024).

SHOW BUGCHECK

Displays the value, name, and text associated with one or all bugcheck codes.

Format

SHOW BUGCHECK {/ALL (d) | name | number}

Parameters

name
Value, name, and text of the named bugcheck code.

number
Value, name, and text of the requested bugcheck code.

The parameters **name** and **number** and the qualifier **/ALL** are all mutually exclusive.

Qualifier

/ALL
Displays complete list of all the bugcheck codes, giving their value, name, and text. It is the default.

Description

The SHOW BUGCHECK command displays the value, name, and text associated with bugcheck codes.

Examples

1.
```
SDA> SHOW BUGCHECK 100
0100  DIRENTRY       ACP failed to find same directory entry
```

The SHOW BUGCHECK command in this example shows the requested bugcheck by number.

2.
```
SDA> SHOW BUGCHECK DECNET
08D0  DECNET         DECnet detected a fatal error
```

The SHOW BUGCHECK command in this example shows the requested bugcheck by name.

3.
```
SDA> SHOW BUGCHECK

BUGCHECK codes and texts
------------------------
0008  ACPMBFAIL      ACP failure to read mailbox
0010  ACPVAFAIL      ACP failure to return virtual address space
0018  ALCPHD         Allocate process header error
0020  ALCSMBCLR      ACP tried to allocate space already allocated

      .
      .
      .
```

The SHOW BUGCHECK command in this example shows the requested bugcheck by displaying all codes.

SHOW CALL_FRAME

Displays the locations and contents of the quadwords representing a procedure call frame.

Format

SHOW CALL_FRAME {[starting-address] | /NEXT_FP}

Parameter

starting-address
Expression representing the starting address of the procedure call frame to be displayed. The default **starting-address** is the contents of the FP register of the SDA current process.

Qualifier

/NEXT_FP
Displays the procedure call frame starting at the address stored in the FP longword of the last call frame displayed by this command. You must have issued a SHOW CALL_FRAME command previously in the current SDA session in order to use the /NEXT_FP qualifier to the command.

Description

Whenever a procedure is called, information is stored on the stack of the calling routine in the form of a procedure call frame. The SHOW CALL_FRAME command displays the locations and contents of the call frame. The starting address of the call frame is determined from the specified starting address, the /NEXT_FP qualifier, or the address contained in the SDA current process FP register (the default action).

When using the SHOW CALL_FRAME/NEXT_FP command to follow a chain of call frames, SDA signals the end of the chain by the following message:

```
%SDA-E-NOTINPHYS, 00000000.00000000 : not in physical memory
```

This message indicates that the saved FP in the previous call frame has a zero value.

Example

```
SDA> SHOW CALL_FRAME
Call Frame Information
----------------------
        Stack Frame Procedure Descriptor
Flags:  Base Register = FP, No Jacket, Native
        Procedure Entry: FFFFFFFF.837E9F10           EXCEPTION_PRO+01F10
        Return address on stack = FFFFFFFF.837E8A1C     EXE$CONTSIGNAL_C+0019C
```

```
Registers saved on stack
------------------------
7FF95F98  FFFFFFFF.FFFFFFFB  Saved R2
7FF95FA0  FFFFFFFF.8042AEA0  Saved R3    EXCEPTION_NPRW+040A0
7FF95FA8  00000000.00000002  Saved R5
7FF95FB0  FFFFFFFF.804344A0  Saved R13   SCH$CLREF+00188
7FF95FB8  00000000.7FF9FC00  Saved R29
   .
   .
   .
SDA> SHOW CALL_FRAME/NEXT_FP
Call Frame Information
----------------------
        Stack Frame Procedure Descriptor
Flags:  Base Register = FP, No Jacket, Native
        Procedure Entry: FFFFFFFF.800FA388            RMS_NPRO+04388
        Return address on stack = FFFFFFFF.80040BFC    EXCEPTION_NPRO+00BFC

Registers saved on stack
------------------------
7FF99F60  FFFFFFFF.FFFFFFFD  Saved R2
7FF99F68  FFFFFFFF.80425BA0  Saved R3    EXCEPTION_NPRW+03DA0
7FF99F70  FFFFFFFF.80422020  Saved R4    EXCEPTION_NPRW+00220
7FF99F78  00000000.00000000  Saved R5
7FF99F80  FFFFFFFF.835C24A8  Saved R6    RMS_PRO+004A8
7FF99F88  00000000.7FF99FC0  Saved R7
7FF99F90  00000000.7FF9FDE8  Saved R8
7FF99F98  00000000.7FF9FDF0  Saved R9
7FF99FA0  00000000.7FF9FE78  Saved R10
7FF99FA8  00000000.7FF9FEBC  Saved R11
7FF99FB0  FFFFFFFF.837626E0  Saved R13   EXE$OPEN_MESSAGE+00088
7FF99FB8  00000000.7FF9FD70  Saved R29
.
    .
    .
SDA> SHOW CALL_FRAME/NEXT_FP
Call Frame Information
----------------------
        Stack Frame Procedure Descriptor
Flags:  Base Register = FP, No Jacket, Native
        Procedure Entry: FFFFFFFF.835C2438            RMS_PRO+00438
        Return address on stack = FFFFFFFF.83766020    EXE$OPEN_MESSAGE_C+00740

Registers saved on stack
------------------------
7FF9FD88  00000000.7FF9FDA4  Saved R2
7FF9FD90  00000000.7FF9FF00  Saved R3
7FF9FD98  00000000.7FFA0050  Saved R29
```

The SHOW CALL_FRAME commands in this SDA session follow a chain of call frames from that specified in the FP of the SDA current process.

SHOW CLUSTER

Displays connection manager and system communications services (SCS) information for all nodes in a cluster.

Format

SHOW CLUSTER {[{/ADDRESS=*n* | /CSID=*csid* | /NODE=*name*}] | /SCS}

Parameters

None.

Qualifiers

/ADDRESS=*n*

Displays only the OpenVMS Cluster system information for a specific OpenVMS Cluster member node, given the address of the cluster system block (CSB) for the node. This is mutually exclusive with the /CSID=*csid* and /NODE=*name* qualifiers.

/CSID=*csid*

Displays only the OpenVMS Cluster system information for a specific OpenVMS Cluster member node. The value *csid* is the cluster system identification number (CSID) of the node to be displayed. You can find the CSID for a specific node in a cluster by examining the **CSB list** display of the SHOW CLUSTER command. Other SDA displays refer to a system's CSID. For instance, the SHOW LOCKS command indicates where a lock is mastered or held by CSID. This is mutually exclusive with the /ADDRESS=*n* and /NODE=*name* qualifiers.

/NODE=*name*

Displays only the OpenVMS Cluster system information for a specific OpenVMS Cluster member node, given its SCS node name. This is mutually exclusive with the /ADDRESS=*n* and /CSID=*csid* qualifiers.

/SCS

Displays a view of the cluster as seen by SCS.

Description

The SHOW CLUSTER command provides a view of the OpenVMS Cluster system from either the perspective of the connection manager (the default behavior), or from the perspective of the port driver or drivers (if the /SCS qualifier is used).

OpenVMS Cluster as Seen by the Connection Manager

The SHOW CLUSTER command provides a series of displays.

The **OpenVMS Cluster summary** display supplies the following information:

- Number of votes required for a quorum
- Number of votes currently available
- Number of votes allocated to the quorum disk
- Status summary indicating whether or not a quorum is present

The **CSB list** displays information about the OpenVMS Cluster system blocks (CSBs) currently in operation; one CSB is assigned to each node of the cluster. For each CSB, the **CSB list** displays the following information:

- Address of the CSB
- Name of the OpenVMS Cluster node it describes
- CSID associated with the node
- Number of votes (if any) provided by the node
- State of the CSB
- Status of the CSB

For information about the state and status of nodes, see the description of the ADD CLUSTER command of the SHOW CLUSTER utility in the *OpenVMS System Management Utilities Reference Manual*.

The **cluster block** display includes information recorded in the cluster block (CLUB), including a list of activated flags, a summary of quorum and vote information, and other data that applies to the cluster from the perspective of the node for which the SDA is being run.

The **cluster failover control block** display provides detailed information concerning the cluster failover control block (CLUFCB). The **cluster quorum disk control block** display provides detailed information from the cluster quorum disk control block (CLUDCB).

Subsequent displays provide information for each CSB listed previously in the **CSB list** display. Each display shows the state and flags of a CSB, as well as other specific node information. (See the ADD MEMBER command of the SHOW CLUSTER utility in the *OpenVMS System Management Utilities Reference Manual* for information about the flags for OpenVMS Cluster nodes.)

If any of the qualifiers /ADDRESS=*n*, /CSID=*csid*, or /NODE=*name* are specified, then the SHOW CLUSTER command displays only the information from the CSB of the specified node.

OpenVMS Cluster as Seen by the Port Driver

The SHOW CLUSTER/SCS command provides a series of displays.

The **SCS listening process directory** lists those processes that are listening for incoming SCS connect requests. For each of these processes, this display records the following information:

- Address of its directory entry
- Connection ID
- Name
- Explanatory information, if available

The **SCS systems summary** display provides the system block (SB) address, node name, system type, system ID, and the number of connection paths for each SCS system. An **SCS system** can be a OpenVMS Cluster member, storage controller, or other such device.

Subsequent displays provide detailed information for each of the system blocks and the associated path blocks. The system block displays include the maximum message and datagram sizes, local hardware and software data, and SCS poller information. Path block displays include information that describes the connection, including remote functions and other path-related data.

Examples

1.
```
SDA> SHOW CLUSTER
OpenVMS Cluster data structures


               --- OpenVMS Cluster Summary ---

     Quorum   Votes   Quorum Disk Votes   Status Summary
     ------   -----   -----------------   --------------
        2       2           1             qf_dynvote,qf_vote,quorum
                    --- CSB list ---

Address   Node    CSID      Votes   State     Status
-------   ----    ----      -----   -----     ------

805FA780  FLAM5   00010006    0     local   member,qf_same,qf_noaccess
8062C400  ROMRDR  000100ED    1     open    member,qf_same,qf_watcher,qf_active
8062C780  VANDQ1  000100EF    0     open    member,qf_same,qf_noaccess
             --- Cluster Block (CLUB) 805FA380 ---

Flags: 16080005 cluster,qf_dynvote,init,qf_vote,qf_newvote,quorum

Quorum/Votes                 2/2    Last transaction code         02
Quorum Disk Votes              1    Last trans. number           596
Nodes                          3    Last coordinator CSID   000100EF
Quorum Disk             $1$DIA0    Last time stamp      31-DEC-1992
Found Node SYSID    00000000FC03                           17:26:35
Founding Time         3-JAN-1993    Largest trans. id       00000254
                        21:04:21    Resource Alloc. retry          0
Index of next CSID          0007    Figure of Merit         00000000
Quorum Disk Cntrl Block  805FADC0    Member State Seq. Num       0203
Timer Entry Address     00000000    Foreign Cluster         00000000
CSP Queue                  empty

     --- Cluster Failover Control Block (CLUFCB) 805FA4C0 ---

Flags: 00000000

Failover Step Index      00000037    CSB of Synchr. System    8062C780
Failover Instance ID     00000254

     --- Cluster Quorum Disk Control Block (CLUDCB) 805FADC0 ---

State     : 0002 qs_rem_act
Flags     : 0100 qf_noaccess
CSP Flags : 0000

Iteration Counter              0             UCB address     00000000
Activity Counter               0             TQE address     805FAE00
Quorum file LBN         00000000             IRP address     00000000
                                             Watcher CSID    000100ED

     --- FLAM5 Cluster System Block (CSB) 805FA780 ---

State:  0B local
Flags:  070260AA member,qf_same,qf_noaccess,selected,local,status_rcvd,send_status
Cpblty: 00000000
SWVers: 7.0
HWName: DEC 3000 Model 400
```

```
Quorum/Votes       1/0    Next seq. number    0000    Send queue      00000000
Quor. Disk Vote      1    Last seq num rcvd   0000    Resend queue    00000000
CSID          00010006    Last ack. seq num   0000    Block xfer Q.   805FA7D8
Eco/Version       0/23    Unacked messages       0    CDT address     00000000
Reconn. time  00000000    Ack limit              0    PDT address     00000000
Ref. count           2    Incarnation   1-JAN-1993    TQE address     00000000
Ref. time  31-AUG-1992                    00:00:00    SB address      80421580
              17:26:35    Lock mgr dir wgt       0    Current CDRP    00000001

     --- ROMRDR Cluster System Block (CSB) 8062C400 ---

State:  01 open
Flags:  0202039A member,qf_same,cluster,qf_active,selected,status_rcvd
Cpblty: 00000000
SWVers: 7.0
HWName: DEC 3000 Model 400

Quorum/Votes       2/1    Next seq. number    B350    Send queue      00000000
Quor. Disk Vote      1    Last seq num rcvd   E786    Resend queue    00000000
CSID          000100ED    Last ack. seq num   B350    Block xfer Q.   8062C458
Eco/Version       0/22    Unacked messages       1    CDT address     805E8870
Reconn. time  00000000    Ack limit              3    PDT address     80618400
Ref. count           2    Incarnation  19-AUG-1992    TQE address     00000000
Ref. time  19-AUG-1992                    16:15:00    SB address      8062C140
              16:17:08    Lock mgr dir wgt       0    Current CDRP    00000000

     --- VANDQ1 Cluster System Block (CSB) 8062C780 ---

State:  01 open
Flags:  020261AA member,qf_same,qf_noaccess,cluster,selected,status_rcvd
Cpblty: 00000000
SWVers: 7.0
HWName: DEC 3000 Model 400

Quorum/Votes       1/0    Next seq. number    32B6    Send queue      00000000
Quor. Disk Vote      1    Last seq num rcvd   A908    Resend queue    00000000
CSID          000100EF    Last ack. seq num   32B6    Block xfer Q.   8062C7D8
Eco/Version       0/23    Unacked messages       1    CDT address     805E8710
Reconn. time  00000000    Ack limit              3    PDT address     80618400
Ref. count           2    Incarnation  17-AUG-1992    TQE address     00000000
Ref. time  19-AUG-1992                    15:37:06    SB address      8062BCC0
              16:21:22    Lock mgr dir wgt       0    Current CDRP    00000000

         --- SWPCTX Cluster System Block (CSB) 80D3B1C0 ---

State:  0B local
Flags:  030A60AA member,qf_same,qf_noaccess,selected,send_ext_status,local,status_rcvd
Cpblty: 00000037 rm8sec,vcc,dts,cwcreprc,threads
SWVers: V7.0
HWName: DEC 3000 Model 400

Quorum/Votes       1/1    Next seq. number    0000    Send queue      00000000
Quor. Disk Vote      1    Last seq num rcvd   0000    Resend queue    00000000
CSID          00010001    Last ack. seq num   0000    Block xfer Q.   80D3B218
Eco/Version       0/26    Unacked messages       0    CDT address     00000000
Reconn. time  00000000    Ack limit              0    PDT address     00000000
Ref. count           2    Incarnation  12-JUL-1996    TQE address     00000000
Ref. time  16-JUL-1996                    15:36:17    SB address      80C50800
              16:15:48    Lock mgr dir wgt       0    Current CDRP    00000001
```

This example illustrates the default output of the SHOW CLUSTER command.

2. SDA> SHOW CLUSTER/SCS

```
OpenVMS Cluster data structures
--------------------------

                --- SCS Listening Process Directory ---

Entry Address    Connection ID    Process Name           Information
-------------    -------------    ------------           -----------

  80C71EC0         74D20000       SCS$DIRECTORY          Directory Server
  80C72100         74D20001       MSCP$TAPE              NOT PRESENT HERE
  80E16940         74D20002       MSCP$DISK              MSCP$DISK
  80E23B40         74D20003       VMS$SDA_AXP            Remote SDA
  80E23B40         74D20003       VMS$SDA_AXP            Remote SDA
  80E25540         74D20004       VMS$VAXcluster         ................
  80E29E80         74D20005       SCA$TRANSPORT
  813020C0         74D20053       PATHWORKScluster       .....TurboServer

                   --- SCS Systems Summary ---

  SB Address    Node      Type      System ID        Paths
  ----------    ----      ----      ---------        -----

  8493BC00     ARUSHA     VMS      000000004CA1        2
  80E23800     HSJ201     HSJ      4200101A1B20        1
  80E3FF40     ORNOT      VMS      000000004CA7        2
  80E43F40     LOADQ      VMS      000000004C31        2
  80E473C0     HSJ300     HSJ      420010051D20        1
  80E47CC0     HSJ101     HSJ      420010081720        1
  80E47D40     HSJ100     HSJ      4200100B1520        1
  80E478C0     HSJ600     HSJ      420010070920        1
  80E49180     HSJ401     HSJ      4200100D0320        1
  80E47DC0     HSJ301     HSJ      420010091F20        1
  80E47E40     HSJ601     HSJ      4200100A0B20        1
  80E49500     HSJ400     HSJ      4200100C0120        1
  80E5BF80     CHOBE      VMS      000000004CD6        2
  80E5F080     ETOSHA     VMS      000000004CF3        2
  80E5FC00     VMS        VMS      000000004C7A        2
  80E4FF80     HSJ501     HSJ      4200101C0720        1
  80E5FD80     HSJ200     HSJ      420010191920        1
  80E5FE80     HSJ500     HSJ      4200101B0520        1
  80E5FE00     IPL31      VMS      000000004F52        2
  80E59F80     ZAPNOT     VMS      000000004CBB        2
  80E61F80     ALTOS      VMS      000000004D0F        2
  80E72000     TSAVO      VMS      000000004CFE        2
  80ED5D00     SLYTHE     VMS      000000004DD1        1
  80EDDD00     AZSUN      VMS      000000004D56        1
  80EDDE00     CALSUN     VMS      000000004EA4        1
  80EDFC00     4X4TRK     VMS      00000000FF26        1
  80EE93C0     GNRS       VMS      00000000FC2B        1
  80EE94C0     IXIVIV     VMS      000000004E56        1
  80EF1A80     CLAIR      VMS      000000004CDF        1
  80EF1C00     INT4       VMS      00000000FD70        1
  80EFDF80     SCOP       VMS      00000000FC87        1
  80EFFAC0     MOCKUP     VMS      00000000FCD5        1

                    --- ARUSHA System Block (SB) 8493BC00 ---

System ID            000000004CA1    Local software type          VMS
Max message size              216    Local software vers.        V7.2
Max datagram size             576    Local software incarn.  DF4AC300
Local hardware type          ALPH                                009F7570
Local hardware vers. 000000000003    SCS poller timeout          5AD3
                     040400000000    SCS poller enable mask        27
Status:  00000000
```

```
                  --- Path Block (PB) 80E55F80 ---

              Status:  0020  credit

Remote sta. addr.    000000000016    Remote port type         00000010
Remote state                 ENAB    Number of data paths            2
Remote hardware rev.     00000008    Cables state           A-OK B-OK
Remote func. mask        ABFF0D00    Local state                  OPEN
Reseting port                  16    Port dev. name               PNA0
Handshake retry cnt.            2    SCS MSGBUF address       80E4C528
Msg. buf. wait queue     80E55FB8    PDT address              80E2A180

                  --- Path Block (PB) 80ED0900 ---

              Status:  0020  credit

Remote sta. addr.    0000000000DF    Remote port type               NI
Remote state                 ENAB    Number of data paths            2
Remote hardware rev.     00000104    Cables state           A-OK B-OK
Remote func. mask        83FF0180    Local state                  OPEN
Reseting port                  00    Port dev. name               PEA0
Handshake retry cnt.            3    SCS MSGBUF address       80ED19A0
Msg. buf. wait queue     80ED0938    PDT address              80EC3C70

   .
   .
   .
```

This example illustrates the output of the SHOW CLUSTER /SCS command.

SHOW CONNECTIONS

Displays information about all active connections between System Communications Services (SCS) processes or a single connection.

Format

SHOW CONNECTIONS [{/ADDRESS=*cdt-address* | /NODE=*name* | /SYSAP=*name*}]

Parameters

None.

Qualifiers

/ADDRESS=cdt-address
Displays information contained in the connection descriptor table (CDT) for a specific connection. You can find the *cdt-address* for any active connection on the system in the *CDT summary page* display of the SHOW CONNECTIONS command. In addition, CDT addresses are stored in many individual data structures related to SCS connections. These data structures include class driver request packets (CDRPs) and unit control blocks (UCBs) for class drivers that use SCS, and cluster system blocks (CSBs) for the connection manager.

/NODE=name
Displays all CDTs associated with the specified remote SCS node name.

/SYSAP=name
Displays all CDTs associated with the specified local SYSAP.

Description

The SHOW CONNECTIONS command provides a series of displays.

The **CDT summary page** lists information regarding each connection on the local system, including the following:

- CDT address
- Name of the local process with which the CDT is associated
- Connection ID
- Current state
- Name of the remote node (if any) to which it is currently connected

The **CDT summary page** concludes with a count of CDTs that are free and available to the system.

SHOW CONNECTIONS next displays a page of detailed information for each active CDT listed previously.

Example

```
SDA> SHOW CONNECTIONS

              --- CDT Summary Page ---

CDT Address   Local Process     Connection ID    State      Remote Node
-----------   -------------     -------------    -----      -----------

 805E7ED0     SCS$DIRECTORY       FF120000       listen
 805E8030     MSCP$TAPE           FF120001       listen
 805E8190     VMS$VMScluster      FF120002       listen
 805E82F0     MSCP$DISK           FF120003       listen
 805E8450     SCA$TRANSPORT       FF120004       listen
 805E85B0     MSCP$DISK           FF150005       open        VANDQ1
 805E8710     VMS$VMScluster      FF120006       open        VANDQ1
 805E8870     VMS$VMScluster      FF120007       open        ROMRDR
 805E89D0     MSCP$DISK           FF120008       open        ROMRDR
 805E8C90     VMS$DISK_CL_DRVR    FF12000A       open        ROMRDR
 805E8DF0     VMS$DISK_CL_DRVR    FF12000B       open        VANDQ1
 805E8F50     VMS$TAPE_CL_DRVR    FF12000C       open        VANDQ1

Number of free CDT's:  188

          --- Connection Descriptor Table (CDT) 80C44850 ---

State:  0001 listen             Local Process:        MSCP$TAPE
Blocked State:  0000

Local Con. ID   899F0003    Datagrams sent        0    Message queue   80C4488C
Remote Con. ID  00000000    Datagrams rcvd        0    Send Credit Q.  80C44894
Receive Credit         0    Datagram discard      0    PB address      00000000
Send Credit            0    Message Sends         0    PDT address     00000000
Min. Rec. Credit       0    Message Recvs         0    Error Notify    822FFCC0
Pend Rec. Credit       0    Mess Sends NoFP       0    Receive Buffer  00000000
Initial Rec. Credit    0    Mess Recvs NoFP       0    Connect Data    00000000
Rem. Sta.   000000000000    Send Data Init.       0    Aux. Structure  00000000
Rej/Disconn Reason     0    Req Data Init.        0    Fast Recvmsg Rq 00000000
Queued for BDLT        0    Bytes Sent            0    Fast Recvmsg PM 00000000
Queued Send Credit     0    Bytes rcvd            0    Change Affinity 00000000
                            Total bytes map       0

      --- Connection Descriptor Table (CDT) 805E8030 ---

State:  0001 listen           Local Process:        MSCP$TAPE
Blocked State:  0000

Local Con. ID   FF120001    Datagrams sent        0    Message queue   805E8060
Remote Con. ID  00000000    Datagrams rcvd        0    Send Credit Q.  805E8068
Receive Credit         0    Datagram discard      0    PB address      00000000
Send Credit            0    Messages Sent         0    PDT address     00000000
Min. Rec. Credit       0    Messages Rcvd.        0    Error Notify    804540D0
Pend Rec. Credit       0    Send Data Init.       0    Receive Buffer  00000000
Initial Rec. Credit    0    Req Data Init.        0    Connect Data    00000000
Rem. Sta.   000000000000    Bytes Sent            0    Aux. Structure  00000000
Rej/Disconn Reason     0    Bytes rcvd            0
Queued for BDLT        0    Total bytes map       0
Queued Send Credit     0
   .
   .
   .
```

This example shows the default output of the SHOW CONNECTIONS command.

SHOW CPU

When analyzing a dump, displays information about the state of a CPU at the time of the system failure.

Note

SHOW CPU is only valid when you are analyzing a crash dump. It is not a valid command when you are analyzing the running system, because all the CPU-specific information may not be available.

Format

SHOW CPU [cpu-id]

Parameter

cpu-id
Numeric value from 00 to $1F_{16}$ indicating the identity of the CPU for which context information is to be displayed. If you specify a value outside this range, or you specify the **cpu-id** of a CPU that was not active at the time of the system failure, SDA displays the following message:

```
%SDA-E-CPUNOTVLD, CPU not booted or CPU number out of range
```

If you use the **cpu-id** parameter, the SHOW CPU command performs an implicit SET CPU command, making the CPU indicated by **cpu-id** the current CPU for subsequent SDA commands. (See the description of the SET CPU command and Section 2.5 for information on how this can affect the CPU context—and process context—in which SDA commands execute.)

Qualifiers

None.

Description

The SHOW CPU command displays system failure information about the CPU specified by **cpu-id** or, by default, the SDA current CPU, as defined in Section 2.5. You cannot use the SHOW CPU command when examining the running system with SDA.

The SHOW CPU command produces several displays. The first display is a brief description of the system failure and its environment that includes the following:

- Reason for the bugcheck.
- Name of the currently executing process. If no process has been scheduled on this CPU, SDA displays the following message:

  ```
  Process currently executing: no processes currently scheduled on the processor
  ```

- File specification of the image executing within the current process (if there is a current process).
- Interrupt priority level (IPL) of the CPU at the time of the system failure.
- The CPU database address.

- The CPU's capability set.

Next, the **general registers** display shows the contents of the CPU's integer registers (R0 to R30), and the AI, RA, PV, FP, PC, and PS at the time of the system failure.

The **processor registers** display consists of the following parts:

- Common processor registers
- Processor-specific registers
- Stack pointers

The first part of the processor registers display includes registers common to all Alpha processors, which are used by the operating system to maintain the current process virtual address space, system space, or other system functions. This part of the display includes the following registers:

- Hardware privileged context block base register (PCBB)
- System control block base register (SCBB)
- Software interrupt summary register (SISR)
- Address space number register (ASN)
- AST summary register (ASTSR)
- AST enable register (ASTEN)
- Interrupt priority level register (IPL)
- Processor priority level register (PRBR)
- Page table base register (PTBR)
- Virtual page table base register (VPTB)
- Floating-point control register (FPCR)
- Machine check error summary register (MCES)

The last part of the display includes the four stack pointers: the pointers of the kernel, executive, supervisor, and user stacks (KSP, ESP, SSP, and USP, respectively).

The SHOW CPU command concludes with a listing of the spinlocks, if any, owned by the CPU at the time of the system failure, reproducing some of the information given by the SHOW SPINLOCKS command. The spinlock display includes the following information:

- Name of the spinlock.
- Address of the spinlock data structure (SPL).
- The owning CPU's CPU ID.
- IPL of the spinlock.
- Indication of the depth of this CPU's ownership of the spinlock. A number greater than 1 indicates that this CPU has nested acquisitions of the spinlock.
- Rank of the spinlock.
- Timeout interval for spinlock acquisition (in terms of 10 milliseconds).
- Shared array (shared spinlock context block pointers)

Example

```
SDA> SHOW CPU 0
CPU 00 Processor crash information
----------------------------------

CPU 00 reason for Bugcheck: CPUEXIT, Shutdown requested by another CPU

Process currently executing on this CPU:   None

Current IPL: 31  (decimal)

CPU database address:  81414000

CPUs Capabilities:    PRIMARY,QUORUM,RUN

General registers:

R0   = FFFFFFFF.81414000  R1   = FFFFFFFF.81414000  R2   = 00000000.00000000
R3   = FFFFFFFF.810AD960  R4   = 00000000.01668E90  R5   = 00000000.00000001
R6   = 66666666.66666666  R7   = 77777777.77777777  R8   = FFFFFFFF.814FB040
R9   = 99999999.99999999  R10  = FFFFFFFF.814FB0C0  R11  = BBBBBBBB.BBBBBBBB
R12  = CCCCCCCC.CCCCCCCC  R13  = FFFFFFFF.810AD960  R14  = FFFFFFFF.81414018
R15  = 00000000.00000004  R16  = 00000000.000006AC  R17  = 00000000.00000047
R18  = 00000000.00000000  R19  = 00000000.00000000  R20  = FFFFFFFF.8051A494
R21  = 00000000.00000000  R22  = 00000000.00000001  R23  = 00000000.00000010
R24  = FFFFFFFF.81414000  AI   = FFFFFFFF.81414000  RA   = FFFFFFFF.81006000
PV   = 00000001.FFFFFFFF  R28  = 00000000.00000000  FP   = FFFFFFFF.88ABDFD0
PC   = FFFFFFFF.8009C95C  PS   = 18000000.00001F04

Processor Internal Registers:

ASN  = 00000000.00000000                    ASTSR/ASTEN =          00000000
IPL  =          0000001F  PCBB = 00000000.01014080  PRBR = FFFFFFFF.81414000
PTBR = 00000000.0000FFBF  SCBB = 00000000.000001E8  SISR = 00000000.00000100
VPTB = FFFFFEFC.00000000  FPCR = 00000000.00000000  MCES = 00000000.00000000

        KSP    = FFFFFFFF.88ABDCD8
        ESP    = FFFFFFFF.88ABF000
        SSP    = FFFFFFFF.88AB9000
        USP    = FFFFFFFF.88AB9000

                Spinlocks currently owned by CPU 00

SCS                                    Address        810AF300
Owner CPU ID        00000000           IPL            00000008
Ownership Depth     00000000           Rank           0000001A
Timeout Interval    002DC6C0           Share Array    00000000
```

This example shows the default output of the SHOW CPU command.

SHOW CRASH

Displays information about the state of the system at the time of failure. Provides system information identifying a running system.

Format

SHOW CRASH [/CPU=*n*]

Parameters

None.

Qualifier

/CPU=n
Allows exception data to be displayed from CPUs other than the one considered as the crash CPU when more than one CPU crashes simultaneously.

Description

The SHOW CRASH command has two different functions, depending on whether you use it to analyze a running system or a system failure.

When used during the analysis of a running system, the SHOW CRASH command produces a display that describes the system and the version of OpenVMS Alpha that it is running. The **system crash information** display contains the following information:

- Name and version number of the operating system
- Major and minor IDs of the operating system
- Identity of the Alpha system, including an indication of its cluster membership
- CPU ID of the primary CPU
- Address of all CPU databases

When used during the analysis of a system failure, the SHOW CRASH command produces several displays that identify the system and describe its state at the time of the failure.

If the current CPU context for SDA is not that of the processor that signaled the bugcheck, or the CPU specified with the /CPU=*n* qualifier, the SHOW CRASH command first performs an implicit SET CPU command to make that processor the current CPU for SDA. (See the description of the SET CPU command and Section 2.5 for a discussion of how this can affect the CPU context—and process context—in which SDA commands execute.)

The **system crash information** display in this context provides the following information:

- Date and time of the system failure.
- Name and version number of the operating system.
- Major and minor IDs of the operating system.
- Identity of the system.

- CPU IDs of both the primary CPU and the CPU that initiated the bugcheck. In a uniprocessor Alpha system, these IDs are identical.
- Bitmask of the active and available CPUs in the system.
- For each active processor in the system, the name of the bugcheck that caused the system failure. Generally, there will be only one significant bugcheck in the system. All other processors typically display the following as their reason for taking a bugcheck:

  ```
  CPUEXIT, Shutdown requested by another CPU
  ```

Subsequent screens of the SHOW CRASH command display information about the state of each active processor on the system at the time of the system failure. The information in these screens is identical to that produced by the SHOW CPU command, including the general-purpose registers, processor-specific registers, stack pointers, and records of spinlock ownership. The first such screen presents information about the processor that caused the failure; others follow according to the numeric order of their CPU IDs.

Examples

1.
```
SDA> SHOW CRASH

System crash information
------------------------
Time of system crash:  1-JAN-2001 00:00:00.00

Version of system: OpenVMS (TM) Alpha Operating System, Version X901-SSB

System Version Major ID/Minor ID: 3/0

VMScluster node: VMSTS6, a

Crash CPU ID/Primary CPU ID:  00/00

Bitmask of CPUs active/available:  00000001/00000001

CPU bugcheck codes:
        CPU 00 -- INVEXCEPTN, Exception while above ASTDEL

System State at Time of Exception
---------------------------------
Exception Frame:
----------------
        R2  = FFFFFFFF.810416C0  SCS$GA_LOCALSB+005C0
        R3  = FFFFFFFF.81007E60  EXE$GPL_HWRPB_L
        R4  = FFFFFFFF.850AEB80
        R5  = FFFFFFFF.81041330  SCS$GA_LOCALSB+00230
        R6  = FFFFFFFF.81038868  CON$INITLINE
        R7  = FFFFFFFF.81041330  SCS$GA_LOCALSB+00230
        PC  = FFFFFFFF.803EF81C  SYS$TTDRIVER+0F81C
        PS  = 30000000.00001F04

         FFFFFFFF.803EF80C:     STL             R24,#X0060(R5)
         FFFFFFFF.803EF810:     LDL             R28,#X0138(R5)
         FFFFFFFF.803EF814:     BIC             R28,R27,R28
         FFFFFFFF.803EF818:    00000138
   PC => FFFFFFFF.803EF81C:     HALT
         FFFFFFFF.803EF820:     HALT
         FFFFFFFF.803EF824:     BR              R31,#XFF0000
         FFFFFFFF.803EF828:     LDL             R24,#X0138(R5)
         FFFFFFFF.803EF82C:     BIC             R24,#X40,R24

   PS =>
         MBZ SPAL      MBZ    IPL VMM MBZ CURMOD INT PRVMOD de
           0   30   00000000000 1F  0   0   KERN   1   KERN
```

```
Signal Array
------------
        Length = 00000003
        Type   = 0000043C
        Arg    = FFFFFFFF.803EF81C  SYS$TTDRIVER+0F81C
        Arg    = 30000000.00001F04
%SYSTEM-F-OPCDEC, opcode reserved to Digital fault at PC=FFFFFFFF803EF81C, PS=00001F04

Saved Scratch Registers in Mechanism Array
------------------------------------------
R0   = 00000000.00000000  R1   = FFFFFFFF.811998B8  R16  = 00000000.00001000
R17  = FFFFFFFF.8119B1F0  R18  = 00000000.00000010  R19  = FFFFFFFF.810194F0
R20  = 00000000.00000000  R21  = 0000000F.00000000  R22  = 00000000.00000000
R23  = 00000000.00004000  R24  = 00000000.00001000  R25  = 00000000.00000000
R26  = FFFFFFFF.81041474  R27  = 00000000.00004000  R28  = 00000000.00001000

   .
   .
   .
                           (CPU-specific display omitted)
   .
   .
   .
```

This long display reflects the output of the SHOW CRASH command within the analysis of a system failure.

2.
```
SDA> SHOW CRASH

System crash information
------------------------
Time of system crash: 12-OCT-2000 11:27:58.02

Version of system: OpenVMS (TM) Alpha Operating System, Version X74B-FT2

System Version Major ID/Minor ID: 3/0

System type: DEC 3000 Model 400

Crash CPU ID/Primary CPU ID:  00/00

Bitmask of CPUs active/available:  00000001/00000001

CPU bugcheck codes:
        CPU 00 -- PGFIPLHI, Pagefault with IPL too high

System State at Time of Page Fault:
-----------------------------------

Page fault for address 00000000.00046000 occurred at IPL: 8
Memory management flags: 00000000.00000001 (instruction fetch)

Exception Frame:
----------------
        R2  = 00000000.00000003
        R3  = FFFFFFFF.810B9280  EXCEPTION_MON+39C80
        R4  = FFFFFFFF.81564540  PCB
        R5  = 00000000.00000088
        R6  = 00000000.000458B0
        R7  = 00000000.7FFA1FC0
        PC  = 00000000.00046000
        PS  = 20000000.00000803
```

```
      00000000.00045FF0:     LDQ             R2,#X0050(FP)
      00000000.00045FF4:     LDQ             R12,#X0058(FP)
      00000000.00045FF8:     LDQ             R13,#X0060(FP)
      00000000.00045FFC:     LDQ             R14,#X0068(FP)
PC => 00000000.00046000:     BIS             R1,R17,R1
      00000000.00046004:     BIS             R31,#X01,R25
      00000000.00046008:     STQ_U           R1,#X0002(R10)
      00000000.0004600C:     BSR             R26,#X00738C
      00000000.00046010:     LDQ_U           R16,#X0002(R10)

PS =>
      MBZ  SPAL      MBZ    IPL  VMM  MBZ  CURMOD  INT  PRVMOD de
       0    20   00000000000 08   0    0    KERN    0    USER

.
.
.
                                     (CPU-specific display omitted)
.
.
.
```

This display reflects the output of a SHOW CRASH command within the analysis of a PGFIPLHI bugcheck.

SHOW DEVICE

Displays a list of all devices in the system and their associated data structures, or displays the data structures associated with a given device or devices.

Format

SHOW DEVICE [device-name | /ADDRESS=ucb-address | /CDT=cdt_address | /CHANNELS | /HOMEPAGE | /PDT | /UCB=ucb-address]

Parameter

device-name
Device or devices for which data structures are to be displayed. The following table lists several uses of the **device-name** parameter:

To Display the Structures For . . .	Action
All devices in the system	Do not specify a **device-name** (for example, SHOW DEVICE).
A single device	Specify an entire **device-name** (for example, SHOW DEVICE VTA20).
All devices of a certain type on a single controller	Specify only the device type and controller designation (for example, SHOW DEVICE RTA or SHOW DEVICE RTB).
All devices of a certain type on any controller	Specify only the device type (for example, SHOW DEVICE RT).
All devices whose names begin with a certain character or character string	Specify the character or character string (for example, SHOW DEVICE D).
All devices on a single node or HSC	Specify only the node name or HSC name (for example, SHOW DEVICE GREEN$).
All devices with a certain allocation class	Specify the allocation class including leading and trailing $, for example, SHOW DEVICE 63.

Qualifiers

/ADDRESS=ucb-address
Indicates the device for which data structure information is to be displayed by the address of its unit control block (UCB). The /ADDRESS qualifier is an alternate method of supplying a device name to the SHOW DEVICE command. If both the **device-name** parameter and the /ADDRESS qualifier appear in a single SHOW DEVICE command, SDA responds only to the parameter or qualifier that appears first.

/CDT=cdt_address
Identifies the device by the address of its Connector Descriptor Table (CDT). This applies to cluster port devices only.

/CHANNELS
Displays information on active Memory Channel channel blocks. This qualifier is ignored for devices other than Memory Channel.

/HOMEPAGE

Displays fields from the Memory Channel Home Page. This qualifier is ignored for devices other than Memory Channel.

/PDT

Displays the Memory Channel Port Descriptor Table. This qualifier is ignored for devices other than Memory Channel.

/UCB=ucb-address

This is a synonym for /ADDRESS=ucb-address as described previously.

Description

The SHOW DEVICE command produces several displays taken from system data structures that describe the devices in the system configuration.

If you use the SHOW DEVICE command to display information for more than one device or one or more controllers, it initially produces the **device data block (DDB) list** to provide a brief summary of the devices for which it renders information in subsequent screens.

Information in the **DDB list** appears in five columns, the contents of which are as follows:

- Address of the device data block (DDB)
- Controller name
- Name of the ancillary control process (ACP) associated with the device
- Name of the device driver
- Address of the driver prologue table (DPT)

The SHOW DEVICE command then produces a display of information pertinent to the device controller. This display includes information gathered from the following structures:

- Device data block (DDB)
- Primary channel request block (CRB)
- Interrupt dispatch block (IDB)
- Driver dispatch table (DDT)

If the controller is an HSC controller, SHOW DEVICE also displays information from its system block (SB) and each path block (PB).

Many of these structures contain pointers to other structures and driver routines. Most notably, the DDT display points to various routines located within driver code, such as the start I/O routine, unit initialization routine, and cancel I/O routine.

For each device unit subject to the SHOW DEVICE command, SDA displays information taken from its unit control block, including a list of all I/O request packets (IRPs) in its I/O request queue. For certain mass storage devices, SHOW DEVICE also displays information from the primary class driver data block (CDDB), the volume control block (VCB), and the ACP queue block (AQB). For units that are part of a shadow set, SDA displays a summary of shadow set membership.

As it displays information for a given device unit, SHOW DEVICE defines the following symbols as appropriate:

Symbol	Meaning
UCB	Address of unit control block
SB	Address of system block
ORB	Address of object rights block
DDB	Address of device data block
DDT	Address of driver dispatch table
CRB	Address of channel request block
SUD	Address of supplementary VCB data
SHAD	Address of host-based shadowing data structure
AMB	Associated mailbox UCB pointer
IRP	Address of I/O request packet
2P_UCB	Address of alternate UCB for dual-pathed device
LNM	Address of logical name block for mailbox
PDT	Address of port descriptor table
CDDB	Address of class driver descriptor block for MSCP served device
2P_CDDB	Address of alternate CDDB for MSCP served device
RWAITCNT	Resource wait count for MSCP served device
VCB	Address of volume control block for mounted device
2P_DDB	Address of secondary DDB
VP_IRP	Address of volume processing IRP
MMB	Address of merge management block
CPYLOCK	ID of copier lock
VU_TO	Virtual Unit Timeout (seconds)
VU_UCB	UCB address of Virtual Unit
MPDEV	Address of multipath data structure
PRIMARY_UCB	UCB address for primary path
CURRENT_UCB	UCB address for current path

If you are examining a driver-related system failure, you may find it helpful to issue a SHOW STACK command after the appropriate SHOW DEVICE command, to examine the stack for any of these symbols. Note, however, that although the SHOW DEVICE command defines those symbols relevant to the last device unit it has displayed, and redefines symbols relevant to any subsequently displayed device unit, it does not undefine symbols. (For instance, SHOW DEVICE DUA0 defines the symbol PDT, but SHOW DEVICE MBA0 does not undefine it, even though the PDT structure is not associated with a mailbox device.) To maintain the accuracy of such symbols that appear in the stack listing, use the DEFINE command to modify the symbol name. For example:

```
SDA> DEFINE DUA0_PDT PDT
SDA> DEFINE MBA0_UCB UCB
```

See the descriptions of the READ and FORMAT commands for additional information on defining and examining the contents of device data structures.

Examples

1.
```
SDA> SHOW DEVICE/ADDRESS=8041E540
OPA0                                  VT300_Series       UCB address    8041E540

Device status:   00000010 online
Characteristics: 0C040007 rec,ccl,trm,avl,idv,odv
                 00000200 nnm

Owner UIC [000001 ,000004]  Operation count       160    ORB address    8041E4E8
      PID          00010008 Error count             0    DDB address    8041E3F8
Class/Type            42/70 Reference count         2    DDT address    8041E438
Def. buf. size           80 BOFF             00000001    CRB address    8041E740
DEVDEPEND          180093A0 Byte count       0000012C    I/O wait queue 8041E5AC
DEVDEPND2          FB101000 SVAPTE           80537B80
DEVDEPND3          00000000 DEVSTS           00000001
FLCK index               3A
DLCK address       8041E880

*** I/O request queue is empty ***
```

This example reproduces the SHOW DEVICE display for a single device unit, OPA0. Whereas this display lists information from the UCB for OPA0, including some addresses of key data structures and a list of pending I/O requests for the unit, it does not display information about the controller or its device driver. To display the latter information, specify the **device-name** as OPA (for example, SHOW DEVICE OPA).

2.
```
SDA>  SHOW DEVICE DU
I/O data structures
-------------------
                            DDB list
                            --------

       Address    Controller    ACP        Driver            DPT
       -------    ----------  --------   ------------        ---

      80D0B3C0    BLUES$DUA    F11XQP    SYS$DKDRIVER      807735B0
      8000B2B8    RED$DUA      F11XQP    SYS$DKDRIVER      807735B0
      80D08BA0    BIGTOP$DUA   F11XQP    SYS$DKDRIVER      807735B0
      80D08AE0    TIMEIN$DUA   F11XQP    SYS$DKDRIVER      807735B0
   .
   .
   .
Press RETURN for more.
   .
   .
   .
```

This excerpt from the output of the SHOW DEVICE DU command illustrates the format of the **DDB list**. In this case, the **DDB list** concerns itself with those devices whose device type begins with DU. It displays devices of these types attached to various HSCs (RED$ and BLUES$) and systems in a cluster (BIGTOP$ and TIMEIN$).

SHOW DUMP

Displays formatted information from the header, error log buffers, logical memory blocks (LMBs), memory map, compression data, and a summary of the dump. Also displays hexadecimal information of individual blocks.

Format

SHOW DUMP {/ALL | /BLOCK[=*m*[{: | ;}*n*]]
| [/COMPRESSION_MAP
[=*m*[:*n*[:*p*]] | /ERROR_LOGS | /HEADER
| /LMB[={ALL | *n*}] | /SUMMARY
| /MEMORY_MAP]}

Parameters

None.

Qualifiers

/ALL

Displays the equivalent to specifying all the /SUMMARY, /HEADER, /ERROR_LOGS, /COMPRESSION_MAP, /LMB=ALL, and /MEMORY_MAP qualifiers.

/BLOCK[=*m*[{: | ;}*n*]]

Displays a hexadecimal dump of one or more blocks. You can specify ranges by using the following syntax:

no value	Displays next block
m	Displays single block
m:n	Displays a range of blocks from *m* to *n*, inclusive
m;n	Displays a range of blocks starting at *m* and continuing for *n* blocks

/COMPRESSION_MAP[=*m*[:*n*[:*p*]]]

In a compressed dump, displays details of the compression data. You can specify levels of detail by using the following syntax, where *m,n,p* may each be wildcarded (*):

no value	Displays a summary of all compression map blocks.
m	Displays contents of a single compression map block.
m:n	Displays details of single compression map entry.
m:n:p	Displays compressed and raw data for the specified compression section. Note that *m:n:p* may contain wildcards (*).

/ERROR_LOGS

Displays a summary of the error log buffers.

/HEADER

Displays the formatted contents of the dump header.

/LMB[={ALL | *n*}]
In a selective dump, displays the formatted contents of logical memory block (LMB) headers and the virtual address (VA) ranges within the LMB. You can express LMBs to be displayed by using the following syntax:

no value	Displays next LMB
n	Displays LMB at block *n* of the dump
ALL	Displays all LMBs

/MEMORY_MAP
In a full dump, displays the contents of the memory map.

/SUMMARY
Displays a summary of the dump. This is the default.

Description

The SHOW DUMP command displays information about the structure of the dump file. It displays the header, the error log buffers, and, if appropriate, the compression map, the logical memory block (LMB) headers, and the memory map. Use this command when troubleshooting dump analysis problems.

Examples

1. SDA> SHOW DUMP/SUMMARY

```
Summary of dump file DKA300:[SYS0.SYSEXE]SYSDUMP.DMP;8
-----------------------------------------------------
Dump type:                  Compressed selective
Size of dump file:          000203A0/000203A0 (132000./132000.)
Highest VBN written:        0000D407          (54279.)
Uncompressed equivalent:    0001AF1C          (110364.)
Compression ratio:          2.03:1            (49.2%)

                                                                    Uncomp    Uncomp
                     Dump file section            VBN      Blocks     VBN     blocks
--------------------------------------------  ---------- --------  -------  --------
Dump header                                     00000001 00000002
Error log buffers                               00000003 00000020
Compression map                                 00000023 00000010
LMB 0000 (PT space)                             00000033 00000038  00000033 000000D2
LMB 0001 (S0/S1 space)                          0000006B 0000621B  00000105 000095A5
LMB 0002 (S2 space)                             00006286 000001A3  000096AA 00000352
LMB 0003 (Page tables of key process "SYSTEM")  00006429 00000005  000099FC 00000062
LMB 0004 (Memory of key process "SYSTEM")       0000642E 00000071  00009A5E 00000342
   .
   .
   .
LMB 0003 (Page tables of key process "NETACP")  0000697B 00000009  0000AE14 00000052
LMB 0004 (Memory of key process "NETACP")       00006984 000013F7  0000AE66 00001F42
LMB 0005 (Key global pages)                     00007D7B 000002BA  0000CDA8 00000312
LMB 0006 (Page tables of process "DTWM")        00008035 00000013  0000D0BA 00000082
LMB 0007 (Memory of process "DTWM")             00008048 000013A3  0000D13C 000022E4
   .
   .
   .
LMB 0006 (Page tables of process "Milord_FTA1:")  0000C5E3 00000005  00019A44 00000062
LMB 0007 (Memory of process "Milord_FTA1:")     0000C5E8 00000074  00019AA6 00000222
LMB 0008 (Remaining global pages)               0000C65C 00000DAC  00019CC8 00001255
```

This example of the SHOW DUMP/SUMMARY command gives a summary of a selective dump.

2. SDA> SHOW DUMP/HEADER

```
Dump header
-----------

    Header field                      Meaning                          Value

--------------------  ---------------------------------------  -----------------

DMP$W_FLAGS           Flags                                                 0FC1
                       DMP$V_OLDDUMP:    Dump has been analyzed
                       DMP$V_WRITECOMP:  Dump write was completed
                       DMP$V_ERRLOGCOMP: Error log buffers written
                       DMP$V_DUMP_STYLE: Selective dump
                                         Verbose messages
                                         Dump off system disk
                                         Compressed
DMP$B_FLAGS2          Additional flags                                        09
                       DMP$V_COMPRESSED: Dump is compressed
                       DMP$V_ALPHADUMP:  This is an OpenVMS Alpha dump

DMP$Q_SYSIDENT        System version                                 "X69G-FT1"
DMP$Q_LINKTIME        Base image link date/time       " 8-JUN-1996 02:07:27.31"
DMP$L_SYSVER          Base image version                               03000000
DMP$W_DUMPVER         Dump version                                         0704

DMP$L_DUMPBLOCKCNT    Count of blocks dumped for memory                0000D3D5
DMP$L_NOCOMPBLOCKCNT  Uncompressed blocks dumped for memory            0001AEEA
DMP$L_SAVEPRCCNT      Number of processes saved                        00000014

    .
    .
    .

EMB$Q_CR_TIME         Crash date/time                 " 3-JUL-1996 09:30:13.36"
EMB$L_CR_CODE         Bugcheck code                               "SSRVEXCEPT"
EMB$B_CR_SCS_NAME     Node name                                     "SWPCTX  "
EMB$T_CR_HW_NAME      Model name                          "DEC 3000 Model 400"
EMB$T_CR_LNAME        Process name                                    "SYSTEM"

DMP$L_CHECKSUM        Dump header checksum                             439E5E91
```

This example of the SHOW DUMP/HEADER command shows the information in the header.

SHOW EXECUTIVE

Displays the location and size of each loadable image that makes up the executive.

Format

SHOW EXECUTIVE [execlet-name | /SUMMARY]

Parameter

execlet-name
Data only for the specified loadable image. You can use wildcards in **execlet-name**, in which case SDA displays data for all matching loadable images. The default action is for SDA to display data for all loadable images.

Qualifier

/SUMMARY
Displays a single line of output for all loadable images.

Description

The executive consists of two base images and a number of other executive images.

The base image called SYS$BASE_IMAGE.EXE contains:

- Symbol vectors for universal executive routines and data cells
- Procedure descriptors for universal executive routines
- Globally referenced data cells

The base image called SYS$PUBLIC_VECTORS.EXE contains:

- Symbol vectors for system service procedures
- Procedure descriptors for system services
- Transfer routines for system services

The base images are the pathways to routines and system service procedures in the other executive images.

The SHOW EXECUTIVE command lists the location and size of each executive image. It can enable you to determine whether a given memory address falls within the range occupied by a particular image. (Table 4–1 describes the contents of each executive image.)

SHOW EXECUTIVE also displays the base address and length for each nonzero length image section.

On OpenVMS Alpha the execlets may be sliced. This means each different image section can be relocated in system memory so that the sections are no longer contiguous. The SHOW EXECUTIVE display contains information on where each image section resides.

The difference between a sliced image and a non-sliced image in the display is that the base, the end, and the length of a sliced image are blank. Only the image section base, end, and length are valid.

There are six different image section types: nonpaged read only, nonpaged read-write, paged read only, paged read-write, init, and fixup. Only the image sections loaded into system memory are displayed.

The MAP command makes it easier to find out in which execlet an address resides. See the description of the MAP command for details.

By default, SDA displays each location within an executive image as an offset from the beginning of the image, for instance, EXCEPTION+00282. Similarly, those symbols that represent system services point to the transfer routine in SYS$PUBLIC_VECTORS.EXE and not to the actual system service procedure. When tracing the course of a system failure through the listings of modules contained within a given executive image, you may find it useful to load into the SDA symbol table all global symbols and global entry points defined within one or all executive images. See the description of the READ command for additional information.

The SHOW EXECUTIVE command usually shows all components of the executive, as illustrated in the following example. In rare circumstances, you may obtain a partial listing. For instance, after it has loaded the EXCEPTION module (in the INIT phase of system initialization), the system can successfully post a bugcheck exception and save a crash dump before loading all the executive images that are normally loaded.

Examples

1.
```
SDA> SHOW EXECUTIVE
VMS Executive layout
--------------------
Image                                    Base     End     Length   SymVec
---------------------------------------- -------- -------- -------- --------
SYS$WSDRIVER                            A21B2000 A21BA000 00008000
    Nonpaged read only                  A21B2000 A21B3600 00001600
    Nonpaged read/write                 A21B6000 A21B6800 00000800
        Linked  5-APR-1998 12:08          LDRIMG 80DA0700 --< not sliced >--

SYS$LTDRIVER                            A217A000 A21B2000 00038000
    Nonpaged read only                  A217A000 A21A8800 0002E800
    Nonpaged read/write                 A21AA000 A21AEA00 00004A00
        Linked  4-APR-1998 22:42          LDRIMG 80D8F600 --< not sliced >--

LAT$RATING                              A2172000 A217A000 00008000
    Nonpaged read only                  A2172000 A2172600 00000600
    Nonpaged read/write                 A2176000 A2176600 00000600
        Linked  4-APR-1998 22:45          LDRIMG 80D8F740 --< not sliced >--

SYS$RTTDRIVER                           A216A000 A2172000 00008000
    Nonpaged read only                  A216A000 A216D600 00003600
    Nonpaged read/write                 A216E000 A216EA00 00000A00
        Linked  4-APR-1998 22:56          LDRIMG 80D86C80 --< not sliced >--
        .
        .
        .
        .
        .
SYS$OPDRIVER
    Nonpaged read only                  80022000 80025800 00003800
    Nonpaged read/write                 9E92F000 9E92FA00 00000A00
        Linked  4-APR-1998 22:42          LDRIMG 80C1E8C0 --< sliced >--
```

```
SYS$CNBTDRIVER
    Nonpaged read only                    80020000 80021000 00001000
    Nonpaged read/write                   9E92EC00 9E92F000 00000400
        Linked  4-APR-1998 22:35            LDRIMG 80C1D7C0 --< sliced >--

SYS$CPU_ROUTINES_1605
    Nonpaged read only                    8000E000 8001EE00 00010E00
    Nonpaged read/write                   9E92AA00 9E92EC00 00004200
        Linked  8-APR-1998 10:04            LDRIMG 80C1DB80 --< sliced >--

SYS$BASE_IMAGE                                                       9E916320
    Nonpaged read only                    80002000 8000D000 0000B000
    Nonpaged read/write                   9E905C00 9E92AA00 00024E00
        Linked  6-APR-1998 16:00            LDRIMG 80C1DA40 --< sliced >--

SYS$PUBLIC_VECTORS                                                   9E903CB8
    Nonpaged read only                    80000000 80002000 00002000
    Nonpaged read/write                   9E900000 9E905C00 00005C00
        Linked  4-APR-1998 22:22            LDRIMG 80C1D900 --< sliced >--
```

The SHOW EXECUTIVE command displays the location and length of executive images.

2.
```
SDA> SHOW EXECUTIVE SYS$GAL*
VMS Executive layout
--------------------
Image                                     Base     End     Length   SymVec
---------------------------------------- -------- -------- -------- --------
SYS$GALAXY                               A1A62000 A1A8A000 00028000
    Nonpaged read only                   A1A62000 A1A83600 00021600
    Nonpaged read/write                  A1A86000 A1A89A00 00003A00
        Linked  4-APR-1998 22:43           LDRIMG 80CCA280 --< not sliced >--
```

This example displays the use of the wildcard with the SHOW EXECUTIVE command.

3. SDA> SHOW EXECUTIVE/SUMMARY

```
VMS Executive layout summary
----------------------------
Image                                  LDRIMG    Base     End     Length   SymVec
-------------------------------------- -------- -------- -------- -------- --------

SYS$MADDRIVER                          80D2A900 83848000 83860000 00018000
SYS$DADDRIVER                          80E00C80 83838000 83848000 00010000
SYS$LASTDRIVER                         80E3C600 8381C000 83838000 0001C000
SYS$LTDRIVER                           80E305C0 837E4000 8381C000 00038000
LAT$RATING                             80E35500 837DC000 837E4000 00008000
SYS$RTTDRIVER                          80DCDF00 837D4000 837DC000 00008000
SYS$CTDRIVER                           80D7BFC0 837C4000 837D4000 00010000
NDDRIVER                               80D86000 8377A000 83782000 00008000
SYS$FTDRIVER                           80DD4280 83772000 8377A000 00008000
   .
   .
   .
   .
   .
   .
SYSTEM_PRIMITIVES                      80D13580       --< sliced >--
SYSTEM_DEBUG                           80D12840 82FA4000 82FF4000 00050000
SYS$OPDRIVER                           80D11B00       --< sliced >--
SYS$ESBTDRIVER                         80D10DC0       --< sliced >--
SYS$NISCA_BTDRIVER                     80D10080       --< sliced >--
SYS$CNBTDRIVER                         80D0EF80       --< sliced >--
SYS$CPU_ROUTINES_0402                  80D0F340       --< sliced >--
SYS$BASE_IMAGE                         80D0F200       --< sliced >--      80C16300
SYS$PUBLIC_VECTORS                     80D0F0C0       --< sliced >--      80C03C78
```

This example displays the list of executive images, giving base, end, and length information for those that are not sliced.

SHOW GALAXY

Displays a brief one-page summary of the state of the Galaxy and all the instances in the Galaxy.

Format

SHOW GALAXY

Parameters

None.

Qualifiers

None.

Example

```
SDA> SHOW GALAXY

Galaxy summary
--------------
  GMDB address       Creator node ID  Revision      Creation time         State
-----------------    ---------------  --------  -----------------------  ---------------
FFFFFFFF.7F234000        00000001        1.0    31-MAR-1999 13:15:08.08     OPERATIONAL

Node ID    NODEB address     Name    Version       Join time             State
--------  -----------------  --------  --------  -----------------------  ---------------
00000000  FFFFFFFF.7F236000  ANDA1A      1.0    31-MAR-1999 14:11:09.08          MEMBER  (current instance)
00000001  FFFFFFFF.7F236200  ANDA2A      1.0    31-MAR-1999 14:10:49.06          MEMBER
00000002  FFFFFFFF.7F236400  ANDA3A      1.0    31-MAR-1999 14:13:26.16          MEMBER
00000003  FFFFFFFF.7F236600                     - Node block is empty -
```

SHOW GCT

Displays the contents of the Galaxy configuration tree either in summary (hierarchical) or in detail, node by node.

Format

SHOW GCT [/ADDRESS=*n*] | [/ALL] | [CHILDREN] |
| [/HANDLE=*n*] | [/OWNER=*n*] | [/SUMMARY (default)] | [/TYPE=*type*]

Parameters

None.

Qualifiers

/ADDRESS=*n*
Provides a detailed display of the Galaxy configuration tree (GCT) node at the given address.

/ALL
Provides a detailed display of all nodes in the tree.

/CHILDREN
When used with /ADDRESS=*n* or /HANDLE=*n*, the /CHILDREN qualifier causes SDA to display all nodes in the configuration tree that are children of the specified node.

/HANDLE=*n*
Provides a detailed display of the Galaxy configuration tree (GCT) node with the given handle.

/OWNER=*n*
Provides a detailed display of all nodes in the tree currently owned by the node with the given handle.

/SUMMARY
Provides a summary display of the Galaxy configuration tree (GCT) in hierarchical form. This qualifier is the default.

/TYPE=*type*
Provides a detailed display of all nodes in the tree of the given type, which can be one of the following:

BUS	CAB	COMMUNITY
CPU	CPU_MODULE	EXP_CHASSIS
FRU_DESC	FRU_ROOT	HARD_PARTITION
HOSE	HW_ROOT	IO_CTRL
IOP	MEMORY_CTRL	MEMORY_DESC
MEMORY_SUB	PARTITION	POWER_ENVIR
PSEUDO	RISER	ROOT
SBB	SLOT	SMB
SOC	SW_ROOT	SYS_CHASSIS
SYS_INTER_SWITCH	TEMPLATE_ROOT	

The type given may be an exact match, in which case just that type is displayed (for example, a CPU); or a partial match, in which case all matching types are displayed (for example, /TYPE=CP displays both CPU and CPU_MODULE nodes).

Examples

```
1. SDA> SHOW GCT

Galaxy Configuration Tree summary
---------------------------------

Base address of Config Tree: FFFFFFFF.83694040 (2 pages)

                                              Initial  Current    Name/Min PA/     OS type/Max PA/
 Handle       Hierarchy            Id          Owner    Owner       Base PA         Size (bytes)             Flags
-------- ------------------- ----------------- -------- -------- ----------------- ----------------- ------------------------
00000000 Root                00000000.00000000                   414C4147-5958-0030-0000-......
         |
00000240 |_HW_Root           00000000.00000000
00000280 | |_IOP             00000000.00000006 00001800          000000A0.00000000 000000AF.FFFFFFFF
00000300 | |_IOP             00000000.00000007 00001700          000000B0.00000000 000000BF.FFFFFFFF
00000380 | |_IOP             00000000.00000008 00001600          000000C0.00000000 000000CF.FFFFFFFF
00000400 | |_CPU_Module      00000000.00000000 00001580
00000440 | | |_CPU           00000000.09000000 00001600                                              Primary
00000480 | | |_CPU           00000000.1B000001 00001600 00001800
000004C0 | |_CPU_Module      00000000.00000001 00001580
00000500 | | |_CPU           00000000.1B000002 00001600 00001800
00000540 | | |_CPU           00000000.10000003 00001600 00001700
00000580 | |_CPU_Module      00000000.00000002 00001580
000005C0 | | |_CPU           00000000.07000004 00001700                                              Primary
00000600 | | |_CPU           00000000.0A000005 00001700 00001800
00000640 | |_CPU_Module      00000000.00000003 00001580
00000680 | | |_CPU           00000000.07000006 00001800                                              Primary
000006C0 | | |_CPU           00000000.0C000007 00001800 00001600
00000700 | |_Memory_Sub      00000000.00000000 00001580          00000000.00000000 00000000.FFFFFFFF
00000780 |   |_Memory_Ctrl   00000000.00000005 00001600
000007C0 |   |_Memory_Desc   00000000.00000000 00001600          00000000.00000000 00000000.40000000
         |   | |_Fragment                      00001600          00000000.00000000 00000000.00200000 Console Private Base
         |   | |_Fragment                      00001600          00000000.00200000 00000000.3FD7E000 Private Base
         |   | |_Fragment                      00001600          00000000.3FF7E000 00000000.00082000 Console Private Base
00000A40 |   |_Memory_Desc   00000000.40000000 00001700          00000000.40000000 00000000.40000000
         |   | |_Fragment                      00001700          00000000.40000000 00000000.00200000 Console Private Base
         |   | |_Fragment                      00001700          00000000.40200000 00000000.3FD7E000 Private Base
         |   | |_Fragment                      00001700          00000000.7FF7E000 00000000.00082000 Console Private Base
00000CC0 |   |_Memory_Desc   00000000.80000000 00001800          00000000.80000000 00000000.40000000
         |   | |_Fragment                      00001800          00000000.80000000 00000000.00200000 Console Private Base
         |   | |_Fragment                      00001800          00000000.80200000 00000000.3FD7E000 Private Base
         |   | |_Fragment                      00001800          00000000.BFF7E000 00000000.00082000 Console Private Base
00000F40 |   |_Memory_Desc   00000000.C0000000 00001580          00000000.C0000000 00000000.40000000
         |     |_Fragment                      00001580          00000000.C0000000 00000000.40000000 Shared
         |
000011C0 |_SW_Root           00000000.00000000
00001580 | |_Community       00000000.00000000 000011C0
00001600 |   |_Partition     00000000.00000000 00001580          ANDA1A            OpenVMS Alpha
00001700 |   |_Partition     00000000.00000001 00001580          ANDA2A            OpenVMS Alpha
00001800 |   |_Partition     00000000.00000002 00001580          ANDA3A            OpenVMS Alpha
         |
00001200 |_Template_Root     00000000.00000000
00001240   |_IOP             00000000.00000000
000012C0   |_CPU             00000000.00000000
00001300   |_Memory_Desc     00000000.00000000                                     00000000.02000000
```

VM-0770A-AI

This command shows the summary (hierarchical) display of the configuration tree.

2. SDA> SHOW GCT/HANDLE=00000700

```
Galaxy Configuration Tree
-------------------------

Handle:                          00000700   Address:        FFFFFFFF.83694740
Node type:                     Memory_Sub   Size:                        0080
Id:                     00000000.00000000   Flags:          00000000.00000001 Hardware

Related nodes:

    Node relationship     Handle          Type                   Id
  ---------------------  --------   ---------------------   -----------------
  Initial owner          00001580   Community               00000000.00000000
  Current owner          -<Same>-
  Parent                 00000240   HW_Root                 00000000.00000000
  Previous sibling       00000640   CPU_Module              00000000.00000003
  Next sibling           -<None>-
  Child                  00000780   Memory_Ctrl             00000000.00000005
  Configuration binding  00000240   HW_Root                 00000000.00000000
  Affinity binding       00000240   HW_Root                 00000000.00000000

Min. physical address:   00000000.00000000
Max. physical address:   00000000.FFFFFFFF
```

This command shows the detailed display of the specified node.

SHOW GLOBAL_SECTION_TABLE, SHOW GST

Displays information contained in the global section table, including pageable sections of loadable images.

Format

SHOW GLOBAL_SECTION_TABLE or SHOW GST [/SECTION_INDEX=*n*]

Parameters

None.

Qualifiers

/SECTION_INDEX=*n*
Displays only the global section table entry for the specified section.

Description

Displays the entire contents of the global section table, unless you specify the qualifier /SECTION_INDEX. This command is equivalent to SHOW PROCESS/PROCESS_SECTION_TABLE/SYSTEM. SDA displays the information in Table 4–3 for each GST entry.

Table 4–3 Global Section Table Entry Information

Part	Definition
INDEX	Index number of the entry. Entries in the global section table begin at the highest location in the table, and the table expands toward lower addresses.
ADDRESS	Address of the global section table entry.
SECT/GPTE	Virtual address that marks the beginning of the first of the section described by this entry, if a loadable image; or the virtual address of the global page table entry for the first page, if a global section.
CCB	Address of the channel control block on which the section file is open. This field is zero for loadable images.
PAGELETS	Length of the global section. This is in units of pagelets, except for a PFN-mapped section in which the units are pages.
VBN	Virtual block number. The number of the file's virtual block that is mapped into the section's first page.
WINDOW	Address of the window control block on which the section file is open.
REFCNT	Number of pages of this section that are currently mapped.

(continued on next page)

Table 4–3 (Cont.) Global Section Table Entry Information

Part	Definition
FLINK	Forward link. The pointer to the next entry in the GST list.
BLINK	Backward link. The pointer to the previous entry in the GST list.
FLAGS	Flags that describe the access that the system and processes have to the global section.

Example

```
SDA> SHOW GST

Global Section Table
--------------------

Global section table information
--------------------------------

        Last entry allocated     00000238
        First free entry         00000000

Global section table
--------------------

 Index   Address   Sect/GPTE Addr     CCB/GSD   Pagelets    VBN      Window    Refcnt  Flink Blink   Flags
-------- -------- -----------------   --------  --------  --------  --------  -------- ----- -----  --------------------
00000001 81409FD8 FFFFFFFF.83384000   00000000  00000025  00000003  81419E40  00000003  0000  0000  AMOD=KRNL

00000002 81409FB0 FFFFFFFF.833AE000   00000000  00000064  00000220  8141A040  00000007  0000  0000  AMOD=KRNL

00000003 81409F88 FFFFFFFF.83312000   00000000  00000001  0000063A  81450BC0  00000001  0000  0000  CRF WRT AMOD=KRNL

00000004 81409F60 FFFFFFFF.833C0000   00000000  00000003  00000003  814233C0  00000001  0000  0000  AMOD=KRNL

00000005 81409F38 FFFFFEFE.00058890   82065C70  00000002  0000000D  814F9AC0  00000003  0005  0005  WRTMOD=EXEC AMOD=USER PERM
  Name = INS$82065BC0_003                                                                           SYSGBL
  File = DISK$X97D_R2Y:[VMS$COMMON.SYSLIB]DECW$TRANSPORT_COMMON.EXE;1

00000006 81409F10 FFFFFFFF.833E6000   00000000  00000011  00000023  8142E480  00000002  0000  0000  AMOD=KRNL

00000007 81409EE8 FFFFFEFE.00052010   82025CA0  0000000C  00000004  814C0600  00000000  0007  0007  WRTMOD=EXEC AMOD=USER PERM
  File = DISK$X97D_R2Y:[VMS$COMMON.SYSLIB]SYS$SSISHR.EXE;1                                          SYSGBL

00000008 81409EC0 FFFFFFFF.83400000   00000000  000000B4  00000003  81446340  0000000C  0000  0000  AMOD=KRNL

00000009 81409E98 FFFFFFFF.83418000   00000000  00000038  000000B7  81446340  00000001  0000  0000  CRF WRT AMOD=KRNL

0000000A 81409E70 FFFFFEFE.00052028   820261B0  00000027  00000019  814C0AC0  00000003  000A  000A  WRTMOD=EXEC AMOD=USER PERM
  Name = INS$82026130_006                                                                           SYSGBL
  File = DISK$X97D_R2Y:[VMS$COMMON.SYSLIB]DISMNTSHR.EXE;1

0000000B 81409E48 FFFFFEFE.00052050   82026630  0000007A  00000004  814C0D00  00000008  000B  000B  WRTMOD=EXEC AMOD=USER PERM
  Name = INS$82026540_002                                                                           SYSGBL
  File = DISK$X97D_R2Y:[VMS$COMMON.SYSLIB]DTI$SHARE.EXE;1

.
.
.
```

VM-0750A-AI

SHOW GLOCK

Displays the Galaxy locks for the Galaxy Management Database (GMDB), process tables, and/or system tables.

Format

```
SHOW GLOCK   [/BRIEF]
             [/GMDB_TABLE]
             [/PROCESS_TABLE [=n]]
             [/SYSTEM_TABLE [=n]]
             [/ALL]
             [/ADDRESS=n [/PHYSICAL]]
             [/HANDLE=n [/LINKED]]
```

Parameters

None.

Qualifiers

/BRIEF
Displays a single line for each Galaxy lock, regardless of any other qualifiers.

/GMDB_TABLE
Displays the Galaxy lock table for the Galaxy Management Database (GMDB) including the embedded and attached Galaxy locks.

/PROCESS_TABLE [=*n*]
Displays all the process Galaxy lock tables with the embedded and attached Galaxy locks, as well as a summary table. The /PROCESS_TABLE=*n* qualifier displays the single Galaxy lock table without a summary page.

/SYSTEM_TABLE [=*n*]
Displays all the system Galaxy lock tables with the embedded and attached Galaxy locks, as well as a summary table. The /SYSTEM_TABLE=*n* qualifier displays the single Galaxy lock table without a summary page.

/ALL
Displays information provided by the /GMDB_TABLE, /PROCESS_TABLE, and /SYSTEM_TABLE qualifiers. The /ALL qualifier also displays information from the base GMDB Galaxy lock.

/ADDRESS=*n* [/PHYSICAL]
Displays the single Galaxy lock at address *n*. Because process Galaxy locks are located by their physical address, you must use the /PHYSICAL qualifier to enter such an address.

/HANDLE=*n* [/LINKED]
Displays the single Galaxy lock whose handle is *n*. The optional qualifier /LINKED causes SDA to display all Galaxy locks linked to the one specified.

Examples

1. SDA> SHOW GLOCK

```
Galaxy Lock Database
--------------------

Base address of GLock segment of GMDB:      FFFFFFFF.7F238000
Length:                                     00000000.00082000

  Nodes:                 00000000.00000007   Flags:          00000000.00000000

Process tables:          00000000.00000400   System tables:  00000000.00000400
  First free:                     00000002                            00000001
  First used:                     00000001                            00000000

Embedded GLocks:

GLock address:           FFFFFFFF.7F238020   Handle:         80000000.00000805

  GLock name:            GMDB_GLOCK_LOCK     Flags:                         00
  Owner count:                          00   Owner node:                    00
  Node sequence:                      0000   Owner:                     000000
  IPL:                                  08   Previous IPL:                  00
  Wait bitmask:          00000000.00000000   Timeout:                 00000000
  Thread ID:             00000000.00000000

GLock address:           FFFFFFFF.7F238190   Handle:         80000000.00000833

  GLock name:            PRC_LCKTBL_LOCK     Flags:                         00
  Owner count:                          00   Owner node:                    00
  Node sequence:                      0000   Owner:                     000000
  IPL:                                  08   Previous IPL:                  00
  Wait bitmask:          00000000.00000000   Timeout:                 00000000
  Thread ID:             00000000.00000000

GLock address:           FFFFFFFF.7F2381D0   Handle:         80000000.0000083B

  GLock name:            SYS_LCKTBL_LOCK     Flags:                         00
  Owner count:                          00   Owner node:                    00
  Node sequence:                      0000   Owner:                     000000
  IPL:                                  08   Previous IPL:                  00
  Wait bitmask:          00000000.00000000   Timeout:                 00000000
  Thread ID:             00000000.00000000
```

This example shows the summary of the Galaxy lock database.

2. SDA> SHOW GLOCK/PROCESS_TABLE

```
Galaxy Lock Database: Process Lock Table #0001
----------------------------------------------

Base address of Process Lock Table #0001:   FFFFFFFF.7F23A000

  Lock size:                          0040   Flags:                         01  VALID
  Region Index/Sequence:     0008/00000001   Access mode:                   03
  Region physical size:  00000000.00002000   Virtual size:   00000000.00002000
  Number of locks:       00000000.00000080   Nodes:          00000000.00000007

Per-node reference counts:

    Node   Count
    ----   -----
    0000    0001
    0001    0001
    0002    0001

Embedded GLock:

GLock address:           FFFFFFFF.7F23A040   Handle:         80000000.00000C09
```

```
  GLock name:            PLCKTBL_LOCK001     Flags:                         00
  Owner count:                        00     Owner node:                    00
  Node sequence:                    0000     Owner:                     000000
  IPL:                                00     Previous IPL:                  00
  Wait bitmask:        00000000.00000000     Timeout:                 00000000
  Thread ID:           00000000.00000000

Attached GLocks:

GLock address:        P00000000.C05EC7C0   Handle:        00000001.000000F9

  GLock name:            CPU_BAL_LOCK        Flags:                         00
  Owner count:                        00     Owner node:                    00
  Node sequence:                    0000     Owner:                     000000
  IPL:                                00     Previous IPL:                  00
  Wait bitmask:        00000000.00000000     Timeout:                 00000000
  Thread ID:           00000000.00000000

   .
   .
   .

GLock address:        P00000000.C05EC000   Handle:        00000001.00000001

  GLock name:            CPU_BAL_LOCK        Flags:                         00
  Owner count:                        00     Owner node:                    00
  Node sequence:                    0000     Owner:                     000000
  IPL:                                00     Previous IPL:                  00
  Wait bitmask:        00000000.00000000     Timeout:                 00000000
  Thread ID:           00000000.00000000

Used GLock count = 0020

Free GLock count = 0060

Galaxy Lock Database: Process Lock Table Summary
------------------------------------------------

Total used Process Lock Tables:             00000001
Total free Process Lock Tables:             000003FF
```

This example shows the Galaxy locks for all processes.

SHOW GMDB

Displays the contents of the Galaxy Management Database (GMDB) and/or the node blocks of the instances in the Galaxy system.

Format

SHOW GMDB [/ALL]
[/NODE [=*name*|=n|/ADDRESS=*n*] [/SUMMARY]

Parameters

None.

Qualifiers

/ADDRESS
Specifies the address of a single node block to be displayed when used with the /NODE qualifier. See the description of the /NODE qualifier.

/ALL
Displays the contents of the Galaxy Management Database and all node blocks that have ever been used (contents nonzero).

/NODE [=*name*|=*n*|/ADDRESS=*n*]
Displays the contents of the specified node block, given by either the name of the instance, the partition number, or the address of the node block. If the /NODE qualifier is given alone, then the node block for the current instance is displayed.

/SUMMARY
Displays a one-page summary of the GMDB and all node blocks.

Note

The default action displays the contents of the Galaxy Management Database.

Examples

```
1. SDA> SHOW GMDB

Galaxy Management Database
-------------------------

Base address of GMDB:                         FFFFFFFF.7F234000
Base address of NODEB for this instance:      FFFFFFFF.7F236000

  Revision:                          1.0   Maximum node ID:         00000003
  Creation time:   31-MAR-1999 13:15:08.08  Incarnation:    00000000.00000003
  State:                     OPERATIONAL   Creator node:            00000001
  Base size:           00000000.00004000   Total size:     00000000.000A6000
  Last joiner ID:               00000002   Remover node ID:         FFFFFFFF
  Last leaver ID:               00000002   Node timeout (msec)         5000.
  Lock owner                    00000002   Lock flags:                  0000
  Break owner:                  FFFFFFFF   Breaker ID:              FFFFFFFF

Version Information:

  Min Version Operational            1.0   Min Version Allowed          1.0
  Max Version Operational            1.0

Membership bitmask:      FFFFFFFF.7F236800
```

```
  Valid bits:                  00000004   State:         00000000.0000001E  AUTO_LOCK TIMEOUT_CRASH....
  Unit count:                      0001   Unit size:              QUADWORD
  Lock IPL:                          16   Saved IPL:              00000008
  Count of bits set:           00000003
  Timeout count:               000186A0
  Summary bitmask:    00000000.00000001

  Unit bitmask:
       ........ ........ ........ .......7   00000000

Remove node bitmask:     FFFFFFFF.7F236880

  Valid bits:                  00000004   State:         00000000.00000018  SUMMARY_BITS SET_COUNT
  Unit count:                      0001   Unit size:              QUADWORD
  Count of bits set:           00000000
  Summary bitmask:    00000000.00000000

  Unit bitmask:
       ........ ........ ........ .......0   00000000

Subfacility validation flags:     00000000

  Galaxy locks segment:  FFFFFFFF.7F238000   Length:        00000000.00082000
  Shared memory segment: FFFFFFFF.7F2BA000   Length:        00000000.0000A000
  CPU comms segment:     FFFFFFFF.7F2C4000   Length:        00000000.00014000
  CPU info segment:      FFFFFFFF.7F2D8000   Length:        00000000.00002000
  Membership segment:    FFFFFFFF.7F2DA000   Length:        (empty)

MMAP address:            FFFFFFFF.7F234200

  Level count:                     0000   Flags:                      0001  VALID
  Top page count:              00000053   Virtual size:   00000000.000A6000
  PFN list page count:         00000000   First PFN:              00060000
  Data page count:             00000053)
```

This example shows the overall summary of the Galaxy Management Database.

```
 2. SDA> SHOW GMDB/NODE=0

GMDB: Node ID 00000000 (current instance)
-----------------------------------------

Base address of node block:              FFFFFFFF.7F236000

  Version:                          1.0   Node name:                ANDA1A
  Join time:       31-MAR-1999 14:11:09.08  Incarnation:    00000000.00000005
  State:                         MEMBER   Crash_all acknowledge:   00000000
  Validation done:             00000000   Reform done:             00000000

  IP interrupt mask:     00000000.00000000

Little brother:                00000002   Heartbeat:      00000000.0019EAD1
Big brother:                   00000001   Last watched_node:       00000000

  Watched_node #0:       FFFFFFFF.7F236078   Node watched:            00000002
  Last heartbeat:        00000000.0017C1AD   Miss count:              00000000)
```

This example shows Galaxy Management Database information for the specified instance.

SHOW GSD

Displays information contained in the global section descriptors.

Format

SHOW GSD [/ADDRESS=*n* | /ALL | /DELETED | /GLXGRP
| /GLXSYS | /GROUP | /SYSTEM]

Parameters

None.

Qualifiers

/ADDRESS=*n*
Displays a specific global section descriptor entry, given its address.

/ALL
Displays information in all the global section descriptors, that is, the system, group, and deleted global section descriptors, plus the Galaxy group and Galaxy system global section descriptors, if the system or dump being analyzed is a member of an OpenVMS Galaxy system. This qualifier is the default.

/DELETED
Displays information in the deleted (that is, delete pending) global section descriptors.

/GLXGRP
Displays information in the group global section descriptors of a Galaxy system.

/GLXSYS
Displays information in the system global section descriptors of a Galaxy system.

/GROUP
Displays information in the group global section descriptors.

/SYSTEM
Displays information in the system global section descriptors.

Description

The SHOW GSD command displays information that resides in the global section descriptors. Table 4–4 shows the fields and their meaning.

Table 4–4 GSD Fields

Field	Meaning
ADDRESS	Gives the address of the global section descriptor.
NAME	Gives the name of the global section.
GSTX	Gives the global section table index.
FLAGS	Gives the settings of flags for specified global section, as a hexadecimal number; also displays key flag bits by name.
BASEPFN[1]	Gives physical page frame number at which the section starts.
PAGES[1]	Gives number of pages (not pagelets) in section.
REFCNT[1]	Gives number of times this global section is mapped.

[1]This field applies only to PFN mapped global sections.

Example

```
SDA > SHOW GSD

System Global Section Descriptor List
--------------------------------------                                     -----------PFNMAP----------

ADDRESS    NAME          GSTX    FLAGS                                      BASEPFN    PAGES     REFCNT

817DAF30   SECIDX_422    02DD    0082C3C9   WRT AMOD=USER PERM
817DAE60   SECIDX_421    02DC    008A83CD   DZRO WRT AMOD=USER PAGFIL
817DAD90   SECDIX_420    02DB    0088C3CD   DZRO WRT AMOD=USER PERM PAGFIL
817DACC0   SECDIX_419    02DA    008883DC   DZRO WRT AMOD=USER PAGFIL
817DABE0   SECIDX_418    0000    0001C3C1   AMOD=USER PERM                  00000B0B   00000002  00000000
817DAB00   SECIDX_417    0000    0001C3C1   AMOD=USER PERM                  00000B0B   00000002  00000000
817DA890   SECIDX_412    02D6    0080C3CD   DZRO WRT AMOD=USER PERM
817DA850   SECIDX_411    02D5    008083CD   DZRO WRT AMOD=USER
       .
       .
       .
```

ZK-8830A-GE

SHOW HEADER

Displays the header of the dump file.

Format

SHOW HEADER

Parameters

None.

Qualifiers

None.

Description

The SHOW HEADER command produces a 10-column display, each line of which displays both the hexadecimal and ASCII representation of the contents of the dump file header in 32-byte intervals. Thus, the first eight columns, when read right to left, represent the hexadecimal contents of 32 bytes of the header; the ninth column, when read left to right, records the ASCII equivalent of the contents. (The period [.] in this column indicates an ASCII character that cannot be displayed.)

After it displays the contents of the header blocks, the SHOW HEADER command displays the hexadecimal contents of the saved error log buffers.

See the *OpenVMS AXP Internals and Data Structures* manual for a discussion of the information contained in the dump file header. See also the SHOW DUMP and CLUE ERRLOG commands, which you can use to obtain formatted displays of the dump header and error log buffers.

Example

```
SDA> SHOW HEADER

Dump file header
----------------
00000000 7FFA6000 00000000 7FFA1C98 00000000 0000187C 08090FC1 00000004  ....Á...|.........ú......‘ú.....     00000000
00001FFF 0000000D 00002000 80D0A000 00000000 7AFFBAD0 00000000 7FFAC100  .Áú.....Ðº.z......Ð.............     00000020
0000B162 00000000 00000001 00000000 00040704 FCFFFFFF 03000000 80C13670  p6Á........ü................b±..     00000040
00000000 00000400 00000008 00000000 3154462D 31393658 00000011 00000000  ........X691-FT1................     00000060
00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  ................................     00000080
00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  ................................     000000A0
FF7FC000 FFFFFFFD FF000000 80C220F0 00000000 00000000 00000000 00000000  ............ð Â.....ý....À......     000000C0
.
.
.

Saved error log messages
------------------------
0004FFF9 0000040B 00000001 00000000 00000070 80D0B000 80D0A00C 00000000  ......Ð..°Ð.p.......ù...........     80D0A000
B4510020 60030000 00000000 00000020 20585443 50575308 00000000 00020000  .........SWPCTX  ......‘ .Q´....     80D0A020
30303320 43454412 00000002 00000000 3154462D 31393658 0000009A 2C31075A  Z.1,....X691-FT1.........DEC 300     80D0A040
000000AA 59EC7C0A 00000000 00000000 00000000 00303034 206C6564 6F4D2030  0 Model 400.............|ìYª...     80D0A060
20585443 50575308 00000000 00020000 0004FFF9 0000040B 00000001 00000000  ............ù............SWPCTX      80D0A080
3154462D 31393658 0001009A 2C3107FD 1DDB0040 60030000 00000000 00000020   ..........‘@.Û.ý.1,....X691-FT1     80D0A0A0
00000000 00303034 206C6564 6F4D2030 30303320 43454412 00000003 00000000  .........DEC 3000 Model 400.....     80D0A0C0
4B442458 54435057 530A0064 000001AB 00000000 00010001 00000000 00000000  ................«...d..SWPCTX$DK     80D0A0E0
.
.                                                                                                                   ZK-8861A-GE
.
```

The SHOW HEADER command displays the contents of the dump file's header. Ellipses indicate hexadecimal information omitted from the display.

SHOW LAN

Displays information contained in various local area network (LAN) data structures.

Format

SHOW LAN [/qualifier[,...]]

Parameters

None.

Qualifiers

/CLIENT=*name*
Specifies that information be displayed for the specified client. Valid client designators are SCA, DECNET, LAT, MOPRC, TCPIP, DIAG, ELN, BIOS, LAST, USER, ARP, MOPDL, LOOP, BRIDGE, DNAME, ENCRY, DTIME, and LTM. The /CLIENT, /DEVICE, and /UNIT qualifiers are synonymous and mutually exclusive.

/CLUEXIT
Specifies that cluster protocol information be displayed.

/COUNTERS
Specifies that the LAN station block (LSB) and unit control block (UCB) counters be displayed.

/CSMACD
Specifies that Carrier Sense Multiple Access with Collision Detect (CSMA/CD) information for the LAN be displayed. By default, both CSMA/CD and Fiber Distributed Data Interface (FDDI) information is displayed.

/DEVICE=*name*
Specifies that information be displayed for the specified device, unit, or client. For each LAN adapter on the system, there is one **device** and multiple users of that device called, **units** or **clients**. Device designators are specified in the format **XXdn**, where **XX** is the type of device, **d** is the device letter, and **n** is the unit number. The device letter and unit number are optional. The first unit, which is always present, is the template unit. These are specified as indicated in this example for a DEMNA called EX:

/DEVICE=EX—display all EX devices on the system
/DEVICE=EXA—display the first EX device only
/DEVICE=EXA0—display the first EXA unit
/DEVICE=SCA—display SCA unit
/DEVICE=LAT—display LAT units

Valid client names are listed in the /CLIENT=*name* qualifier. The /CLIENT, /DEVICE, and /UNIT qualifiers are synonymous and mutually exclusive.

/ELAN
Specifies information from an Emulated LAN (ELAN) that runs over an asynchronous transfer mode (ATM) network. The /ELAN qualifier displays the LAN Station Block (LSB) address, device state, and the LSB fields pertinent

to an ELAN for both the parent ATM device and the ELAN pseudo-device drivers. It also specifies the name, description, parent device, state, and LAN emulation client (LEC) attributes of the ELAN.

The qualifier /ELAN used with the device qualifier (/ELAN/DEVICE=ELA) will only display information for the specified device or pseudo-device.

/ERRORS
Specifies that the LSB and UCB error counters be displayed.

/FDDI
Specifies that Fiber Distributed Data Interface (FDDI) information for the LAN be displayed. By default, both CSMA/CD and FDDI information is displayed.

/FULL
Specifies that all information from the LAN, LSB, and UCB data structures be displayed.

/COUNTERS
Specifies internal counters of the drivers by displaying the internal counters. If the /ICOUNTERS qualifier is used with the /DEVICE qualifier, the /ICOUNTERS specifies the internal counters of a specific driver.

/QUEUE
Specifies a listing of all queues, whether their status is valid or invalid, and all elements of the queues. If the /QUEUE qualifier is used with the /DEVICE qualifier, the /QUEUE specifies a specific queue.

/SUMMARY
Specifies that only a summary of LAN information (a list of flags, LSBs, UCBs, and base addresses) be printed. This is the default.

/TIMESTAMPS
Specifies that time information (such as start and stop times and error times) from the device and unit data structures be printed. SDA displays the data in chronological order.

/UNIT=*name*
Specifies that information be displayed for the specified unit. See the descriptions for /CLIENT=*name* and /DEVICE=*name* qualifiers.

/VCI
Specifies that information be displayed for the VMS Communication Interface Block (VCIB) for each LAN device with an active VCI user. If you use the /VCI qualifier with the /DEVICE qualifier, the VCIB is only displayed for the specified device.

Description

The SHOW LAN command displays information contained in various local area network (LAN) data structures. By default, or when the /SUMMARY qualifier is specified, SHOW LAN displays a list of flags, LSBs, UCBs, and base addresses. When the /FULL qualifier is specified, SHOW LAN displays all information found in the LAN, LSB, and UCB data structures.

Examples

1. SDA> SHOW LAN/FULL

```
LAN Data Structures
-------------------
               -- LAN Information Summary 23-MAY-1996 13:07:52 --

LAN flags:  00000004 LAN_INIT

LAN block address          80DB7140    Timer DELTA time            10000000
Number of stations                2    DAT sequence number                1
LAN module version                1    First SVAPTE                FFDF60F0
LANIDEF version                  51    Number of PTEs                     3
LANUDEF version                  26    SVA of first page           8183C000
First LSB address          80DCA980

            -- LAN CSMACD Network Management 23-MAY-1996 13:07:52 --

Creation time                  None    Times created                      0
Deletion time                  None    Times deleted                      0
Module EAB                 00000000    Latest EIB                  00000000
Port EAB                   00000000
Station EAB                00000000
NM flags:  00000000

             -- LAN FDDI Network Management 23-MAY-1996 13:07:52 --

Creation time                  None    Times created                      0
Deletion time                  None    Times deleted                      0
Module EAB                 00000000    Link EAB                    00000000
Port EAB                   00000000    PHY port EAB                00000000
Station EAB                00000000    Module EIB                  00000000
NM flags:  00000000

LAN Data Structures
-------------------
               -- ESA Device Information 23-MAY-1996 13:07:52 --

LSB address                80DCA980    Driver code address         80CAE838
Driver version    00000001.07010037    Device1 code address        00000000
Device1 version   00000000.00000000    Device2 code address        00000000
Device2 version   00000000.00000000    LAN code address            80CAFA00
LAN version       00000001.07010112    DLL type                      CSMACD
Device name                 EY_NITC2   MOP name                         MXE
MOP ID                           94    HW serial               Not supplied
HW version                 00000000    Promiscuous mode                 OFF
Controller mode              NORMAL    Promiscuous UCB             00000000
Internal loopback               OFF    All multicast state              OFF
Hardware address  08-00-03-DE-00-12    CRC generation mode               ON
Physical address  AA-00-04-00-88-FE    Full Duplex Enable               OFF
Active unit count                 1    Full Duplex State                OFF
Line speed                       10

Flags:  00000000
Char:   00000000
Status: 00000003 RUN,INITED
```

```
LAN Data Structures
-------------------
            -- ESA Device Information (cont) 23-MAY-1996 13:07:52 --

Put rcv ptr/index          00000000    Get rcv ptr/index          00000015
Put xmt ptr/index          80DCB620    Get xmt ptr/index          80DCB620
Put cmd ptr/index          00000000    Get cmd ptr/index          00000000
Put uns ptr/index          00000000    Get uns ptr/index          00000000
Put smt ptr/index          00000000    Get smt ptr/index          00000000
RBufs owned by dev                0    Rcv packet limit                 32
XEnts owned by dev                0    XEnts owned by host               4
CEnts owned by dev                0    Transmit timer                    0
UEnts owned by dev                0    Control timer                     0
SEnts owned by dev                0    Periodic SYSID timer            599
Current rcv buffers              17    Ring unavail timer                0
Rqst MAX rcv buffers             32    USB timer                        26
Rqst MIN rcv buffers             16    Receive alignment                 0
Curr MAX rcv buffers             32    Receive buffer size            1518
Curr MIN rcv buffers             16    Min 1st chain segment             0
FILL rcv buffers                 16    Min transmit length               0
ADD  rcv buffers                 32    Dev xmt header size               0

LAN Data Structures
-------------------

            -- ESA Device Information (cont) 23-MAY-1996 13:07:52 --

Last receive        23-MAY 13:07:51    Last transmit       23-MAY 13:07:50
ADP address                80D4B280    IDB address                80DCA880
DAT stage                  00000000    DAT xmt status    0000003C.003C0001
DAT number started                1    DAT xmt complete    23-MAY 13:07:19
DAT number failed                 0    DAT rcv found                  None
DAT VCRP                   80DCBB80    DAT UCB                    00000000
Mailbox enable flag               0    CRAM read comman           00000000
CSR base phys addr 00000000.00000000   CRAM write comma           00000000
Mailboxes in use                  0    Media                          UNDF
2nd LW status flags        00000000

LAN Data Structures
-------------------
         -- ESA Network Management Information 23-MAY-1996 13:07:52 --

Creation time                  None    Create count                      0
Deletion time                  None    Enable count                      0
Enabled time                   None    Number of ports                   0
Disabled time                  None    Events logged                     0
EIB address                00000000    NMgmt assigned addr            None
LLB address                00000000    Station name itmlst        00000000
LHB address                00000000    Station itmlst len                0
First LPB address          00000000

LAN Data Structures
-------------------
                -- ESA Fork Information 23-MAY-1996 13:07:52 --

ISR   FKB sched     23-MAY 13:07:51    ISR   FKB in use flag          FREE
ISR   FKB time      23-MAY 13:07:51    ISR   FKB count                 200
IPL8  FKB sched     23-MAY 13:07:20    IPL8  FKB in use flag          FREE
IPL8  FKB time      23-MAY 13:07:20    IPL8  FKB count                   1
RESET FKB sched                None    RESET FKB in use flag          FREE
RESET FKB time                 None    RESET FKB count                   0
NM    FKB sched                None    NM    FKB in use flag          FREE
NM    FKB time                 None    NM    FKB count                   0
Fork status code                  0
```

```
LAN Data Structures
-------------------
                -- ESA Queue Information 23-MAY-1996 13:07:52 --
Control hold queue      80DCACF0  Status:  Valid, empty
Control request queue   80DCACF8  Status:  Valid, empty
Control pending queue   80DCAD00  Status:  Valid, empty
Transmit request queue  80DCACE8  Status:  Valid, empty
Transmit pending queue  80DCAD18  Status:  Valid, empty
Receive buffer list     80DCAD38  Status:  Valid, 17 elements
Receive pending queue   80DCAD20  Status:  Valid, empty
Post process queue      80DCAD08  Status:  Valid, empty
Delay queue             80DCAD10  Status:  Valid, empty
Auto restart queue      80DCAD28  Status:  Valid, empty
Netwrk mgmt hold queue  80DCAD30  Status:  Valid, empty

          -- ESA Multicast Address Information 23-MAY-1996 13:07:52 --

AB-00-00-04-00-00

                  -- ESA Unit Summary 23-MAY-1996 13:07:52 --

UCB      UCB Addr  Fmt   Value          Client    State
---      --------  ---   -----          ------  -----------
ESA0     80D4F6C0
ESA1     80E35400  Eth   60-03          DECNET  0017 STRTN,LEN,UNIQ,STRTD

LAN Data Structures
-------------------
              -- ESA Counters Information 23-MAY-1996 13:07:52 --

Octets received               596   Octets sent                     230
PDUs received                   8   PDUs sent                         5
Mcast octets received         596   Mcast octets sent               138
Mcast PDUs received             8   Mcast PDUs sent                   3
Unrec indiv dest PDUs           0   PDUs sent, deferred               0
Unrec mcast dest PDUs           1   PDUs sent, one coll               0
Data overruns                   0   PDUs sent, mul coll               0
Unavail station buffs           0   Excessive collisions              0
Unavail user buffers            0   Late collisions                   0
CRC errors                      0   Carrier check failure             0
Alignment errors                0   Last carrier failure           None
Rcv data length err             0   Coll detect chk fail              5
Frame size errors               0   Short circuit failure             0
Frames too long                 0   Open circuit failure              0
Seconds since zeroed           34   Transmits too long                0
Station failures                0   Send data length err              0
```

```
LAN Data Structures
-------------------
           -- ESA Counters Information (cont) 23-MAY-1996 13:07:52 --

No work transmits                0    Ring avail transitions          0
Buffer_Addr transmits            0    Ring unavail transitions        0
SVAPTE/BOFF transmits            0    Loopback sent                   0
Global page transmits            0    System ID sent                  0
Bad PTE transmits                0    ReqCounters sent                0
Restart pending counter          0    Internal counters size         40
+00 MCA not enabled            187    +2C Generic (or unused)  00000000
+04 Xmt underflows               0    +30 Generic (or unused)  00000000
+08 Rcv overflows                0    +34 Generic (or unused)  00000000
+0C Memory errors                0    +38 Generic (or unused)  80DCAD18
+10 Babbling errors              0    +3C Generic (or unused)  80DCAD18
+14 Local buffer errors          0    +40 Generic (or unused)  004E0840
+18 LANCE interrupts           202    +44 Generic (or unused)  61616161
+1C Xmt ring <31:0>       00000000    +48 Generic (or unused)  61616161
+20 Xmt ring <63:32>      00000000    +4C Generic (or unused)  61616161
+24 Soft errors handled          0    +50 Generic (or unused)  61616161
+28 Generic (or unused)   00000000    +54 Generic (or unused)  61616161

LAN Data Structures
-------------------
                -- ESA Error Information 23-MAY-1996 13:07:52 --

Fatal error count                0    Last error CSR           00000000
Fatal error code              None    Last fatal error             None
Prev  error code              None    Prev fatal error             None
Transmit timeouts                0    Last USB time                None
Control timeouts                 0    Last UUB time                None
Restart failures                 0    Last CRC time                None
Power failures                   0    Last CRC srcadr              None
Bad PTE transmits                0    Last length erro             None
Loopback failures                0    Last exc collisi             None
System ID failures               0    Last carrier fai             None
ReqCounters failures             0    Last late collis             None

LAN Data Structures
-------------------
             -- ESA0 Template Unit Information 23-MAY-1996 13:07:52 --

LSB address               80DCA980    Error count                     0
VCIB address              00000000    Parameter mask           00000000
Stop IRP address          00000000    Promiscuous mode              OFF
Restart IRP address       00000000    All multicast mode            OFF
LAN medium                  CSMACD    Source Routing mode   TRANSPARENT
Packet format             Ethernet    Access mode             EXCLUSIVE
Eth protocol type            00-00    Shared user DES              None
802E protocol ID    00-00-00-00-00    Padding mode                   ON
802.2 SAP                       00    Automatic restart        DISABLED
802.2 Group SAPs       00,00,00,00    Allow prom client              ON
Controller mode             NORMAL    Can change address            OFF
Internal loopback              OFF    802.2 service                User
CRC generation mode             ON    Rcv buffers to save             1
Functional Addr mod             ON    Minimum rcv buffers             4
Hardware address 08-00-03-DE-00-12    User transmit FC/AC            ON
Physical address FF-FF-FF-FF-FF-FF    User receive FC/AC            OFF
```

```
LAN Data Structures
-------------------
         -- ESA1 60-03 (DECNET) Unit Information 23-MAY-1996 13:07:52 --

LSB address                80DCA980    Error count                        0
VCIB address               00000000    Parameter mask              00DA8695
Stop IRP address           80E047C0    Promiscuous mode                 OFF
Restart IRP address        00000000    All multicast mode               OFF
LAN medium                   CSMACD    Source Routing mode      TRANSPARENT
Packet format              Ethernet    Access mode                EXCLUSIVE
Eth protocol type             60-03    Shared user DES                 None
802E protocol ID     00-00-00-00-00    Padding mode                      ON
802.2 SAP                        00    Automatic restart           DISABLED
802.2 Group SAPs        00,00,00,00    Allow prom client                 ON
Controller mode              NORMAL    Can change address               OFF
Internal loopback               OFF    802.2 service                   User
CRC generation mode              ON    Rcv buffers to save               10
Functional Addr mod              ON    Minimum rcv buffers                4
Hardware address  08-00-03-DE-00-12    User transmit FC/AC               ON
Physical address  AA-00-04-00-88-FE    User receive FC/AC               OFF

LAN Data Structures
-------------------
     -- ESA1 60-03 (DECNET) Unit Information (cont) 23-MAY-1996 13:07:52 --

Last receive        23-MAY 13:07:47    Starter's PID               0001000F
Last transmit       23-MAY 13:07:50    Maximum header size               16
Last start attempt  23-MAY 13:07:20    Maximum buffer size             1498
Last start done     23-MAY 13:07:20    Rcv quota charged              15040
Last start failed              None    Default FC value                  00
MCA match enabled                01    Default AC value                  00
Last MCA filtered AB-00-00-04-00-00    Maintenance state                 ON

UCB status:  00000017 STRTN,LEN,UNIQ,STRTD

Receive IRP queue      80E356E8  Status:  Valid, 1 element
Receive pending queue   80E356E0  Status:  Valid, empty

Multicast address table, embedded:
  AB-00-00-04-00-00

LAN Data Structures
-------------------
        -- ESA1 60-03 (DECNET) Counters Information 23-MAY-1996 13:07:52 --

Octets received                 483    Octets sent                      180
PDUs received                     7    PDUs sent                          3
Mcast octets received           483    Mcast octets sent                180
Mcast PDUs received               7    Mcast PDUs sent                    3
Unavail user buffer               0    Multicast not enabled              0
Last UUB time                  None    User buffer too small              0
```

The SHOW LAN/FULL command displays information for all LAN, LSB, and UCB data structures.

2. SDA> SHOW LAN/TIME

```
              -- LAN History Information 12-FEB-1995 11:08:48 --

12-FEB 11:08:47.92  ESA                Last receive
12-FEB 11:08:47.92  ESA                Last fork scheduled
12-FEB 11:08:47.92  ESA                Last fork time
12-FEB 11:08:47.77  ESA5     LAST      Last receive
12-FEB 11:08:47.72  ESA3     LAT       Last receive
12-FEB 11:08:41.25  ESA                Last transmit
12-FEB 11:08:41.25  ESA5     LAST      Last transmit
12-FEB 11:08:40.02  ESA2     DECnet    Last receive
12-FEB 11:08:39.14  ESA2     DECnet    Last transmit
12-FEB 11:08:37.39  ESA3     LAT       Last transmit
12-FEB 10:19:25.31  ESA                Last unavail user buffer
12-FEB 10:19:25.31  ESA2     DECnet    Last unavail user buffer
11-FEB 14:10:20.09  ESA5     LAST      Last start completed
11-FEB 14:10:02.16  ESA3     LAT       Last start completed
11-FEB 14:09:58.44  ESA2     DECnet    Last start completed
11-FEB 14:09:57.44  ESA                Last DAT transmit
```

The SHOW LAN/TIME command displays print time information from device and unit data structures.

3. SDA> SHOW LAN/VCI/DEVICE=ICB

```
              -- ICB VCI Information 17-APR-1996 14:22:07 --

LSB address  = 80A1D580
Device state = 00000003 RUN,INITED

        -- ICB2 80-41 (LAST) VCI Information 17-APR-1996 14:22:07 --

VCIB address =    8096F238
CLIENT flags:     00000001 RCV_DCB
LAN flags:        00000004 LAN_INIT
DLL flags:        00000005 XMT_CHAIN,PORT_STATUS
UCB status:       00000015 STRTN,UNIQ,STRTD

VCI ID                        LAST    VCI version              00010001
UCB address               80A4C5C0    DP VCRP address          00000000
Hardware address  00-00-93-08-52-CF    LDC address              80A1D720
Physical address  00-00-93-08-52-CF    LAN medium                     TR
Transmit available        80A1D670    Outstanding operations          0
Maximum receives                 0    Outstanding receives            0
Max xmt size                  4444    Header size                    52
Build header rtn          808BF230    Report event rtn         86327130
XMT initiate rtn          808BF200    Transmit complete rtn    86326D80
XMT frame rtn             808BF210    Receive complete rtn     86326A80

     -- ICB2 80-41 (LAST) VCI Information (cont) 17-APR-1996 14:22:07 --

Portmgmt initiate rtn     808BF0C0    Portmgmt complete rtn    86327100
Monitor request rtn       00000000    Monitor transmit rtn     00000000
Monitor flags             00000000    Monitor receive rtn      00000000
Port usable               00000000    Port unusable            00000000
```

The SHOW LAN/VCI/DEVICE=ICB command displays the VCIB for a Token Ring device (ICB) that has an active VCI user (LAST).

4. SDA> SHOW LAN/ELAN

```
        -- HCA Emulated LAN LSB Information 17-APR-1996 14:08:02 --

LSB address = 8098D200
Device state = 00000101 RUN,RING_AVAIL

Driver CM VC setup adr   808986A0   Driver CM VC teardown adr   80898668
NIPG CM handle adr       8096C30C   NIPG CM SVC handle          00000000
NIPG CM agent handle adr 809B364C   NIPG CM mgr lineup handle   809B394C
NIPG CM ILMI IO handle   809B378C   MIB II handle adr           809B94CC
MIB handle adr           809B3ACC   Queue header for EL LSBs    00000000
DEC MIB handle adr       809BBD8C   NIPG current TQEs used      00000000
Count of allocated TQEs  0000000D   NIPG current pool used      0000D2C0
NIPG pool allocations    00075730

        -- ELA Emulated LAN LSB Information 17-APR-1996 14:08:02 --

LSB address = 80AB08C0
Device state = 00000001 RUN

ELAN name = ELAN 1
ELAN description = ATM ELAN
ELAN parent = HCA0
ELAN state = 00000001 ACTIVE

MAX transmit size     MTU_1516        ELAN media type      LAN_802_3
LEC attr buff adr     80AB1FC0        LEC attr buff size    00000328
Event mask            00000000        PVC identifer         00000000
Extended sense        00000000

         -- ELA Emulated LAN LEC Attributes 17-APR-1996 14:08:02 --

LAN type          00000000         LAN MTU               00000001
Proxy flag        00000000         Control timeout       0000000A
Max UF count      00000001         Max UF time           00000001
VCC timeout       000004B0         Max retry count       00000002
LEC id            00000002         Forw delay time       0000000F
Flush timeout     00000004         Path switch delay     00000006
SM state          00000070         Illegal CTRL frames   00000000
CTRL xmt failures 00000000         CTRL frames sent      0000000C
CTRL frames_rcvd  00000012         LEARPs sent           00000000
LEARPS rcvd       00000000         UCASTs sent direct    00000000
UCASTs flooded    00000006         UCASTs discarded      00000001
NUCASTs sent      00000000
Local ESI         00000000.00000000
BUS ATM addr      399999000000000008002BA57E80.AA000302FF12.00
LES ATM addr      399999000000000008002BA57E80.AA000302FF14.00
My ATM addr       399999000000000008002BA57E80.08002B2240A0.00
```

The SHOW LAN/ELAN command displays information for the parent ATM device (HCA) driver and the ELAN pseudo-device (ELA) driver.

5. SDA> SHOW LAN/ELAN/DEV=ELA

```
        -- ELA Emulated LAN LSB Information 17-APR-1996 14:08:22 --

LSB address = 80AB08C0
Device state = 00000001 RUN

ELAN name = ELAN 1
ELAN description = ATM ELAN
ELAN parent = HCA0
ELAN state = 00000001 ACTIVE

MAX transmit size     MTU_1516          ELAN media type      LAN_802_3
LEC attr buff adr     80AB1FC0          LEC attr buff size    00000328
Event mask            00000000          PVC identifer         00000000
Extended sense        00000000

         -- ELA Emulated LAN LEC Attributes 17-APR-1996 14:08:22 --

LAN type             00000000          LAN MTU              00000001
Proxy flag           00000000          Control timeout      0000000A
Max UF count         00000001          Max UF time          00000001
VCC timeout          000004B0          Max retry count      00000002
LEC id               00000002          Forw delay time      0000000F
Flush timeout        00000004          Path switch delay    00000006
SM state             00000070          Illegal CTRL frames  00000000
CTRL xmt failures    00000000          CTRL frames sent     0000000C
CTRL frames_rcvd     00000012          LEARPs sent          00000000
LEARPS rcvd          00000000          UCASTs sent direct   00000000
UCASTs flooded       00000006          UCASTs discarded     00000001
NUCASTs sent         00000000
Local ESI            00000000.00000000
BUS ATM addr         39999990000000008002BA57E80.AA000302FF12.00
LES ATM addr         39999990000000008002BA57E80.AA000302FF14.00
My ATM addr          39999990000000008002BA57E80.08002B2240A0.00
```

The SHOW LAN/ELAN/DEVICE=ELA command displays information for the ELAN pseudo-device (ELA) driver only.

6. SDA> SHOW LAN/ELAN/DEVICE=HCA

```
       -- HCA Emulated LAN LSB Information 17-APR-1996 14:08:25 --

LSB address = 8098D200
Device state = 00000101 RUN,RING_AVAIL

Driver CM VC setup adr   808986A0    Driver CM VC teardown adr    80898668
NIPG CM handle adr       8096C30C    NIPG CM SVC handle           00000000
NIPG CM agent handle adr 809B364C    NIPG CM mgr lineup handle    809B394C
NIPG CM ILMI IO handle   809B378C    MIB II handle adr            809B94CC
MIB handle adr           809B3ACC    Queue header for EL LSBs     00000000
DEC MIB handle adr       809BBD8C    NIPG current TQEs used       00000000
Count of allocated TQEs  0000000D    NIPG current pool used       0000D2C0
NIPG pool allocations    000757B2
```

The SHOW LAN/ELAN/DEVICE=HCA command displays information for the ATM device (HCA) driver only.

SHOW LOCKS

Displays information about all lock management locks in the system, or about a specified lock.

Format

SHOW LOCKS {lock-id | /ADDRESS=*n* | /ALL (d) |
/BLOCKING | /BRIEF | /CACHED | /CONVERT | /GRANTED
| /NAME=*name* | /POOL |
/STATUS=(*keyword* [,*keyword...*]) | /SUMMARY |
/WAITING}

Parameter

lock-id
Name of a specific lock.

Qualifiers

/ADDRESS=n
Displays a specific lock, given the address of the lock block.

/ALL
Lists all locks that exist in the system. This is the default behavior of the SHOW LOCKS command.

/BLOCKING
Displays only the locks that have a blocking AST specified or attached.

/BRIEF
Displays a single line of information for each lock.

/CACHED
Displays locks that are no longer valid. The memory for these locks is saved so that later requests for locks can use them. Cached locks are not displayed in the other SHOW LOCKS commands.

/CONVERT
Displays only the locks that are on the conversion queue.

/GRANTED
Displays only the locks that are on the granted queue.

/NAME=*name*
Displays all locks on the specified resource. *Name* can be the actual name of the resource, if it only contains uppercase letters, numerals, the underscore (_), dollar sign, colon (:), and some other printable characters, as for example, /NAME=MY_LOCK. If it contains other printable characters (including lowercase letters), you may need to enclose the name in quotation marks (""), as for example, /NAME="My_Lock/47". If it contains nonprintable characters, you can specify the name as a comma-separated list comprised of strings and hexadecimal numbers. For example, /NAME=("My_Lock",0C00,"/47") would specify the name "My_Lock<NUL><FF>/47". The hexadecimal number can be no more than 8 digits (4 bytes) in length. Nonprintable sequences or more than 4 bytes must be split into

multiple hexadecimal numbers. The maximum length of a resource name is 32 characters.

/POOL
Displays the lock manager's poolzone information, which contains the lock blocks (LKB) and resource blocks (RSB).

/STATUS=(*keyword*[,*keyword*...])
Displays only the locks that have the specified status bits set in the LKB$L_STATUS field. Status keywords are as follows:

Keyword	Meaning
2PC_IP	Indicates a two-phase operation in progress
2PC_PEND	Indicates a two-phase operation pending
ASYNC	Completes request asynchronously
BLKASTFLG	Specifies a blocking AST
BLKASTQED	Indicates a blocking AST is queued
BRL	Indicates a byte range lock
CACHED	Indicates a lock block in cache
CVTSUBRNG	Indicates a sub-range convert request
CVTTOSYS	Converts back to system-owned lock
DBLKAST	Delivers a blocking AST
DCPLAST	Delivers a completion AST
DPC	Indicates a delete pending cache lock
FLOCK	Indicates a fork lock
GRSUBRNG	Grants sub-range lock
IP	Indicates operation in process
MSTCPY	Indicates a lock block is a master copy
NEWSUBRNG	Indicates a new sub-range request
NOQUOTA	Does not charge quota
PCACHED	Indicates lock block needs to be cached
PROTECT	Indicates a protected lock
RESEND	Resends during failover
RM_RBRQD	Requires remaster rebuild
RNGBLK	Specifies a range block
RNGCHG	Indicates a changing range
TIMOUTQ	Indicates lock block is on timeout queue
VALBLKRD	Indicates read access to lock value block
VALBLKWRT	Indicates write access to lock value block
WASSYSOWN	Indicates was system-owned lock

/SUMMARY
Displays summary data and performance counters.

/WAITING
Displays only the waiting locks.

Description

The SHOW LOCKS command displays the information described in Table 4–5 for each lock management lock in the system, or for the lock indicated by **lock-id**, an address or name. (Use the SHOW SPINLOCKS command to display information about spinlocks.) You can obtain a similar display for the locks owned by a specific process by issuing the appropriate SHOW PROCESS/LOCKS command. See the *OpenVMS Programming Concepts Manual* for additional information.

You can display information about the resource to which a lock is queued by issuing the SHOW RESOURCES command specifying the resource's **lock-id**.

Table 4–5 Contents of the SHOW LOCKS and SHOW PROCESS/LOCKS Displays

Display Element	Description
Process Index[1]	Index in the PCB array to a pointer to the process control block (PCB) of the process that owns the lock.
Name[1]	Name of the process that owns the lock.
Extended PID[1]	Clusterwide identification of the process that owns the lock.
Lock ID	Identification of the lock.
PID	Systemwide identification of the lock.
Flags	Information specified in the request for the lock.
Par. ID	Identification of the lock's parent lock.
Sublocks	Count of the locks that the lock owns.
LKB	Address of the lock block (LKB). If a blocking AST has been enabled for this lock, the notation "BLKAST" appears next to the LKB address.
Priority	The lock priority.
Granted at	Lock mode at which the lock was granted.
RSB	Address of the resource block.
Resource	Dump of the resource name. The two leftmost columns of the dump show its contents as hexadecimal values, the least significant byte being represented by the rightmost two digits. The rightmost column represents its contents as ASCII text, the least significant byte being represented by the leftmost character.
Status	Status of the lock, information used internally by the lock manager.
Length	Length of the resource name.
Mode	Processor access mode of the namespace in which the resource block (RSB) associated with the lock resides.

[1]This display element is produced only by the SHOW PROCESS/LOCKS command.

(continued on next page)

Table 4–5 (Cont.) Contents of the SHOW LOCKS and SHOW PROCESS/LOCKS Displays

Display Element	Description
Owner	Owner of the resource. Certain resources owned by the operating system list “System” as the owner. Resources owned by a group have the number (in octal) of the owning group in this field.
Copy	Indication of whether the lock is mastered on the local system or is a process copy.

Examples

1.
```
SDA>  SHOW LOCKS

Lock Database
-------------

Lock id:  3E000002           PID:    00000000   Flags: CONVERT NOQUEUE SYNCSTS
Par. id:  00000000           SUBLCKs:       0          NOQUOTA CVTSYS
LKB:      FFFFFFFF.7DF48150   BLKAST: 81107278
Priority:     0000

Granted at    CR   00000000-FFFFFFFF

RSB:                 FFFFFFFF.7DF68D50
Resource:            494D6224 42313146  F11B$bMI  Status: NOQUOTA VALBLKR VALBLKW
 Length   18         4D55445F 5944414C  LADY_DUM
 Kernel mode         00000000 00005350  PS......
 System              00000000 00000000  ........

Local copy

Lock Database
-------------

Lock id:  3F000003           PID:    00000000   Flags: VALBLK  CONVERT SYNCSTS
Par. id:  0100007A           SUBLCKs:       0          CVTSYS
LKB:      FFFFFFFF.7DF48250   BLKAST: 00000000
Priority:     0000

Granted at    NL   00000000-FFFFFFFF

RSB:                 FFFFFFFF.7DF51D50
Resource:            01F77324 42313146  F11B$s÷.  Status: NOQUOTA VALBLKR VALBLKW
 Length   10         00000000 00000000  ........
 Kernel mode         00000000 00000000  ........
 System              00000000 00000000  ........

Local copy

Lock Database
-------------

Lock id:  0A000004           PID:    0001000F   Flags: VALBLK  CONVERT SYNCSTS
Par. id:  00000000           SUBLCKs:       0          SYSTEM  NODLCKW NODLCKB
LKB:      FFFFFFFF.7DF48350   BLKAST: 81190420         QUECVT
Priority:     0000

Granted at    EX   00000000-FFFFFFFF

RSB:                 FFFFFFFF.7DF50850
Resource:            004F0FDF 24534D52  RMS$ß.O.  Status: VALBLKR VALBLKW
 Length   26         5F313039 58020000  ...X901_
 Exec. mode          00202020 204C354B  K5L    .
 System              00000000 00000000  ........

Local copy

    .
    .
    .
```

2.
```
SDA>  SHOW RESOURCES/LOCKID=0A000004

Resource Database
-----------------
RSB:         FFFFFFFF.7DF50850  GGMODE:     EX  Status: DIRENTR VALID
Parent RSB:  00000000.00000000  CGMODE:     EX
Sub-RSB count:      0           FGMODE:     EX
Lock Count:         1           RQSEQNM:  0000
BLKAST count:       1           CSID: 00000000  (MILADY)

Resource:           004F0FDF 24534D52  RMS$ß.O.  Valblk: 00000000 00000000
 Length   26        5F313039 58020000  ...X901_          00000000 00000000
 Exec. mode         00202020 204C354B  K5L    .
 System             00000000 00000000  ........  Seqnum: 00000000

Granted queue (Lock ID / Gr mode / Range):
 0A000004  EX 00000000-FFFFFFFF

Conversion queue (Lock ID / Gr mode / Range -> Rq mode / Range):
     *** EMPTY QUEUE ***

Waiting queue (Lock ID / Rq mode / Range):
     *** EMPTY QUEUE ***
```

This SDA session shows the output of the SHOW LOCKS command for several locks. The SHOW RESOURCES command, executed for the last displayed lock, verifies that the lock is in the resource's granted queue. (See Table 4–23 for a full explanation of the contents of the display of the SHOW RESOURCES command.)

```
3. SDA> SHOW LOCK/BRIEF/BLOCKING

Lock Database
-------------
   LKB Address     Lockid  ParentId   PID     BLKAST  SubLocks RQ GR  Queue     RSB Address           Resource Name          Mode
----------------- -------- -------- -------- -------- -------- -- -- ------- ----------------- ------------------------------ ----
FFFFFFFF.7FF42450 51000003 00000000 00000000 80CC7648        0    CR Granted FFFFFFFF.7FF45050 F11B$bSWPCTX_DUMPS             Kern
FFFFFFFF.7FF42850 01000005 00000000 00000000 80CB5020      111    CR Granted FFFFFFFF.7FF42950 F11B$vX6JU_R3N                 Kern
FFFFFFFF.7FF42A50 01000006 00000000 00000000 80CD3D98        0    PR Granted FFFFFFFF.7FF42B50 VCC$vX6JU_R3N                  Kern
FFFFFFFF.7FF42E50 4D000008 00000000 00000000 80CC7648        0    CR Granted FFFFFFFF.7FF43150 F11B$bX6JU_R3N                 Kern
FFFFFFFF.7FF43E50 13000010 00000000 00000000 80CD3D98        0    PR Granted FFFFFFFF.7FF53D50 VCC$vSWPCTX_DUMPS              Kern
FFFFFFFF.7FF48750 12000033 03000094 00010008 80CE7220        0    PW Granted FFFFFFFF.7FF48E50 APPENDER                       Exec
FFFFFFFF.7FF49550 1500003A 00000000 00010008 00010B20        0    CR Granted FFFFFFFF.7FF54E50 AUDRSV$DJ......X6JU_R3N    ... User
FFFFFFFF.7FF49B50 1300003D 00000000 00010007 00035EF8        0    CR Granted FFFFFFFF.7FF56250 OPC$opcom-restart              User
FFFFFFFF.7FF4BE50 2100004F 00000000 0001000B 80CE66F0        4    NL Granted FFFFFFFF.7FF4DC50 RMS$y......X6JU_R3N    ...     Exec
FFFFFFFF.7FF4C950 13000054 00000000 0001000B 80CE66F0        0    EX Granted FFFFFFFF.7FF4CE50 RMS$ß.O....X6JU_R3N    ...     Exec
FFFFFFFF.7FF4E050 0B00005F 00000000 00010009 80CE66F0        4    NL Granted FFFFFFFF.7FF4AD50 RMS$£......X6JU_R3N    ...     Exec
FFFFFFFF.7FF4EA50 0C000064 00000000 00010007 00035F30        0    CR Granted FFFFFFFF.7FF56150 OPC$opcom-abort                User
FFFFFFFF.7FF51350 18000078 00000000 00010011 0000B930        0    PR Granted FFFFFFFF.7FF44E50 NET$NETPROXY_MODIFIED          Kern
FFFFFFFF.7FF52850 0C000082 00000000 00000000 80CB5020        0    CR Granted FFFFFFFF.7FF43550 F11B$vSWPCTX_DUMPS             Kern
FFFFFFFF.7FF53250 09000087 00000000 00010008 80CE66F0        4    EX Granted FFFFFFFF.7FF49850 RMS$J......X6JU_R3N    ...     Exec
FFFFFFFF.7FF46C50 2700008E 00000000 0001000A 80CE66F0        2    EX Granted FFFFFFFF.7FF53750 RMS$.......X6JU_R3N    ...     Exec
FFFFFFFF.7FF54750 03000094 00000000 00010008 80CE66F0        2    EX Granted FFFFFFFF.7FF4A950 RMS$K......X6JU_R3N    ...     Exec
FFFFFFFF.7FF54B50 04000098 10000042 00010008 00011358        0    CR Granted FFFFFFFF.7FF55050 WRITER                         User
FFFFFFFF.7FF54D50 05000099 11000047 00010009 00010F48        0    PR Granted FFFFFFFF.7FF56F50 JBC$_CHECK_DB                  User
FFFFFFFF.7FF55150 0100009A 10000042 00010008 000112E0        0    CR Granted FFFFFFFF.7FF55250 DOORBELL                       User
FFFFFFFF.7FF55350 0200009B 00000000 00010008 00010B20        0    CR Granted FFFFFFFF.7FF55450 AUDRSV$DK......X6JU_R3N    ... User
FFFFFFFF.7FF55550 0200009C 00000000 00010008 80CE66F0        2    EX Granted FFFFFFFF.7FF55850 RMS$L......X6JU_R3N    ...     Exec
FFFFFFFF.7FF55D50 020000A0 00000000 00010008 000123E0        0    CR Granted FFFFFFFF.7FF55C50 AUDRSV$OL......X6JU_R3N    ... User
FFFFFFFF.7FF57250 040000A9 00000000 0001000A 80CE66F0        2    EX Granted FFFFFFFF.7FF4AD50 RMS$£......X6JU_R3N    ...     Exec
FFFFFFFF.7FF57A50 030000AF 110000AA 0001000A 00012628        0    PR Granted FFFFFFFF.7FF57D50 QMAN$REF........               User
FFFFFFFF.7FF58150 010000B2 110000AA 0001000A 000109C0        0    PR Granted FFFFFFFF.7FF58050 QMAN$NEW_JOBCTL                User
FFFFFFFF.7FF58E50 050000B9 110000AA 0001000A 000147F8        0    PR Granted FFFFFFFF.7FF58F50 QMAN$MASTER_QUEUES             User
```

ZK-9158A-AI

This example shows the brief display for all locks with a blocking AST.

SHOW MACHINE_CHECK

Displays the contents of the stored machine check frame. This command is valid for the DEC 4000 Alpha, DEC 7000 Alpha, and DEC 10000 Alpha computers only.

Format

SHOW MACHINE_CHECK [/FULL] [cpu-id]

Parameter

cpu-id
Numeric value from 00 to $1F_{16}$ indicating the identity of the CPU for which context information is to be displayed. This parameter changes the SDA current CPU (the default) to the CPU specified with **cpu-id**. If you specify a value outside this range, or you specify the **cpu-id** of a processor that was not active at the time of the system failure, SDA displays the following message:

```
%SDA-E-CPUNOTVLD, CPU not booted or CPU number out of range
```

If you use the **cpu-id** parameter, the SHOW MACHINE_CHECK command performs an implicit SET CPU command, making the CPU indicated by **cpu-id** the current CPU for subsequent SDA commands. (See the description of the SET CPU command and Section 2.5 for information on how this can affect the CPU context—and process context—in which SDA commands execute.)

Qualifier

/FULL
Specifies that a detailed version of the machine check information be displayed. This is currently identical to the default summary display.

Description

The SHOW MACHINE_CHECK command displays the contents of the stored machine check frame. A separate frame is allocated at boot time for every CPU in a multiple-CPU system. This command is valid for the DEC 4000 Alpha, DEC 7000 Alpha, and DEC 10000 Alpha computers only.

If you do not specify a qualifier, a summary version of the machine check frame is displayed.

The default **cpu-id** is the SDA current CPU.

Examples

1.
```
SDA> SHOW MACHINE_CHECK
CPU 00 Stored Machine Check Crash Data
--------------------------------------

Processor specific information:
-------------------------------
Exception address:    FFFFFFFF.800B0250    Exception Summary:  00000000.00000000
Pal base address:     00000000.00008000    Exception Mask:     00000000.00000000
HW Interrupt Request: 00000000.00000342    HW Interrupt Ena:   00000001.FFC01CE0
MM_CSR                00000000.00003640    ICCSR:              00000002.381F0000
D-cache address:      00000007.FFFFFFFF    D-cache status:     00000000.000002E0
BIU status:           00000000.00000050    BIU address [7..0]: 00000000.000060E0
BIU control:          00000008.50006447    Fill Address:       00000000.00006120
Single-bit syndrome:  00000000.00000000    Processor mchck VA: 00000000.00006190
A-box control:        00000000.0000040E    B-cache TAG:        00106100.83008828

System specific information:
----------------------------
Garbage bus info:     00200009 00000038    Device type:                 000B8001
LCNR:                          00000001    Memory error:                00000000
LBER:                          00000009    Bus error synd 0,1: 00000000 00000000
Bus error cmd:        00048858 00AB1C88    Bus error synd 2,3: 00000000 0000002C
LEP mode:                      00010010    LEP lock address:            00041108
```

The SHOW MACHINE_CHECK command in this SDA display shows the contents of the stored machine check frame.

2.
```
SDA> SHOW MACHINE_CHECK 1

CPU 01 Stored Machine Check Crash Data
--------------------------------------

Processor specific information:
-------------------------------
Exception address:    FFFFFFFF.800868A0    Exception Summary:  00000000.00000000
Pal base address:     00000000.00008000    Exception Mask:     00000000.00000000
HW Interrupt Request: 00000000.00000342    HW Interrupt Ena:   00000000.1FFE1CE0
MM_CSR                00000000.00005BF1    ICCSR:              00000000.081F0000
D-cache address:      00000007.FFFFFFFF    D-cache status:     00000000.000002E0
BIU status:           00000000.00000050    BIU address [7..0]: 00000000.000063E0
BIU control:          00000008.50006447    Fill Address:       00000000.00006420
Single-bit syndrome:  00000000.00000000    Processor mchck VA: 00000000.00006490
A-box control:        00000000.0000040E    B-cache TAG:        35028EA0.50833828

System specific information:
----------------------------
Garbage bus info:     00210001 00000038    Device type:                 000B8001
LCNR:                          00000001    Memory error:                00000080
LBER:                          00040209    Bus error synd 0,1: 00000000 00000000
Bus error cmd:        00048858 00AB1C88    Bus error synd 2,3: 00000000 0000002C
LEP mode:                      00010010    LEP lock address:            00041108
```

The SHOW MACHINE_CHECK command in this SDA display shows the contents of the stored machine check frame for **cpu-id** 01.

SHOW MEMORY

Displays the availability and usage of memory resources.

Format

SHOW MEMORY [/ALL][/BUFFER_OBJECTS][/CACHE][/FILES]
[/FULL][/GH_REGIONS][/PHYSICAL_PAGES][/POOL]
[/RESERVED][/SLOTS]

Parameters

None.

Qualifiers

/ALL
Displays all available information, that is, information displayed by the following qualifiers:

/BUFFER_OBJECTS
/CACHE
/FILES
/GH_REGIONS
/PHYSICAL_PAGES
/POOL
/RESERVED
/SLOTS

This is the default display.

/BUFFER_OBJECTS
Displays information about system resources used by buffer objects.

/CACHE
Displays information about either the Virtual I/O Cache facility or the Extended File Cache facility. The system parameter VCC_FLAGS determines which is used. The cache facility information is displayed as part of the SHOW MEMORY and SHOW MEMORY/CACHE/FULL commands.

/FILES
Displays information about the use of each paging and swapping file currently installed.

/FULL
Displays additional information about each pool area when used with the /POOL qualifier. This qualifier is ignored unless you specify the /POOL qualifier. When used with the /CACHE qualifier, /FULL displays additional information about the use of the Virtual I/O Cache facility, but is ignored if the Extended File Cache facility is in use.

/GH_REGIONS
Displays information about the granularity hint regions (GHR) that have been established. For each of these regions, information is displayed about the size of the region, the amount of free memory, the amount of memory in use, and the amount of memory released to OpenVMS from the region. The granularity

hint regions information is also displayed as part of SHOW MEMORY, SHOW MEMORY/ALL, and SHOW MEMORY/FULL commands.

/PHYSICAL_PAGES
Displays information about the amount of physical memory and the number of free and modified pages.

/POOL
Displays information about the usage of each dynamic memory (pool) area, including the amount of free space and the size of the largest contiguous block in each area.

/RESERVED
Displays information about memory reservations.

/SLOTS
Displays information about the availability of partition control block (PCB) vector slots and balance slots.

Description

For more information about the SHOW MEMORY command, see the description in the *OpenVMS DCL Dictionary: N–Z*.

SHOW PAGE_TABLE

Displays a range of system page table entries, the entire system page table, or the entire global page table.

Format

SHOW PAGE_TABLE {range|/FREE [/HEADER=*address*]
|/GLOBAL|/GPT|/PT
|/INVALID_PFN [=*option*]
|/NONMEMORY_PFN [=*option*]
|/PTE_ADDRESS|/SECTION_INDEX=*n*
|/S0S1 (d)|/S2|/SPTW|=ALL}
{/L1|/L2|/L3 (d)}

Parameter

range
Range of virtual addresses or PTE addresses for which SDA displays page table entries. If the qualifier /PTE_ADDRESS is given, then the range is of PTE addresses; otherwise, the range is of virtual addresses.

If /PTE_ADDRESS is given, the range is expressed using the following syntax:

m	Displays the single page table entry at address *m*
m:n	Displays the page table entries from address *m* to address *n*
m;n	Displays *n* bytes of page table entries starting at address *m*

If /PTE_ADDRESS is not given, then range is expressed using the following syntax:

m	Displays the single page table entry that corresponds to virtual address *m*
m:n	Displays the page table entries that correspond to the range of virtual addresses from *m* to *n*
m;n	Displays the page table entries that correspond to a range of *n* bytes starting at virtual address *m*

Qualifiers

/FREE
Causes the starting addresses and sizes of blocks of pages in the free PTE list to be displayed. The qualifiers /S0S1 (default), /S2, /GLOBAL, and /HEADER determine which free PTE list is to be displayed. A range cannot be specified, and no other qualifiers can be combined with /FREE.

/GLOBAL
Lists the global page table. When used with the /FREE qualifier, /GLOBAL indicates the free PTE list to be displayed.

/HEADER=address
When used with the /FREE qualifier, the /HEADER=*address* qualifier displays the free PTE list for the specified private page table.

/GPT
Specifies the portion of page table space that maps the global page table as the address range.

/INVALID_PFN [=*option*]
The /INVALID_PFN qualifier, which is valid only on platforms that supply an I/O memory map, causes SDA to display only page table entries that map to PFNs that are not in the system's private memory, nor in Galaxy shared memory, nor are I/O access pages.

See the /NONMEMORY_PFN qualifier definition for a description of the options.

/L1
Lists the Level 1 page table entries for the portion of memory specified.

/L2
Lists the Level 2 page table entries for the portion of memory specified.

/L3
Lists the Level 3 page table entries for the portion of memory specified. This qualifier is the default level.

/NONMEMORY_PFN [=*option*]
The /NONMEMORY_PFN qualifier, supported on all platforms, causes SDA to display only page table entries that are neither in the system's private memory nor in Galaxy shared memory.

Both /INVALID_PFN and /NONMEMORY_PFN qualifiers allow two optional keywords, READONLY and WRITABLE. If neither keyword is given, all relevant pages are displayed. If READONLY is given, only pages marked for no write access are displayed. If WRITABLE is given, only pages that allow write access are displayed. For example, SHOW PAGE_TABLE=ALL/INVALID_PFN=WRITABLE would display all system pages whose protection allows write, but which map to PFNs that do not belong to this system.

/PT
Specifies page table space, as viewed from system context, as the address range.

/PTE_ADDRESS
Specifies that the range given is of PTE addresses instead of the virtual addresses mapped by the PTEs.

/SECTION_INDEX=*n*
Displays the page table for the range of pages in the global section or pageable part of a loaded image. For pageable portions of loaded images, one of the qualifiers /L1, /L2, or /L3 can also be specified.

/S0S1
Specifies S0 and S1 space as the address range. When used with the /FREE qualifer, /S0S1 indicates the free PTE list to be displayed. This is the default portion of memory or free PTE list to be displayed.

/S2
Specifies S2 space as the address range. When used with the /FREE qualifier, /S2 indicates the free PTE list to be displayed.

/SPTW
Displays the contents of the system page table window.

Option

=ALL
The SHOW PAGE = ALL command displays the page table entries for all shared (system) addresses, without regard to the section of memory being referenced. It is equivalent to specifying all of /S0S1, /S2, /SPTW, /PT, /GPT, and /GLOBAL. This option can be qualified by only one of the /L1, /L2, or /L3 qualifiers, or by /INVALID_PFN or /NONMEMORY_PFN.

Description

If the /FREE qualifier is not specified, this command displays page table entries for the specified range of addresses or section of memory. For each virtual address displayed by the SHOW PAGE_TABLE command, the first eight columns of the listing provide the associated page table entry and describe its location, characteristics, and contents. SDA obtains this information from the system page table. Table 4–6 describes the information displayed by the SHOW PAGE_TABLE command.

If the /FREE qualifier is specified, this command displays the free PTE list for the specified section of memory.

The /L1, /L2, and /L3 qualifiers are ignored when used with the /FREE, /GLOBAL, and /SPTW qualifiers.

Table 4–6 Virtual Page Information in the SHOW PAGE_TABLE Display

Value	Meaning
MAPPED ADDRESS	Virtual address that marks the base of the virtual page(s) mapped by the PTE.
PTE ADDRESS	Virtual address of the page table entry that maps the virtual page(s).
PTE	Contents of the page table entry, a quadword that describes a system virtual page.
TYPE	Type of virtual page. Table 4–7 shows the eight types and their meanings.
READ	A code, derived from bits in the PTE, that designates the processor access modes (kernel, executive, supervisor, or user) for which read access is granted.
WRIT	A code, derived from bits in the PTE, that designates the processor access modes (kernel, executive, supervisor, or user) for which write access is granted.
BITS	Letters that represent the setting of a bit or a combination of bits in the PTE. These bits indicate attributes of a page. Table 4–8 shows the codes and their meanings.
GH	Contents of granularity hint bits.

Table 4–7 Types of Virtual Pages

Type	Meaning
VALID	Valid page (in main memory).
TRANS	Transitional page (on free or modified page list).
DZERO	Demand-allocated, zero-filled page.
PGFIL	Page within a paging file.
STX	Section table's index page.
GPTX	Index page for a global page table.
IOPAG	Page in I/O address space.
NXMEM	Page not represented in physical memory. The page frame number (PFN) of this page is not mapped by any of the system's memory controllers. This indicates an error condition.

Table 4–8 Bits In the PTE

Code	Meaning
A	Address space match is set.
M	Page has been modified.
L	Page is locked into a working set.
P	Page is locked in physical memory.
K	Owner is kernel mode.
E	Owner is executive mode.
S	Owner is supervisor mode.
U	Owner is user mode.

If the virtual page has been mapped to a physical page, the last six columns of the listing include information from the page frame number (PFN) database; otherwise, the section is left blank. Table 4–9 describes the physical page information displayed by the SHOW PAGE_TABLE command.

Table 4–9 Physical Page Information in the SHOW PAGE_TABLE Display

Category	Meaning
PGTYP	Type of physical page. Table 4–10 shows the types of physical pages.
LOC	Location of the page within the system. Table 4–11 shows the possible locations with their meaning.
BAK	Place to find information on this page when all links to this PTE are broken: either an index into a process section table or the number of a virtual block in the paging file.

(continued on next page)

Table 4–9 (Cont.) Physical Page Information in the SHOW PAGE_TABLE Display

Category	Meaning
REFCNT	Number of references being made to this page.
FLINK	Forward link within PFN database that points to the next physical page (if the page is on one of the lists: FREE, MODIFIED, BAD, or ZEROED); this longword also acts as the count of the number of processes that are sharing this global section.
BLINK	Backward link within PFN database (if the page is on one of the lists: FREE, MODIFIED, BAD, or ZEROED); also acts as an index into the working set list.

Table 4–10 Types of Physical Pages

Page Type	Meaning
PROCESS	Page is part of process space.
SYSTEM	Page is part of system space.
GLOBAL	Page is part of a global section.
GBLWRT	Page is part of a global, writable section.
PPGTBL	Page is part of a process page table.
GPGTBL	Page is part of a global page table.
PHD[1]	Page is part of a process PHD.
PPT(Ln)[1]	Page is a process page table page at level *n*.
SPT(Ln)[2]	Page is a system page table page at level *n*.
SHPT[3]	Page is part of a shared page table.
PFNLST[2]	Page is in a Shared Memory Common Property Partition PFN database.
SHM_REG[3]	Page is in a Shared Memory Region.
UNKNOWN	Unknown.

[1]These page types are variants of the PPGTBL page type.
[2]These page types are variants of the system page type.
[3]This page type is a variant of the GBLWRT page type.

Table 4–11 Locations of Physical Pages

Location	Meaning
ACTIVE	Page is in a working set.
MFYLST	Page is in the modified page list.
FRELST	Page is in the free page list.
BADLST	Page is in the bad page list.
RELPND	Release of the page is pending.
RDERR	Page has had an error during an attempted read operation.
PAGOUT	Page is being written into a paging file.
PAGIN	Page is being brought into memory from a paging file.
ZROLST	Page is in the zeroed-page list.
UNKNWN	Location of page is unknown.

SDA indicates pages are inaccessible by displaying one of the following messages:

```
-------   1 null page:       VA   FFFFFFFE.00064000     PTE   FFFFFFFD.FF800190

------- 974 null pages:      VA   FFFFFFFE.00064000     PTE   FFFFFFFD.FF800190
                             -to- FFFFFFFE.007FDFFF     -to-  FFFFFFFD.FF801FF8
```

In this case, the page table entries are not in use (page referenced is inaccessible).

```
-------      1 entry not in memory:    VA   FFFFFFFE.00800000   PTE   FFFFFFFD.FF802000

------- 784384 entries not in memory:  VA   FFFFFFFE.00800000   PTE   FFFFFFFD.FF802000
                                       -to- FFFFFFFF.7F7FDFFF   -to-  FFFFFFFD.FFDFDFF8
```

In this case, the page table entries do not exist (PTE itself is inaccessible).

```
-------    1 free PTE:    VA   FFFFFFFF.7F800000   PTE   FFFFFFFD.FFDFEOOO

------- 1000 free PTEs:   VA   FFFFFFFF.7F800000   PTE   FFFFFFFD.FFDFE000
                          -to- FFFFFFFF.7FFCDFFF   -to-  FFFFFFFD.FFDFFF38
```

In this case, the page table entries are in the list of free system pages.

In each case, VA is the MAPPED ADDRESS of the skipped entry, and PTE is the PTE ADDRESS of the skipped entry.

Examples

1.

For an example of SHOW PAGE_TABLE output when the qualifier /FREE has not been given, see the SHOW PROCESS/PAGE_TABLES command.

2.
```
SDA> SHOW PAGE_TABLE/FREE

S0/S1 Space Free PTEs
---------------------
 MAPPED ADDRESS       PTE ADDRESS            PTE           COUNT

FFFFFFFF.82A08000   FFFFFFFD.FFE0A820   0001FFE0.A8580000   00000003
FFFFFFFF.82A16000   FFFFFFFD.FFE0A858   0001FFE0.A8900000   00000003
FFFFFFFF.82A24000   FFFFFFFD.FFE0A890   0001FFE0.B3C00000   00000003
FFFFFFFF.82CF0000   FFFFFFFD.FFE0B3C0   0001FFE0.B4010000   00000001
FFFFFFFF.82D00000   FFFFFFFD.FFE0B400   0001FFE0.B4680000   00000002
```

```
    .
    .
    .
FFFFFFFF.82E48000   FFFFFFFD.FFE0B920   0001FFE0.B9390000   00000001
FFFFFFFF.82E4E000   FFFFFFFD.FFE0B938   0001FFE0.BA200000   00000002
FFFFFFFF.82E88000   FFFFFFFD.FFE0BA20   0001FFE0.C9780000   00000003
FFFFFFFF.8325E000   FFFFFFFD.FFE0C978   0001FFE0.CC980000   00000003
FFFFFFFF.83326000   FFFFFFFD.FFE0CC98   00000000.00000000   0000066D
```

This example shows the output when you invoke the SHOW PAGE_TABLE/FREE command.

SHOW PARAMETER

Displays the name, location, and value of one or more SYSGEN parameters at the time that the system dump is taken.

Format

```
SHOW PARAMETER   [SYSGEN_parameter]
                 [/ACP][/ALL][/CLUSTER][/DYNAMIC][/GALAXY]
                 [/GEN][/JOB][/LGI][/MAJOR][/MULTIPROCESSING]
                 [/PQL][/RMS][/SCS][/SPECIAL][/SYS][/STARTUP]
                 [/TTY]
```

Parameter

SYSGEN_parameter
Name of a parameter to be displayed. The name given may include wildcards. However, a truncated name is not recognized, unlike the equivalent SYSGEN and SYSMAN commands.

Qualifiers

/ACP
Displays all Files-11 ACP parameters.

/ALL
Displays the values of all parameters except the special control parameters.

/CLUSTER
Displays all parameters specific to clusters.

/DYNAMIC
Displays all parameters that can be changed on a running system.

/GALAXY
Displays all parameters specific to Galaxy systems.

/GEN
Displays all general parameters.

/JOB
Displays all Job Controller parameters.

/LGI
Displays all LOGIN security control parameters.

/MAJOR
Displays the most important parameters.

/MULTIPROCESSING
Displays parameters specific to multiprocessing.

/PQL
Displays the parameters for all default and minimum process quotas.

/RMS
Displays all parameters specific to OpenVMS Record Management Services (RMS).

/SCS
Displays all parameters specific to OpenVMS Cluster System Communications Services.

/SPECIAL
Displays all special control parameters.

/STARTUP
Displays the name of the site-independent startup procedure.

/SYS
Displays all active system parameters.

/TTY
Displays all parameters for terminal drivers.

Description

The SHOW PARAMETER command displays the name, location, and value of one or more SYSGEN parameters at the time that the system dump is taken. You can specify either a parameter name, or one or more qualifiers, but not both a parameter and qualifiers. If you do not specify a parameter or qualifiers, then the last parameter displayed is displayed again.

The qualifiers are the equivalent to those available for the SHOW [parameter] command in the SYSGEN utility and the PARAMETERS SHOW command in the SYSMAN utility. See the *OpenVMS System Management Utilities Reference Manual: M–Z* for more information about these two commands. You can combine qualifiers, and all appropriate SYSGEN parameters are displayed.

Note

To see the entire set of parameters, use the SDA command
SHOW PARAMETER /ALL /SPECIAL /STARTUP.

Examples

```
1. SDA> SHOW PARAMETER *SCS*

   Parameter                Variable               Address    Value    (decimal)              Offset
---------------   -------------------------------  --------  --------  ----------  -------------------------------
SCSBUFFCNT        SCS$GW_BDTCNT                    80C159A0      0032          50
SCSCONNCNT        SCS$GW_CDTCNT                    80C159A8      0005           5
SCSRESPCNT        SCS$GW_RDTCNT                    80C159B0      012C         300
SCSMAXDG          SCS$GW_MAXDG                     80C159B8      0240         576
SCSMAXMSG         SCS$GW_MAXMSG                    80C159C0      00D8         216
SCSFLOWCUSH       SCS$GW_FLOWCUSH                  80C159C8      0001           1
SCSSYSTEMID       SCS$GB_SYSTEMID                  80C159D0  0000FE88       65160
SCSSYSTEMIDH      SCS$GB_SYSTEMIDH                 80C159D8  00000000           0
SCSNODE           SCS$GB_NODENAME                  80C159E0  "SWPCTX  "
NISCS_CONV_BOOT   CLU$GL_SGN_FLAGS                 80C15E68         0           0  CLU$V_NISCS_CONV_BOOT (1)
NISCS_LOAD_PEA0   CLU$GL_SGN_FLAGS                 80C15E68         0           0  CLU$V_NISCS_LOAD_PEA0 (0)
NISCS_PORT_SERV   CLU$GL_NISCS_PORT_SERV           80C15E70  00000000           0
SCSICLUSTER_P1    SGN$GB_SCSICLUSTER_P1            80C15EF8  "    "
SCSICLUSTER_P2    SGN$GB_SCSICLUSTER_P2            80C15F00  "    "
SCSICLUSTER_P3    SGN$GB_SCSICLUSTER_P3            80C15F08  "    "
SCSICLUSTER_P4    SGN$GB_SCSICLUSTER_P4            80C15F10  "    "
NISCS_MAX_PKTSZ   CLU$GL_NISCS_MAX_PKTSZ           80C16070  000005DA        1498
NISCS_LAN_OVRHD   CLU$GL_NISCS_LAN_OVRHD           80C16078  00000012          18
```

VM-0060A-AI

This example shows all parameters that have the string "SCS" in their name. For parameters defined as a single bit, the name and value of the bit offset within the location used for the parameter are also given.

```
2. SDA> SHOW PARAMETER WS*

   Parameter                Variable               Address    Value    (decimal)              Offset
---------------   -------------------------------  --------  --------  ----------  -------------------------------
WSMAX             SGN$GL_MAXWSCNT_PAGELETS         80C15710  00006800       26624
     (internal)   SGN$GL_MAXWSCNT_PAGES            80C15718  00000680        1664
WSINC             SCH$GL_WSINC_PAGELETS            80C157F8  00000960        2400
     (internal)   SCH$GL_WSINC_PAGES               80C15800  00000096         150
WSDEC             SCH$GL_WSDEC_PAGELETS            80C15808  00000FA0        4000
     (internal)   SCH$GL_WSDEC_PAGES               80C15810  000000FA         250
```

VM-0764A-AI

This example shows all parameters whose names begin with the string "WS". For parameters that have both an external value (pagelets) and an internal value (pages), both are displayed.

```
3. SDA> SHOW PARAMETER /MULTIPROCESSING /STARTUP

SYSGEN parameters
-----------------

   Parameter                Variable               Address    Value    (decimal)              Offset
---------------   -------------------------------  --------  --------  ----------  -------------------------------
SMP_CPUS          SGN$GL_SMP_CPUS                  80C15688  FFFFFFFF          -1
MULTIPROCESSING   SGN$GB_MULTIPROCESSING           80C15698        03           3
SMP_SANITY_CNT    SGN$GL_SMP_SANITY_CNT            80C156A8  0000012C         300
SMP_SPINWAIT      SGN$GL_SMP_SPINWAIT              80C156B8  000186A0      100000
SMP_LNGSPINWAIT   SGN$GL_SMP_LNGSPINWAIT           80C156C0  002DC6C0     3000000
IO_PREFER_CPUS    SMP$GL_AVAILABLE_PORT_CPUS       80C16130  FFFFFFFF          -1

  Startup command file = SYS$SYSTEM:STARTUP.COM
```

VM-0765A-AI

This example shows all the parameters specific to multiprocessing, plus the name of the site-independent startup command procedure.

SHOW PFN_DATA

Displays information that is contained in the page lists and PFN database.

Format

SHOW PFN_DATA {[/qualifier] | pfn [{:end-pfn | ;length}]}

or

SHOW PFN_DATA/MAP

Parameters

pfn
Page frame number (PFN) of the physical page for which information is to be displayed.

end-pfn
Last PFN to be displayed. When you specify the **end-pfn** parameter, a range of PFNs is displayed. This range starts at the PFN specified by the **pfn** parameter and ends with the PFN specified by the **end-pfn** parameter.

length
Length of the PFN list to be displayed. When you specify the **length** parameter, a range of PFNs is displayed. This range starts at the PFN specified by the **pfn** parameter and contains the number of entries specified by the **length** parameter.

Qualifiers

/ADDRESS=<PFN-entry-address>
Displays the PFN database entry at the address specified. The address specified is rounded to the nearest entry address, so if you have an address that points to one of the fields of the entry, the correct database entry will still be found.

/ALL
Displays the following lists:

Free page list
Zeroed free page list
Modified page list
Bad page list
Untested page list
Private page lists, if any
Per-color or per-RAD free and zeroed free page lists
Entire database in order by page frame number

This is the default behavior of the SHOW PFN_DATA command. SDA precedes each list with a count of the pages it contains and its low and high limits.

/BAD
Displays the bad page list. SDA precedes the list with a count of the pages it contains, its low limit, and its high limit.

/COLOR [={*n*|ALL}]
Displays data on page coloring. Table 4–12 shows the command options available with this qualifier.

Table 4–12 Command Options with the /COLOR and /RAD Qualifiers

Options	Meaning
/COLOR[1] with no value	Displays a summary of the lengths of the color[1] page lists for both free pages and zeroed pages.
/COLOR=*n* where *n* is a color number	Displays the data in the PFN lists (for the specified color) for both free and zeroed pages.
/COLOR=ALL	Displays the data in the PFN lists (for all colors), for both free and zeroed free pages.
/COLOR=*n* or /COLOR=ALL with /FREE or /ZERO	Displays only the data in the PFN list (for the specified color or all colors), for either free or zeroed free pages as appropriate. The qualifiers /BAD and /MODIFIED are ignored with /COLOR=*n* and /COLOR=ALL.
/COLOR without an option specified together with one or more of /FREE, /ZERO, /BAD, or /MODIFIED	Displays the color summary in addition to the display of the requested list.

[1]Wherever COLOR is used in this table, RAD is equally applicable, both in the qualifier name and the meaning.

For more information on page coloring, see *OpenVMS System Management Utilities Reference Manual: M–Z*.

/FREE
Displays the free page list. SDA precedes the list with a count of the pages it contains, its low limit, and its high limit.

/MAP
Displays the contents of the PFN memory map. On platforms that support it, the I/O space map is also displayed. You cannot combine the /MAP qualifier with any parameters or other qualifiers.

/MODIFIED
Displays the modified page list. SDA precedes the list with a count of the pages it contains, its low limit, and its high limit.

/PRIVATE [=address]
Displays private PFN lists. If no address is given, all private PFN lists are displayed; if an address is given, only the PFN list whose head is at the given address is displayed.

/RAD [={n|ALL}]
Displays data on the disposition of pages among the Resource Affinity Domains (RADs) on applicable systems. See Table 4–12 for the command options available with this qualifier.

/SYSTEM
Displays the entire PFN database in order by page frame number, starting at PFN 0000.

/UNTESTED
Displays the state of the untested PFN list that was set up for deferred memory testing.

/ZERO
Displays the contents of the zeroed free page list.

Description

For each page frame number it displays, the SHOW PFN_DATA command lists information used in translating physical page addresses to virtual page addresses. The display has two lines of information. Table 4–13 shows the first line's fields; Table 4–14 shows the second line's fields.

Table 4–13 Page Frame Number Information—Line One Fields

Item	Contents
PFN	Page frame number.
DB ADDRESS	Address of PFN structure for this page.
PT PFN	PFN of the page table page that maps this page.
BAK	Place to find information on this page when all links to this PTE are broken: either an index into a process section table or the number of a virtual block in the paging file.
FLINK	Forward link within PFN database that points to the next physical page (if the page is on one of the lists: FREE, MODIFIED, BAD, or ZEROED); this longword also acts as the count of the number of processes that are sharing this global section.
BLINK	Backward link within PFN database (if the page is on one of the lists: FREE, MODIFIED, BAD, or ZEROED); also acts as an index into the working set list.
SWP/BO	Either a swap file page number or a buffer object reference count, depending on a flag set in the page state field.
LOC	Location of the page within the system. Table 4–11 shows the possible locations with their meaning.
FLAGS	The flags in text form that are set in page state. Table 4–15 shows the possible flags and their meaning.

Table 4–14 Page Frame Number Information—Line Two Fields

Item	Contents
(Blank)	First field of line two is left blank.
PTE ADDRESS	Virtual address of the page table entry that describes the virtual page mapped into this physical page. If no virtual page is mapped into this physical page then "<no backpointer>" is displayed, and the next three fields are left blank.
PTE Type	If a virtual page is mapped into this physical page, a description of the type of PTE is provided across the next three fields: one of "System-space PTE", "Global PTE (section index *nnnn*)", "Process PTE (process index *nnnn*)". If no virtual page is mapped into this physical page, these fields are left blank.
REFCNT	Number of references being made to this page.
PAGETYP	Type of physical page. See Table 4–10 for the types of physical pages and their meanings.
FLAGS	If the page is a page table page, then the contents of the PRN$W_PT_VAL_CNT, PFN$W_PT_LCK_CNT, and PFN$W_PT_WIN_CNT fields are displayed. The format is as follows: `VALCNT = nnnn LCKCNT = nnnn WINCNT = nnnn`

Table 4–15 Flags Set in Page State

Flag	Meaning
BUFOBJ	Set if any buffer objects reference this page
COLLISION	Indicates an empty collision queue when page read is complete
BADPAG	Indicates a bad page
RPTEVT	Indicates a report event on I/O completion
DELCON	Indicates a delete PFN when REFCNT=0
MODIFY	Indicates a dirty page (modified)
UNAVAILABLE	Indicates PFN is unavailable; most likely a console page
SWPPAG_VALID	Indicated swap file page number is valid
TOP_LEVEL_PT	Level one (1) page table
SLOT	Page is part of process's balance set
SHARED	Shared memory page
ZEROED	Shared memory page that has been zeroed

Examples

1.
```
SDA> SHOW PFN_DATA/MAP

System Memory Map
-----------------

Start PFN   PFN count   Flags
---------   ---------   -----
00000000    000000FA    0009  Console Base
000000FA    00003306    000A  OpenVMS Base
00003C00    000003FF    000A  OpenVMS Base
00003FFF    00000001    0009  Console Base
00003400    00000800    0010  Galaxy_Shared
```

This example shows the output when you invoke the SHOW PFN/MAP command.

```
2. SDA> SHOW PFN F23:F2F

PFN data base for PFN range
---------------------------

   PFN      DB  ADDRESS     PT PFN         BAK           FLINK    BLINK   SWP/BO   LOC               FLAGS
            PTE ADDRESS                                                   REFCNT PAGETYP
-------- ----------------- -------- ----------------- -------- -------- ------ ------- ------------------------------
00000F23 FFFFFEFE.00025D78 000004FD FF000000.00000000 00000E85 000004C2  ----  MFYLST  modify
         FFFFFEFC.001ED8E0 Process PTE (process index 001F)              0000  PROCESS

00000F24 FFFFFEFE.00025DA0 000005CD FE000702.00000000 000004B6 00000E8B  ----  FRELST
         FFFFFEFC.000003F0 Process PTE (process index 001A)              0000  PROCESS

00000F25 FFFFFEFE.00025DC8 000012F7 FF000000.00000000 00000008 00000003  ----  ACTIVE  modify
         FFFFFEFD.BF0007F8 Process PTE (process index 0007)              0001  PPT(L3) VALCNT=0007 LCKCNT=0006 WINCNT=FFFF

00000F26 FFFFFEFE.00025DF0 00000000 0000100E.00000F11 00000F11 0000100E  ----  ZROLST
         <no  backpointer>                                               0000  UNKNOWN

00000F27 FFFFFEFE.00025E18 00001839 FF000000.00000000 00000000 00000038  ----  ACTIVE  modify
         FFFFFEFC.00000450 Process PTE (process index 001E)              0001  PROCESS

00000F28 FFFFFEFE.00025E40 000012D4 00000001.00010000 00000000 0000006F  ----  ACTIVE
         FFFFFEFC.00000068 Process PTE (process index 0013)              0001  PROCESS

00000F29 FFFFFEFE.00025E68 000001C6 00000000.00000000 00000000 00000000  ----  ACTIVE
         FFFFFEFD.FFE0D8A0 System-space PTE                              0001  SYSTEM

00000F2A FFFFFEFE.00025E90 000004FD FF000000.00000000 00001086 00001085  ----  MFYLST  modify
         FFFFFEFC.001EC280 Process PTE (process index 001F)              0000  PROCESS

00000F2B FFFFFEFE.00025EB8 00001409 00000102.00010000 00000F2C 0000176F  ----  FRELST
         FFFFFEFE.000570E0 Global PTE (section index 0102)               0000  GLOBAL

00000F2C FFFFFEFE.00025EE0 00001409 00000102.00010000 00000F1D 00000F2B  ----  FRELST
         FFFFFEFE.00057190 Global PTE (section index 0102)               0000  GLOBAL

00000F2D FFFFFEFE.00025F08 000001C6 00000000.00000000 00000000 00000000  ----  ACTIVE
         FFFFFEFD.FFE0D8C0 System-space PTE                              0001  SYSTEM

00000F2E FFFFFEFE.00025F30 0000097C FE000444.00000000 00000000 0000035D  ----  ACTIVE
         FFFFFEFC.00000268 Process PTE (process index 0016)              0001  PROCESS

00000F2F FFFFFEFE.00025F58 00001409 000000FD.00010000 00001278 00000522  ----  FRELST
         FFFFFEFE.00056E60 Global PTE (section index 00FD)               0000  GLOBAL
```

VM-0766A-AI

This example shows the output from SHOW PFN for a range of pages.

SHOW POOL

Displays the contents of the nonpaged dynamic storage pool, the bus-addressable pool, and the paged dynamic storage pool. You can display part or all of each pool. If you do not specify a range or qualifiers, the default is SHOW POOL/ALL. Optionally, you can display the pool history ring buffer and pool statistics.

Format

```
SHOW POOL   {range|/ALL (d)|/BAP |/NONPAGED|/PAGED}
            [/BRIEF|/CHECK|/FREE|/HEADER
            |/MAXIMUM_BYTES [=n]|/SUMMARY |/TYPE=packet-type
            |/SUBTYPE=packet-type|/UNUSED]
            |[/RING_BUFFER]
            |[/STATISTICS [= ALL] [{/NONPAGED |/BAP|/PAGED}]]
```

Parameter

range
Range of virtual addresses in pool that SDA is to examine. You can express a range using the following syntax:

m:n	Range of virtual addresses in pool from *m* to *n*
m;n	Range of virtual addresses in pool starting at *m* and continuing for *n* bytes

Qualifiers

/ALL
Displays the entire contents of the dynamic storage pool, except for those portions that are free (available). This is the default behavior of the SHOW POOL command.

/BAP
Displays the contents of the bus-addressable dynamic storage pool currently in use.

/BRIEF
Displays only general information about the dynamic storage pool and its addresses.

/CHECK
Checks all free packets for POOLCHECK-style corruption, in exactly the same way that the system does when generating a POOLCHECK crash dump.

/FREE
Displays the entire contents, both allocated and free, of the specified region or regions of pool. Use the /FREE qualifier with a **range** to show all of the used and free pool in the given range.

/HEADER
Displays only the first 16 bytes of each data packet found within the specified region or regions of pool.

/MAXIMUM_BYTES [=*n*]
Displays only the first *n* bytes of a pool packet; if you specify /MAXIMUM_BYTES without a value, the default is 64 bytes.

/NONPAGED
Displays the contents of the nonpaged dynamic storage pool currently in use.

/PAGED
Displays the contents of the paged dynamic storage pool currently in use.

/RING_BUFFER
Displays the contents of the nonpaged pool history ring buffer if pool checking has been enabled. Entries are displayed in reverse chronological order, that is, most to least recent.

/STATISTICS [= ALL]
Displays usage statistics about each lookaside list and the variable free list. For each lookaside list, its queue header address, packet size, the number of packets, attempts, fails, and deallocations are displayed. (If pool checking is disabled, the attempts, fails, and deallocations are not displayed.) For the variable free list, its queue header address, the number of packets and the size of the smallest and largest packets are displayed. You can further qualify /STATISTICS by using either /NONPAGED, /BAP, or /PAGED to display statistics for a specified pool area. (Paged pool has no lookaside lists; therefore, only variable free list statistics are displayed.)

If you specify /STATISTICS without the ALL keyword, only active lookaside lists are displayed. Use /STATISTICS = ALL to display all lookaside lists.

/SUBTYPE=*packet-type*
Displays the packets within the specified region or regions of pool that are of the indicated *packet-type*. For information on *packet-type*, see *packet-type* in the Description section.

/SUMMARY
Displays only an allocation summary for each specified region of pool.

/TYPE=*packet-type*
Displays the packets within the specified region or regions of pool that are of the indicated *packet-type*. For information on *packet-type*, see *packet-type* in the Description section.

/UNUSED
Displays only variable free packets and lookaside list packets, not used packets.

Description

The SHOW POOL command displays information about the contents of any specified region of dynamic storage pool. There are several distinct display formats, as follows:

- Pool layout display. This display includes the addresses of the pool structures and lookaside lists, and the ranges of memory used for pool.
- Full pool packet display. This display has a section for each packet, consisting of a summary line (the packet type, its start address and size, and, on systems that have multiple Resource Affinity Domains (RADs), the RAD number), followed by a dump of the contents of the packet in hexadecimal and ASCII.

- Header pool packet display. This display has a single line for each packet. This line contains the packet type, its start address and size, and, on systems that have multiple RADs, the RAD number, followed by the first 16 bytes of the packet, in hexadecimal and ASCII.
- Pool summary display. This display consists of a single line for each packet type, and includes the type, the number of occurrences and the total size, and the percentage of used pool consumed by this packet type.
- Pool statistics display. This display consists of statistics for variable free pool and for each lookaside list. For variable free pool, it includes the number of packets, the total bytes available, and the sizes of the smallest and largest packets. In addition, if pool checking is enabled, the total bytes allocated from the variable list and the number of times pool has been expanded are also displayed.

  For lookaside lists, the display includes the listhead address and size, the number of packets (both the maintained count and the actual count), the operation sequence number for the list, the allocation attempts and failures, and the number of deallocations.

  On systems with multiple RADs, statistics for on-RAD deallocations are included in the display for the first RAD.
- Ring buffer display. This display is only available when pool checking is enabled. It consists of one line for each packet in the ring buffer and includes the address and size of the pool packet being allocated or deallocated, its type, the PC of the caller and the pool routine called, the CPU and IPL of the call, and the system time.

The qualifiers used on the SHOW POOL command determine which displays are generated. The default is the pool layout display, followed by the full pool packet display, followed by the pool summary display, these being generated in turn for Nonpaged Pool, Bus-Addressable Pool (if it exists in the system or dump being analyzed), and then Paged Pool.

If you specify a range, type, or subtype, then the pool layout display is not generated, and the pool summary display is a summary only for the range, type, or subtype, and not for the entire pool.

Not all displays are relevant for all pool types. For example, Paged Pool has no lookaside lists, so the Paged Pool statistics display consists only of variable free pool information. And because there is a single ring buffer for all pools, only one ring buffer display is generated even if all pools are being displayed.

Packet-type

Each packet of pool has a type field (a byte containing a value in the range of 0-255). Many of these type values have names associated that are defined in $DYNDEF in SYS$LIBRARY:LIB.MLB. The *packet-type* specified in the /TYPE qualifier of the SHOW POOL command can either be the value of the pool type or its associated name.

Some pool packet types have an additional subtype field (also a byte containing a value in the range of 0–255), many of which also have associated names. The *packet-type* specified in the /SUBTYPE qualifier of the SHOW POOL command can either be the value of the pool type or its associated name. However, if given as a value, a /TYPE qualifier (giving a value or name) must also be specified. Note also that /TYPE and /SUBTYPE are interchangeable if *packet-type* is given by name. Table 4–16 shows several examples.

Table 4–16 /TYPE and /SUBTYPE Qualifier Examples

/TYPE and /SUBTYPE Qualifiers	Meaning
/TYPE = CI	All CI packets regardless of subtype
/TYPE = CI_MSG	All CI packets with subtype CI_MSG
/TYPE = MISC/SUBTYPE = 120	All MISC packets with subtype 120
/TYPE = 0 or /TYPE = UNKNOWN	All packets with an unknown TYPE/SUBTYPE combination

Examples

```
1. SDA> SHOW POOL

Non-Paged Dynamic Storage Pool
------------------------------

        NPOOL address:                                      81009088
        Pool map address:                                   81562900
        Number of lookaside lists:                               128
        Granularity size:                                         64
        Ring buffer address:                                81552200
        Most recent ring buffer entry:                      815553A0

LSTHDS(s)
---------

             LSTHDS              Variable              Lookaside
  RAD        address             listhead              listheads
  ---   -----------------   -----------------    -----------------
  00    FFFFFFFF.81008830   FFFFFFFF.8100883C    FFFFFFFF.81008868
  01    FFFFFFFF.7FFFE000   FFFFFFFF.7FFFE00C    FFFFFFFF.7FFFE038
  02    FFFFFFFF.7FFFC000   FFFFFFFF.7FFFC00C    FFFFFFFF.7FFFC038
  03    FFFFFFFF.7FFFA000   FFFFFFFF.7FFFA00C    FFFFFFFF.7FFFA038

Segment(s)
----------

         Start       End        Length    RAD
        --------    --------    --------   ---
        81548000    8172B9FF    001E3A00    00
        81735A00    8173D53F    00007B40    00
        81747540    8174BDBF    00004880    00
        81755DC0    81AFDFFF    003A8240    00
        81AFE000    81C43FFF    00146000    01
        81C44000    81D89FFF    00146000    02
        81D8A000    81ECFFFF    00146000    03
        81ED0000    81F1FFFF    00050000    02

Per-RAD Totals
--------------

        RAD                     Length
        ---                     --------
        00                      00598000
        01                      00146000
        02                      00196000
        03                      00146000

        Non-Paged total:        009BA000

Dump of packets allocated from Non-Paged Pool
---------------------------------------------

Packet: MP_CPU                                        Start address:  81548000      Length:  000009C0     RAD:  00

00000000 00000000 0000003E 00000001 00000002 026A09C0 ACD1A180 81C52F40  @/Å..¡Ñ¬À.j.........>...........     81548000
81548038 81548038 81548030 81548030 81548028 81548028 00000000 00000001  ........(.T.(.T.0.T.0.T.8.T.8.T.     81548020
81548058 81548058 81548050 81548050 81548048 81548048 81548040 81548040  @.T.@.T.H.T.H.T.P.T.P.T.X.T.X.T.     81548040

.
.
.

Packet: Unknown                                       Start address:  815489C0      Length:  00000180     RAD:  00

FFFFFFFF AD332000 00500000 00008020 FFFFFFFF 81548B00 FFFFFFFF 81548A80  ..T.......T..... .....P.. 3—....     815489C0

.
.
.

Packet: DDB                                           Start address:  81548B40      Length:  00000300     RAD:  00

AD410000 81564480 81548BC0 000F4240 00000000 63060300 008B798F 962DA431  1¤-..y.....c....@B..À.T..DV...A—     81548B40

.
.
.
```

Continued

VM-0767A-AI

```
Summary of Non-Paged Pool contents
----------------------------------

    Packet type/subtype        Packet count      Packet bytes    Percent
---------------------------  ----------------  ----------------  --------
Unknown                      000001E4          00145BC0          (50.7%)
ADP                          00000009          00000A00           (0.1%)
ACB                          0000008D          00002500           (0.4%)
AQB                          00000002          00001080           (0.2%)

.
.
.

LOADCODE                     0000003D          00004C40           (0.7%)
  LDRIMG                             0000003D          00004C40    (0.7%)

INIT                         00000008          00003B80           (0.6%)
  PCBVEC                             00000001          00001BC0    (0.3%)
  PHVEC                              00000001          00000700    (0.1%)
  MPWMAP                             00000005          00001840    (0.2%)
  PRCMAP                             00000001          00000080    (0.0%)

.
.
.

Total space used: 002825C0 (2631104.) bytes out of 009BA000 (10199040.) bytes
  in 0000184C (6220.) packets

Total space utilization: 25.8%

.
.
.
```

VM-0768A-AI

This example shows the Nonpaged Pool portion of the default SHOW POOL display.

```
2. SDA> SHOW POOL/TYPE=IPC/HEADER 8156E140:815912C0

Non-Paged Dynamic Storage Pool
------------------------------

Dump of packets allocated from Non-Paged Pool
---------------------------------------------

   Packet type/subtype     Start    Length   RAD                   Header contents
-------------------------  -------- -------- ---   -----------------------------------------------------
IPC_TDB                    8156E140 00000040  00   81591180 057B0040 00000040 81591180  ..Y.@...@.{...Y.
IPC_LIST                   815838C0 00009840  00   004C0200 087B9840 0057A740 8158D100  .ÑX.@§W.@.{...L.
IPC_LIST                   8158D100 00001840  00   00040400 087B1840 00570F00 8158E940  @éX...W.@.{.....
IPC_LIST                   8158E940 00002840  00   00140200 087B2840 0056F6C0 81591180  ..Y.ÀöV.@({.....
IPC_TPCB                   81591180 00000080  00   00000000 067B0080 0056CE80 81591200  ..Y..ÎV...{.....
IPC                        81591200 000000C0  00   00000000 007B00C0 0056CE00 815912C0  À.Y..ÎV.À.{.....

Summary of Non-Paged Pool contents
----------------------------------

    Packet type/subtype       Packet count      Packet bytes    Percent
---------------------------  ----------------  ----------------  --------
IPC                          00000006          0000DA40          (100.0%)
  IPC                                00000001          000000C0    (0.3%)
  IPC_TDB                            00000001          00000040    (0.1%)
  IPC_TPCB                           00000001          00000080    (0.2%)
  IPC_LIST                           00000003          0000D8C0   (99.3%)

Total space used: 0000DA40 (55872.) bytes out of 00023180 (143744.) bytes
  in 00000006 (6.) packets

Total space utilization: 38.9%
```

This example shows how you can specify a pool packet type and a range of addresses.

```
3. SDA> SHOW POOL/STATISTICS

Non-Paged Pool statistics for RAD 00
------------------------------------

        On-RAD deallocations (all RADs):                     1221036
        Total deallocations (all RADs):                      1347991
        Percentage of on-RAD deallocations:                    90.6%

Variable list statistics
------------------------

        Number of packets on variable list:                        7
        Total bytes on variable list:                        3613376
        Smallest packet on variable list:                        256
        Largest packet on variable list:                     3598016
        Bytes allocated from variable list:                  2140480
        Times pool expanded:                                       0

Lookaside list statistics
-------------------------

                      List   Packets     Packets    Operation   Allocation  Allocation
  Listhead address    size   (approx)    (actual)   sequence #   attempts    failures    Deallocs
  -----------------   ----  ----------  ----------  ----------  ----------  ----------  ----------
  FFFFFFFF.81008870     64           5           5       10057       10549         492       10062
  FFFFFFFF.81008878    128          21          21         366        4881        4515         387
  FFFFFFFF.81008880    192          33          33       27376       27542         166       27409
  FFFFFFFF.81008888    256           4           4        8367        8476         118        8362

   .
   .
   .
```

This example shows the Nonpaged Pool portion of the SHOW POOL/STATISTICS display.

```
4. SDA> SHOW POOL/RING_BUFFER

Pool History Ring-Buffer
------------------------
                             (2048 entries: Most recent first)

     Packet       Size    Type/Subtype                Caller's PC                    Operation       IPL CPU      Time
----------------- ---- ------------------ ------------------------------------ ------------------- --- --- ----------------
FFFFFFFF.81C65F40  320 SECURITY_PSB       80283A9C NSA_STD$FREE_PSB_C+0024C    DEALLO_POOL_NPP       0   8  009F1E47.549449F0
FFFFFFFF.81C44E00  192 SECURITY_PXB_ARRAY 80283A30 NSA_STD$FREE_PSB_C+001E0    DEALLO_POOL_NPP       0   8  009F1E47.549449F0
FFFFFFFF.81C45A40   64 ACB                8014A09C SCH$INIT_C+00F18            DEALLO_POOL_NPP_SIZ   2   8  009F1E47.549449F0
FFFFFFFF.81C44E00  140 SECURITY_PXB_ARRAY 80283B8C NSA$GET_PSB_C+0005C         ALLO_POOL_NPP         0   8  009F1E47.549449F0
FFFFFFFF.81C65F40  320 SECURITY_PSB       80283B70 NSA$GET_PSB_C+00040         ALLO_POOL_NPP         0   8  009F1E47.549449F0
FFFFFFFF.81C45A40   64 ACB                801281F8 PROCESS_MANAGEMENT_MON+001F ALLO_POOL_NPP         2   8  009F1E47.549449F0
FFFFFFFF.81C52380  576 IRP                8014A09C SCH$INIT_C+00F18            DEALLO_POOL_NPP_SIZ   2   8  009F1E47.549449F0
FFFFFFFF.81C65F40  320 SECURITY_PSB       80283A9C NSA_STD$FREE_PSB_C+0024C    DEALLO_POOL_NPP       2   8  009F1E47.549449F0
FFFFFFFF.81C44E00  192 SECURITY_PXB_ARRAY 80283A30 NSA_STD$FREE_PSB_C+001E0    DEALLO_POOL_NPP       2   8  009F1E47.549449F0
FFFFFFFF.81C47400  256 BUFIO              800F6270 IOC_STD$WAKACP_C+00650      DEALLO_POOL_NPP_SIZ   2   8  009F1E47.549449F0
.
.
.
```

VM-0772A-AI

This example shows the output of the SHOW POOL/RING_BUFFER display.

SHOW PORTS

Displays those portions of the port descriptor table (PDT) that are port independent.

Format

SHOW PORTS [/qualifier[,...]]

Parameters

None.

Qualifiers

/ADDRESS=pdt-address
Displays the specified port descriptor table (PDT). You can find the *pdt-address* for any active connection on the system in the **PDT summary page** display of the SHOW PORTS command. This command also defines the symbol PE_PDT. The connection descriptor table (CDT) addresses are also stored in many individual data structures related to System Communications Services (SCS) connections, for instance, in the path block displays of the SHOW CLUSTER/SCS command.

/BUS=*bus-address*
Displays bus (LAN device) structure data.

/CHANNEL=*channel-address*
Displays channel (CH) data.

/DEVICE
Displays the network path description for a channel.

/MESSAGE
Displays the message data associated with a virtual circuit (VC).

/NODE=*node*
Shows only the virtual circuit block associated with the specific node. When you use the /NODE qualifier, you must also specify the address of the PDT using the /ADDRESS qualifier.

/VC=*vc-address*
Displays the virtual circuit data.

Description

The SHOW PORTS command provides port-independent information from the port descriptor table (PDT) for those CI ports with full System Communications Services (SCS) connections. This information is used by all SCS port drivers.

The SHOW PORTS command does not display similar information about UDA ports, BDA ports, and similar controllers.

The SHOW PORTS command also defines symbols for PEDRIVER based on the cluster configuration. These symbols include the following information:

- Virtual circuit (VC) control blocks for each of the remote systems
- Bus data structure for each of the local LAN adapters
- Some of the data structures used by both PEDRIVER and the LAN drivers

The following symbols are defined automatically:

- VC_nodename—Example: VC_NODE1, address of the local node's virtual circuit to node NODE1.
- CH_nodename—The preferred channel for the virtual circuit. For example, CH_NODE1, address of the local node's preferred channel to node NODE1.
- BUS_busname—Example: BUS_ETA, address of the local node's bus structure associated with LAN adapter ETA0.
- PE_PDT—Address of PEDRIVER's port descriptor table.
- MGMT_VCRP_busname—Example: MGMT_VCRP_ETA, address of the management VCRP for bus ETA.
- HELLO_VCRP_busname—Example: HELLO_VCRP_ETA, address of the HELLO message VCRP for bus ETA.
- VCIB_busname—Example: VCIB_ETA, address of the VCIB for bus ETA.
- UCB_LAVC_busname—Example: UCB_LAVC_ETA, address of the LAN device's UCB used for the local-area OpenVMS Cluster protocol.
- UCB0_LAVC_busname—Example: UCB0_LAVC_ETA, address of the LAN device's template UCB.
- LDC_LAVC_busname—Example: LDC_LAVC_ETA, address of the LDC structure associated with LAN device ETA.
- LSB_LAVC_busname—Example: LSB_LAVC_ETA, address of the LSB structure associated with LAN device ETA.

These symbols equate to system addresses for the corresponding data structures. You can use these symbols, or an address, in SHOW PORTS qualifers that require an address, as in the following:

```
SDA >SHOW PORTS/BUS=BUS_ETA
```

The SHOW PORTS command produces several displays. The initial display, the **PDT summary page**, lists the PDT address, port type, device name, and driver name for each PDT. Subsequent displays provide information taken from each PDT listed on the summary page.

You can use the /ADDRESS qualifier to the SHOW PORTS command to produce more detailed information about a specific port. The first display of the SHOW PORTS/ADDRESS command duplicates the last display of the SHOW PORTS command, listing information stored in the port's PDT. Subsequent displays list information about the port blocks and virtual circuits associated with the port.

Examples

1. SDA > SHOW PORTS

```
OpenVMS Cluster data structures
--------------------------

                  --- PDT Summary Page ---

 PDT Address          Type         Device          Driver Name
 -----------          ----         -------         -----------

  80E2A180             pn          PNA0            SYS$PNDRIVER
  80EC3C70             pe          PEA0            SYS$PEDRIVER

                  --- Port Descriptor Table (PDT) 80E2A180 ---

Type: 09 pn
Characteristics: 0000

Msg Header Size         104  Flags              0000  Message Sends    3648575
Max Xfer Bcnt      00100000  Counter CDRP   00000000  Message Recvs    4026887
Poller Sweep             21  Load Vector    80E2DFCC  Mess Sends NoFP  3020422
Fork Block W.Q.    80E2A270  Load Class           60  Mess Recvs NoFP  3398732
UCB Address        80E23380  Connection W.Q. 80E4BF94  Datagram Sends        0
ADP Address        80E1BF00  Yellow Q.      80E2A2E0  Datagram Recvs        0
Max VC timeout           16  Red Q.         80E2A2E8  Portlock        80E1ED80
SCS Version               2  Disabled Q.    80FABB74  Res Bundle Size      208
                             Port Map       00000001

                  --- Port Descriptor Table (PDT) 80EC3C70 ---

Type: 03 pe
Characteristics: 0000

Msg Header Size          32  Flags              0000  Message Sends     863497
Max Xfer Bcnt      FFFFFFFF  Counter CDRP   00000000  Message Recvs     886284
Poller Sweep             30  Load Vector    80EDBF8C  Mess Sends NoFP   863497
Fork Block W.Q.    80EC3D60  Load Class           10  Mess Recvs NoFP   886284
UCB Address        80EC33C0  Connection W.Q. 80EFF5D4  Datagram Sends        0
ADP Address        00000000  Yellow Q.      80EC3DD0  Datagram Recvs        0
Max VC timeout           16  Red Q.         80EC3DD8  Portlock        00000000
SCS Version               2  Disabled Q.    812E72B4  Res Bundle Size        0
                             Port Map       00000000
```

This example illustrates the default output of the SHOW PORTS command.

2.
```
SDA > SHOW PORTS/ADDRESS=80EC3C70

OpenVMS Cluster data structures
--------------------------

                  --- Port Descriptor Table (PDT) 80EC3C70 ---

Type: 03 pe
Characteristics: 0000

Msg Header Size          32  Flags              0000  Message Sends     864796
Max Xfer Bcnt      FFFFFFFF  Counter CDRP   00000000  Message Recvs     887086
Poller Sweep             30  Load Vector    80EDBF8C  Mess Sends NoFP   864796
Fork Block W.Q.    80EC3D60  Load Class           10  Mess Recvs NoFP   887086
UCB Address        80EC33C0  Connection W.Q. 80EFF5D4  Datagram Sends        0
ADP Address        00000000  Yellow Q.      80EC3DD0  Datagram Recvs        0
Max VC timeout           16  Red Q.         80EC3DD8  Portlock        00000000
SCS Version               2  Disabled Q.    812E72B4  Res Bundle Size       0
                             Port Map       00000000
                             Port Map       00000000

                 --- Port Block 80EC4540 ---

Status: 0001 authorize
VC Count: 20
Secs Since Last Zeroed: 77020

SBUF Size            824    LBUF Size        5042    Fork Count    1943885
SBUF Count            28    LBUF Count          1    Refork Count        0
SBUF Max             768    LBUF Max          384    Last Refork  00000000
SBUF Quo              28    LBUF Quo            1    SCS Messages  1154378
SBUF Miss           1871    LBUF Miss        3408    VC Queue Cnt   361349
SBUF Allocs      1676801    LBUF Allocs     28596    TQE Received   770201
SBUFs In Use           2    LBUFs In Use        0    Timer Done     770201
Peak SBUF In Use     101    Peak LBUF In Use   10    RWAITQ Count    30288
SBUF Queue Empty       0    LBUF Queue Empty    0    LDL Buf/Msg     32868
TR SBUF Queue Empty    0    Ticks/Second       10    ACK Delay     1000000
No SBUF for ACK        0    Listen Timeout      8    Hello Interval     30

Bus Addr  Bus     LAN Address    Error Count Last Error   Time of Last Error
--------  ---  ----------------- ----------- ---------- -----------------------
80EC4C00  LCL  00-00-00-00-00-00          0
80EC5400  EXA  08-00-2B-17-CF-92          0
80EC5F40  FXA  08-00-2B-29-E1-40          0

                 --- Virtual Circuit (VC) Summary ---

VC Addr     Node    SCS ID  Lcl ID    Status Summary       Last Event Time
--------  --------  ------  ------  -----------------   -----------------------
80E566C0  ARUSHA     19617  223/DF  open,path            8-FEB-2001 16:01:57.58
80E98840  ETOSHA     19699  222/DE  open,path            8-FEB-2001 16:01:58.41
80E98A80  VMS        19578  221/DD  open,path            8-FEB-2001 16:01:58.11
   .
   .
   .
```

This example illustrates the output produced by the SHOW PORTS command for the PDT at address 80EC3C70.

SHOW PROCESS

Displays the software and hardware context of any process in the system. If the process is suspended (ANALYZE/SYSTEM), then some displays may be incomplete or unavailable. If the process was outswapped at the time of the system crash, or not included in a selective dump (ANALYZE/CRASH_DUMP), then some displays may be incomplete or unavailable.

Format

SHOW PROCESS {[process-name | ALL]
| /ADDRESS=*pcb_address* | /ID=*nn*
| /INDEX=*nn* | /NEXT | /SYSTEM}
[/ALL | /BUFFER_OBJECTS | /CHANNEL
| /FANDLES | /FID_ONLY | /GSTX=*index* | /IMAGES [=ALL]
| /INVALID_PFN [=*option*] | /NEXT
| /NONMEMORY_PFN [=*option*]
| /LOCKS [/BRIEF] | /L1 | /L2 | /L3
| /PAGE_TABLES [range] | /P0 | /P1 | /P2 | /PT
| /PERSONA [=*address*][/RIGHTS [/AUTHORIZED]]
| /PHD | /PROCESS_SECTION_TABLE | /PST | /PCB
| /POOL [={P0 | P1 | ALL}][range] [/BRIEF]
[/FREE][/HEADER][/MAXIMUM_BYTES [=*n*]]
[/STATISTICS][/SUBTYPE=*packet-type*]
[/SUMMARY][/TYPE=*packet-type*] [/UNUSED]
| /PTE_ADDRESS | /RDE [=*id*]
| /REGIONS [=*id*]
| /REGISTERS | /RMS [=*option*[,...]] | /SECTION_INDEX=*n*
| /SEMAPHORE | /THREADS
| /TQE [=ALL]
| /WORKING_SET_LIST]

Parameters

ALL
Information about all processes that exist in the system.

process-name
Name of the process for which information is to be displayed. Use of the **process-name** parameter or one of the /ADDRESS, /ID, /INDEX, /NEXT, or /SYSTEM qualifiers causes the SHOW PROCESS command to perform an implicit SET PROCESS command, making the indicated process the current process for subsequent SDA commands. When you analyze a crash dump from a multiprocessing system, changing process context may require a switch of CPU context as well. For instance, if you issue a SET PROCESS command for a process that is current on another CPU, SDA automatically changes its CPU context to that of the CPU on which that process is current. You can determine the names of the processes in the system by issuing a SHOW SUMMARY command.

The **process-name** can contain up to 15 uppercase letters, numerals, the underscore (_), dollar sign, colon (:), and some other printable characters. If it contains any other characters (including lowercase letters), you may need to enclose the **process-name** in quotation marks (" ").

Qualifiers

/ADDRESS=*pcb-address*
Specifies the process control block (PCB) address of a process in order to display information about the process.

/ALL
Displays all information shown by the following qualifiers:

/BUFFER_OBJECTS
/CHANNEL
/FANDLES
/IMAGES=ALL
/LOCKS
/PAGE_TABLES
/PCB
/PERSONA/RIGHTS
/PHD
/POOL/HEADER
/PROCESS_SECTION_TABLE
/REGIONS
/REGISTERS
/RMS
/SEMAPHORE
/THREADS
/TQE
/WORKING_SET_LIST

/AUTHORIZED
Used with the /PERSONA/RIGHTS qualifiers. See the /PERSONA/RIGHTS/AUTHORIZED description for the use of the /AUTHORIZED qualifier.

/BRIEF
When used with the /LOCKS qualifier, causes SDA to display each lock owned by the current process in brief format, that is, one line for each lock. When used with the /POOL qualifier, causes SDA to display only general information about process pool and its addresses.

/BUFFER_OBJECTS
Displays all the buffer objects that a process has created.

/CHANNEL
Displays information about the I/O channels assigned to the process.

/FANDLES
Displays the data on the process's fast I/O handles.

/FID_ONLY
When used with /CHANNEL or /PROCESS_SECTION_TABLE (/PST), causes SDA to not attempt to translate the FID (File ID) to a file name when invoked with ANALYZE/SYSTEM.

/FREE
When used with /POOL, displays the entire contents, both allocated and free, of the specified region or regions of pool. Use the /FREE qualifier with a **range** to show all of the used and free pool in the given range.

/GSTX=*index*
When used with the /PAGE_TABLES qualifier, displays only page table entries for the specific global section.

/HEADER
When used with /POOL, displays only the first 16 bytes of each data packet found within the specified region or regions of pool.

/IMAGES [= ALL]
For all images in use by this process, displays the address of the image control block, the start and end addresses of the image, the activation code, the protected and shareable flags, the image name, and the major and minor IDs of the image. The /IMAGES = ALL qualifier also displays the base, end, image offset, and section type for installed resident images in use by this process.

See the *OpenVMS Linker Utility Manual* and the Install utility chapter in the *OpenVMS System Management Utilities Reference Manual* for more information on images installed using the /RESIDENT qualifier.

/ID=*nn*
/INDEX=*nn*
Specifies the process for which information is to be displayed by its index into the system's list of software process control blocks (PCBs), or by its process identification (ID). You can supply the following values for *nn*:

- The process index itself.
- The process identification (PID) or extended PID longword, from which SDA extracts the correct index. You can specify the PID or extended PID of any thread of a process with multiple kernel threads. Any thread-specific data displayed by SHOW PROCESS will be for the given thread.

To obtain these values for any given process, issue the SDA command SHOW SUMMARY/THREADS. You can use the /ID=*nn* and /INDEX=*nn* qualifiers interchangeably.

/INVALID_PFN [=*option*]
See the /PAGE_TABLES qualifier description for an explanation of /INVALID_PFN.

/L1
/L2
/L3
When used with the /PAGE_TABLES qualifier, /L1, /L2, /L3 displays the page table entries at the level specified. /L3 is the default.

/LOCKS [/BRIEF]
Displays the lock management locks owned by the current process.

The /LOCKS [/BRIEF] qualifier produces a display similar in format to that produced by the SHOW LOCKS command. See also the /BRIEF qualifier description. Table 4–5 contains additional information.

/MAXIMUM_BYTES [=*n*]
When used with /POOL, displays only the first *n* bytes of a pool packet; if you specify /MAXIMUM_BYTES without a value, the default is 64 bytes.

/NEXT
Locates the next valid process in the system's process list and selects that process. If there are no further valid processes in the system's process list, SDA returns an error.

/NONMEMORY_PFN [=*option*]
See the /PAGE_TABLES qualifier description for an explanation of /NONMEMORY_PFN.

/P0
/P1
/P2
When used with the /PAGE_TABLES qualifier, /P0, /P1, /P2 displays only page table entries for the specified region. The default is /P0.

/PAGE_TABLES

The /PAGE_TABLES qualifier has the following format:

```
/PAGE_TABLES [/P0(d)|/P1|/P2|/PT][range]
                       [/GSTX=index][/RDE=id]
                       [/REGIONS=id]
                       [/SECTION_INDEX=n][=ALL]
                       [/PTE_ADDRESS]
                       [/INVALID_PFN [={READONLY|WRITABLE}]
                       [/NONMEMORY_PFN [={READONLY|WRITABLE}]
                       {/L1|/L2|/L3(d)}
```

Displays the page tables of the process P0 (process), P1 (control), P2, or PT (page table) region, or, optionally, page table entries for a **range** of addresses. The page table entries at the level specified by /L1, /L2, or /L3 (the default) are displayed.

When /RDE=*id* or /REGIONS=*id* is used with /PAGE_TABLES, SDA displays the page tables for the address range of the specified address region. When you do not specify an ID, the page tables are displayed for all the process-permanent and user-defined regions.

You can express a **range** using the following syntax:

m	Displays the single page table entry that corresponds to virtual address *m*.
m:n	Displays the page table entries that correspond to the range of virtual addresses from *m* to *n*.
m;n	Displays the page table entries that correspond to a range of *n* bytes, starting at virtual address *m*.
=ALL	Use /PAGE_TABLES=ALL to display the entire page table or the process from address zero to the end of process-private page table space.

The /PTE_ADDRESS qualifier causes SDA to treat the specified range as PTE addresses instead of virtual addresses.

The /SECTION_INDEX=*n* qualifier causes SDA to display only the page table entries for the pages in the specified process section.

The /GSTX=*index* qualifier causes SDA to display only the page table entries for the pages in the specified global section.

The /INVALID_PFN qualifier, which is valid on platforms that supply an I/O memory map, causes SDA to display only page table entries that map to PFNs that are not in the system's private memory, nor in Galaxy shared memory, nor are I/O access pages.

The /NONMEMORY_PFN qualifier, which is supported on all platforms, causes SDA to display only page table entries that are neither in the system's private memory nor in Galaxy shared memory.

Both /INVALID_PFN and /NONMEMORY_PFN qualifiers allow two optional keywords, READONLY and WRITABLE. If neither keyword is given, all relevant pages are displayed. If you specify READONLY, only pages marked for no write access are displayed. If you specify WRITABLE, only pages that allow write access are displayed. For example, SHOW PROCESS ALL/PAGE_TABLE=ALL/INVALID_PFN=WRITABLE would display all process pages (for all processes) whose protection allows write, but which map to PFNs that do not belong to this system.

/PCB
Displays the information contained in the process control block (PCB). This is the default behavior of the SHOW PROCESS command.

/PERSONA [=*address*]
Displays all persona security blocks (PSBs) held in the PERSONA ARRAY of the process, and then lists selected information contained in each initially listed PSB. The selected information includes the contents of the following cells inside the PSB:

Flags
Reference count
Execution mode
Audit status
Account name
UIC
Privileges
Rights enabled mask

If you specify a PSB address, the above information is provided for that specific PSB only.

/PERSONA/RIGHTS
Displays all the /PERSONA [=address] information and additional selected information, including all the Rights and their attributes currently held and active for each persona security block (PSB).

/PERSONA/RIGHTS/AUTHORIZED
Displays all the /PERSONA [=address] information and additional selected information, including all the Rights and their attributes authorized for each persona security block (PSB).

/PHD
Lists the information included in the process header (PHD).

/POOL

Displays the dynamic storage pool of the process P0 (process) and/or P1 (control) region, or, optionally a **range** of addresses.

The /POOL qualifier has the following format:

```
/POOL [={P0|P1|ALL}][range][/BRIEF][/FREE][/HEADER]
                    [MAXIMUM_BYTES [=n]][/STATISTICS]
                    [/SUBTYPE=packet-type][/SUMMARY]
                    [/TYPE=packet-type][/UNUSED]
```

You can express a **range** using the following syntax:

m:n Displays the process pool in the range of virtual addresses from *m* to *n*.

m;n Displays process pool in a range of *n* bytes, starting at virtual address *m*.

/PPT
Is a synonym for /PAGE_TABLES.

/PROCESS_SECTION_TABLE [/SECTION_INDEX=*id*]
Lists the information contained in the process section table (PST). The /SECTION_INDEX=*id* qualifier used with /PROCESS_SECTION_TABLE displays the process section table entry for the specified section.

/PST
Is a synonym for /PROCESS_SECTION_TABLE.

/PT
When used with the /PAGE_TABLES qualifier, displays the page table entries for the page table space of the process.

/PTE_ADDRESS
When used with the /PAGE_TABLES qualifier, specifies that the range is of PTE addresses instead of the virtual addresses mapped by the PTE.

/RDE [=*id*]
/REGIONS [=*id*]
Lists the information contained in the process region table for the specified region. If you do not specify a region, the entire table is displayed, including the process-permanent regions. You can use the qualifiers /RDE [=*id*] and /REGIONS [=*id*] interchangeably. When used with the /PAGE_TABLES, causes SDA to display only the page tables for the region given or all regions.

/REGISTERS
Lists the hardware context of the process, as reflected in the process registers stored in the hardware privileged context block (HWPCB), in its kernel stack, and possibly, in its PHD.

/RIGHTS
Used with the /PERSONA qualifier. See the /PERSONA/RIGHTS description for use of the /RIGHTS qualifier.

/RMS [=*option*[,...]]
Displays certain specified RMS data structures for each image I/O or process-permanent I/O file the process has open. To display RMS data structures for process-permanent files, specify the PIO option to this qualifier.

SDA determines the structures to be displayed according to either of the following methods:

- If you provide the name of a structure or structures in the **option** parameter, SHOW PROCESS/RMS displays information from only the specified structures. (See Table 4–2 for a list of keywords that you can supply as options.)

- If you do not specify an **option**, SHOW PROCESS/RMS displays the current list of options as shown by the SHOW RMS command and set by the SET RMS command.

/SECTION_INDEX=*n*
When used with the /PAGE_TABLES qualifier, displays the page table for the range of pages in the specified process section. You can also specify one of the qualifiers /L1, /L2, or /L3.

When used with the /PROCESS_SECTION_TABLE qualifier, displays the PST for the specified process section.

The /SECTION_INDEX=*n* qualifier is ignored if you do not specify either the /PAGE_TABLES or the /PROCESS_SECTION_TABLE qualifier.

/SEMAPHORE
Displays the Inner Mode Semaphore for a multithreaded process.

/STATISTICS
When used with /POOL, displays statistics on the free list(s) in process pool.

/SUBTYPE=*packet-type*
When used with /POOL, displays only packets of the specified subtype. This qualifier is interchangeable with the /TYPE qualifier.

/SUMMARY
When used with /POOL, displays only an allocation summary for each packet type.

/SYSTEM
Displays the system's process control block. The system PCB and process header (PHD) parallel the data structures that describe processes. They contain the system working set, global section table, global page table, and other systemwide data.

/THREADS
Displays the software and hardware context of all the threads associated with the current process.

/TQE [=ALL]
Displays all timer queue entries associated with the current process. If specified as /TQE, a one-line summary is output for each TQE. If specified as /TQE=ALL, a detailed display of the TQE is output. See Table 4–29 for an explanation of TQE types in the one-line summary.

/TYPE=*packet-type*
When used with /POOL, displays only packets of the specified type. This qualifier is interchangeable with the /SUBTYPE qualifier.

/UNUSED
When used with /POOL, displays only free packets.

/WORKING_SET_LIST [={PPT | PROCESS | LOCKED | GLOBAL | MODIFIED | *n*}]

Displays the contents of the requested entries of the working set list for the process. If you do not specify an option, then all working set list entries are displayed. Table 4–17 shows the options available with SHOW PROCESS/WORKING_SET_LIST.

Table 4–17 Options for the /WORKING_SET_LIST Qualifier

Options	Results
PPT	Displays process page table pages
PROCESS	Displays process-private pages
LOCKED	Displays pages locked into the process's working set
GLOBAL	Displays global pages currently in the working set of the process
MODIFIED	Displays working set list entries marked modified
n	Displays a specific working set list entry, where *n* is the working set list index (WSLX) of the entry of interest

Description

The SHOW PROCESS command displays information about the process specified by **process-name**, the process specified in the /ID or /INDEX qualifier, the next process in the system's process list, the system process, or all processes. The SHOW PROCESS command performs an implicit SET PROCESS command under certain uses of its qualifiers and parameters, as noted previously. By default, the SHOW PROCESS command produces information about the SDA current process, as defined in Section 2.5.

The default of the SHOW PROCESS command provides information taken from the software process control block (PCB) and the kernel threads block (KTB) of the SDA current thread. This is the first display provided by the /ALL qualifier and the only display provided by the /PCB qualifier. This information describes the following characteristics of the process:

- Software context
- Condition-handling information
- Information on interprocess communication
- Information on counts, quotas, and resource usage

Among the displayed information are the process PID, EPID, priority, job information block (JIB) address, and process header (PHD) address. SHOW PROCESS also describes the resources owned by the process, such as event flags and mutexes. The "State" field records the current scheduling state for the thread, and indicates the CPU ID of any thread whose state is CUR. See Table 4–28 for a list of all possible states.

The /THREADS qualifier (also part of SHOW PROCESS/ALL), displays information from the KTBs of all threads in the process, instead of only the SDA current thread.

The SHOW PROCESS/ALL command displays additional process-specific information, also provided by several of the individual qualifiers to the command.

The **process registers** display, also produced by the /REGISTERS qualifier, describes the process hardware context, as reflected in its registers. The registers displayed are those of the SDA current thread, or of all threads if either the /THREADS or the /ALL qualifier have been specified.

A process hardware context is stored in the following locations:

- If the process is currently executing on a processor in the Alpha system (that is, in the CUR scheduling state), its hardware context is contained in that processor's registers. (That is, the process registers and the processor's registers contain identical values, as illustrated by a SHOW CPU command for that processor or a SHOW CRASH command, if the process was current at the time of the system failure.)
- If the process is not executing, its privileged hardware context is stored in the part of the PHD known as the HWPCB. Its integer register context is stored on its kernel stack. Its floating-point registers are stored in its PHD.

The **process registers** display first lists those registers stored in the HWPCB, kernel stack, and PHD ("Saved process registers"). If the process to be displayed is currently executing on a processor in the Alpha system, the display then lists the processor's registers ("Active registers for the current process"). In each section, the display lists the registers in the following groups:

- Integer registers (R0 through R29)
- Special-purpose registers (PC and PS)
- Stack pointers (KSP, ESP, SSP, and USP)
- Page table base register (PTBR)
- AST enable and summary registers (ASTEN and ASTSR)
- Address space number register (ASN)

The **semaphore** display, also produced by the /SEMAPHORE qualifier, provides information on the inner-mode semaphore used to synchronize kernel threads. The PC history log, recorded if the system parameter SYSTEM_CHECK is enabled, is also displayed.

The **process header** display, also produced by the /PHD qualifier, provides information taken from the PHD, which is swapped into memory when the process becomes part of the balance set. Each item listed in the display reflects a quantity, count, or limit for the process use of the following resources:

- Process memory
- The pager
- The scheduler
- Asynchronous system traps
- I/O activity
- CPU activity

The **working set information** and **working set list** displays, also produced by the /WORKING_SET_LIST qualifier, describe those virtual pages that the process can access without a page fault. After a brief description of the size, scope, and characteristics of the working set list itself, SDA displays information for each entry in the working set list as shown in Table 4–18.

Table 4–18 Working Set List Entry Information in the SHOW PROCESS Display

Column	Contents
INDEX	Index into the working set list at which information for this entry can be found
ADDRESS	Virtual address of the page that this entry describes
STATUS	Four columns that list the following status information: • Page status of VALID • Type of physical page (See Table 4–10) • Indication of whether the page has been modified • Indication of whether the page is locked into the working set

When SDA locates either one or more unused working set entries, or entries that do not match the specified option, it issues the following message:

```
---- n entries not displayed
```

In this message, *n* is the number (in decimal) of contiguous entries not displayed.

The **process section table information** and **process section table** displays, also produced by the /PROCESS_SECTION_TABLE or /PST qualifier, list each entry in the process section table (PST) and display the offsets to, and the indexes of, the first free entry and last used entry.

SDA displays the information listed in Table 4–19 for each PST entry.

Table 4–19 Process Section Table Entry Information in the SHOW PROCESS Display

Part	Definition
INDEX	Index number of the entry. Entries in the process section table begin at the highest location in the table, and the table expands toward lower addresses.
ADDRESS	Address of the process section table entry.
SECTION ADDRESS	Virtual address that marks the beginning of the first page of the section described by this entry.
CCB	Address of the channel control block on which the section file is open.
PAGELETS	Length of the process section. This is in units of pagelets, except for a PFN-mapped section in which the units are pages.
VBN	Virtual block number. The number of the file's virtual block that is mapped into the section's first page.
WINDOW	Address of the window control block on which the section file is open.

(continued on next page)

Table 4–19 (Cont.) Process Section Table Entry Information in the SHOW PROCESS Display

Part	Definition
REFCNT	Number of pages of this section that are currently mapped.
FLINK	Forward link. The pointer to the next entry in the PST list.
BLINK	Backward link. The pointer to the previous entry in the PST list.
FLAGS	Flags that describe the access that processes have to the process section.

In addition, for each process section that has an associated file, the device and/or file name is displayed. For details of this display, see Table 4–21.

The **regions** display, also produced by the either of the /RDE or /REGIONS qualifiers, shows the contents of the region descriptors. This includes the three default regions (P0, P1, P2), plus any others created by the process. A single region will be displayed if you specify its identifier. The information displayed for each region includes the RDE address, the address range of the region, its identifiers and protection, and links to other RDEs.

If you use the /PAGE_TABLE or /PPT qualifer with /RDE or /REGION, the page table for the region is also displayed, as described below.

The **P0 page table**, **P1 page table**, **P2 page table**, and **PT page table** displays, also produced by the /PAGE_TABLES qualifier, display listings of the process page table entries in the same format as that produced by the SHOW PAGE_TABLE command (see Tables 4–6 through Table 4–11).

The **RMS** display, also produced by the /RMS qualifier, provides information on the RMS internal data structures for all RMS-accessed open files. The data structures displayed depend on the current setting of RMS options, as described under the SET RMS command and Table 4–2.

The **locks** display, also produced by the /LOCKS qualifier, provides information on the locks held by the process. For a full description of the information displayed for process locks, see the SHOW LOCKS command and Table 4–5. You can also specify the /BRIEF qualifier, which is a single-line summary of each process lock; however, no other qualifiers from SHOW LOCKS apply to SHOW PROCESS/LOCKS.

The **process active channels** display, also produced by the /CHANNEL qualifier, displays the information in Table 4–20 for each I/O channel assigned to the process.

Table 4–20 Process Active Channels in the SHOW PROCESS Display

Column	Contents
Channel	Number of the channel.
CCB	The address of the channel control block (CCB).

(continued on next page)

Table 4–20 (Cont.) Process Active Channels in the SHOW PROCESS Display

Column	Contents
Window	Address of the window control block (WCB) for the file if the device is a file-oriented device; zero otherwise.
Status	Status of the device: "Busy" if the device has an I/O operation outstanding; "Dpnd" if the device is deaccess pending; blank otherwise.
Device/file accessed	Name of the device and, if applicable, name of the file being accessed on that device.

The information listed under the heading "Device/file accessed" varies from channel to channel and from process to process. SDA displays certain information according to the conditions listed in Table 4–21.

Table 4–21 Process I/O Channel Information in the SHOW PROCESS Display

Information Displayed[1]	Type of Process
dcuu:	SDA displays this information for devices that are not file structured, such as terminals, and for processes that do not open files in the normal way.
dcuu:*filespec*	SDA displays this information only if you are examining a running system, and only if your process has enough privilege to translate the *file-id* into the *filespec*.
dcuu:(*file-id*)	The *file-id* no longer points to a valid *filespec*, as when you look at a dump from another system; or the process in which you are running SDA does not have enough privilege to translate the *file-id* into the corresponding *filespec*.
`(section file)`	The file in question is mapped into the process's memory.

[1]This table uses the following conventions to identify the information displayed:
dcuu:(*file-id*)*filespec*
where:
dcuu: is the name of the device.
file-id is the RMS file identification, or
filespec is the full file specification, including directory name.

The **images** display, also produced by the /IMAGES qualifier, describes the activated images in the process. SDA displays the information listed in Table 4–22 for each image, plus a summary line giving the total image and total page counts.

Table 4–22 Image Information in the SHOW PROCESS Display

Item	Description
Image Name	The name of the image.
Link Time[1]	The date and time the image was linked.
Section Type[1]	For shareable images, the data for each image section is displayed on a separate line. For privileged shareable images, data for the change mode vector is also displayed on a separate line.
Start	Start address of the image in process memory. For resident shareable images, this is the start address of the process-space portion of the image.
End	End address of the image in process memory. For resident shareable images, this is the end address of the process-space portion of the image.
Type	The image type and/or activation method, plus "PROT" for protected images and "SHR" for shareable images.
IMCB	The address of the Image Management Control Block.
Sym Vect[1]	The address of the image's symbol vector, if any.
Maj,Minor ID[1]	The major and minor revision IDs for the image.
Base[1]	For shareable images, the base address of each image section and/or the change mode vector.
Fnd[1]	For shareable images, the end address of each image section and/or the change mode vector.
ImageOff[1]	For shareable images, the virtual offset within the image file for each image section.

[1]These items are only displayed with SHOW PROCESS/IMAGE=ALL or SHOW PROCESS/ALL.

The **buffer objects** display, also produced by the /BUFFER_OBJECTS qualifier, describes the buffer objects in use by the process. Information displayed by SDA for each buffer object includes its address, access mode, size, flags, plus the base virtual address of the object in process space and system space.

The **fast I/O handles** display, also produced by the /FANDLES qualifier, describes the fast I/O handles used by the process. Information displayed by SDA includes the address and size of the fast I/O handle vector header, then the address, corresponding IRP, state, and buffer object handles for each fast I/O handle, plus information on free vector entries.

The **persona** display, also produced by the /PERSONA qualifier, describes the Persona status block data structures. The default output of /PERSONA consists of summary information for all personae in use by the process (the PSB address, flags, user name) and information for each persona (privilege masks, UIC, and so on). When you specify /PERSONA/RIGHTS (as in SHOW PROCESS/ALL), all the rights currently held and active for each persona are also displayed. When you specify /PERSONA/RIGHTS/AUTHORIZED, all the rights authorized for each persona are displayed instead.

The **pool** display, also produced by the /POOL qualifier, describes the P0 and P1 process pools. The default output of /POOL is the entire contents of each used block of pool. When you specify /POOL/HEADER (as in SHOW PROCESS/ALL), only the first 16 bytes of each used pool block is displayed. By default, all pool in either P0 or P1 is displayed. You can limit this using /POOL=P0 or /POOL=P1. See the description of the SHOW POOL command for explanations of other qualifiers.

The **Timer Queue Entry (TQE)** display, also produced by the /TQE qualifier, describes all timer queue entries that affect the process. The default display (as in SHOW PROCESS/ALL) is a one-line summary of each TQE. If you specify /TQE=ALL, a detailed display of each TQE is given. No other qualifiers from the SHOW TQE command apply to SHOW PROCESS/TQE.

Examples

1. SDA> SHOW PROCESS

```
Process index: 0028   Name: SYSTEM   Extended PID: 000000E8
-----------------------------------------------------------
Process status:          02040001  RES,PHDRES,INTER
        status2:         00000000

PCB address              81444A40    JIB address              81443600
PHD address              821AA000    Swapfile disk address    00000000
KTB vector address       81444D2C    HWPCB address            821AA080
Callback vector address  00000000    Termination mailbox          0000
Master internal PID      00030028    Subprocess count                0
Creator extended PID     00000000    Creator internal PID     00000000
Previous CPU Id          00000000    Current CPU Id           00000000
Previous ASNSEQ  0000000000000003    Previous ASN     0000000000000017
Initial process priority        4    # open files remaining       100/100
Delete pending count            0    Direct I/O count/limit       150/150
UIC                [00001,000004]    Buffered I/O count/limit     149/150
Abs time of last event   01F1A51D    BUFIO byte count/limit     99424/99808
# of threads                    1    ASTs remaining               248/250
Swapped copy of LEFC0    00000000    Timer entries remaining       20/20
Swapped copy of LEFC1    00000000    Active page table count         0
Global cluster 2 pointer 00000000    Process WS page count          43
Global cluster 3 pointer 00000000    Global WS page count           28

Thread index: 0000
------------------
Current capabilities:    System: 0000000C  QUORUM,RUN
                         User:   00000000
Permanent capabilities:  System: 0000000C  QUORUM,RUN
                         User:   00000000
Current affinities:      00000000
Permanent affinities:    00000000
Thread status:           02040001
       status2:          00000000

KTB address              81444A40    HWPCB address            821AA080
PKTA address             7FFEFF98    Callback vector address  00000000
Internal PID             00030028    Callback error           00000000
Extended PID             000000E8    Current CPU id           00000000
State                       LEF      Flags                    00000000
Base priority                   4    Current priority                5
Waiting EF cluster              0    Event flag wait mask     DFFFFFFF
CPU since last quantum       FFF8    Mutex count                     0
ASTs active                  NONE
```

The SHOW PROCESS command displays information taken from the software PCB of SYSTEM, the SDA current process. According to the State field in the display, process SYSTEM is in Local Event Flag Wait.

2. SDA> SHOW PROCESS/ALL

```
Process index: 0013   Name: ACME_SERVER   Extended PID: 00000413
----------------------------------------------------------------
Process status:          00040011  RES,PSWAPM,PHDRES
        status2:         00000010  TCB

PCB address              81AFF480    JIB address              8177E440
PHD address              84166000    Swapfile disk address    00000000
KTB vector address       81B00900    HWPCB address            84166080
Callback vector address  81AFF8C0    Termination mailbox          000F
Master internal PID      00010013    Subprocess count                0
Creator extended PID     00000000    Creator internal PID     00000000
Previous CPU Id          00000004    Current CPU Id           00000004
Previous ASNSEQ  000000000000003D    Previous ASN     0000000000000002
Initial process priority        8    # open files remaining         97/100
Delete pending count            0    Direct I/O count/limit        200/200
UIC                [00001,000004]    Buffered I/O count/limit      199/200
Abs time of last event   0012D67F    BUFIO byte count/limit      66272/66272
# of threads                    2    ASTs remaining                199/200
Swapped copy of LEFC0    00000000    Timer entries remaining        64/64
Swapped copy of LEFC1    00000000    Active page table count         0
Global cluster 2 pointer 00000000    Process WS page count         350
Global cluster 3 pointer 00000000    Global WS page count          100


Process index: 0013   Name: ACME_SERVER   Extended PID: 00000413
----------------------------------------------------------------

Thread index: 0000
------------------
Current capabilities:    System: 0000002C  QUORUM,RUN
                         User:   00000000
Permanent capabilities:  System: 0000002C  QUORUM,RUN
                         User:   00000000
Current affinities:      00000000
Permanent affinities:    00000000
Thread status:           00040011
       status2:          00000010

KTB address              815D0880    HWPCB address            83F62080
PKTA address             7FFEFF98    Callback vector address  815BB780
Internal PID             00010013    Callback error           00000000
Extended PID             00000413    Current CPU id           00000000
State                       HIB      Flags                    00000080
Base priority                   8    Current priority               13
Waiting EF cluster              0    Event flag wait mask     00130013
CPU since last quantum       0286    Mutex count                     0
ASTs active                  NONE

Current process registers
-------------------------
R0   = 00000000.00000001  R1   = FFFFFFFF.815D0880  R2   = 00000000.7BC1CFF0
R3   = 00000000.7BC1CFF0  R4   = 00000000.0009D740  R5   = 00000000.7BC22E38
R6   = 00000000.00000080  R7   = 00000000.00000040  R8   = 00000000.00000001
R9   = 00000000.00000000  R10  = 00000000.00000000  R11  = 00000000.00000004
R12  = 00000000.0009DC80  R13  = FFFFFFFF.810D0B20  R14  = 00000000.7BC230B0
R15  = 00000000.7BC65558  R16  = 00000000.00000001  R17  = 00000000.0009BBE8
R18  = 00000000.00000000  R19  = 00000000.00000000  R20  = FFFFFFFF.FFFFFFFE
R21  = 00000000.00000006  R22  = 00000000.00000000  R23  = 00000000.00000001
R24  = 00000000.0009BBE8  R25  = 00000000.00000000  R26  = FFFFFFFF.801270C8
R27  = FFFFFFFF.810CD888  R28  = 00000000.00000006  FP   = 00000000.0009BC20
PC   = FFFFFFFF.80001934  PS   = 00000000.0000001B
KSP  = 00000000.7FFA1EF0  ESP  = 00000000.7FFA6000  SSP  = 00000000.7FFAE000
USP  = 00000000.0009BC20  PTBR = 00000000.00004F65
AST{SR/EN}    = 0000000F  ASN  = 00000000.000000FD
F0   = 00000000.00000000  F1   = 00000000.00000000  F2   = 00000000.00000000
F3   = 00000000.00000000  F4   = 00000000.00000000  F5   = 00000000.00000000
F6   = 00000000.00000000  F7   = 00000000.00000000  F8   = 00000000.00000000
F9   = 00000000.00000000  F10  = 00000000.00000000  F11  = 00000000.00000000
F12  = 00000000.00000000  F13  = 00000000.00000000  F14  = 00000000.00000000
F15  = 00000000.00000000  F16  = 00000000.00000000  F17  = 00000000.00000000
F18  = 00000000.00000000  F19  = 00000000.00000000  F20  = 00000000.00000000
F21  = 00000000.00000000  F22  = 00000000.00000000  F23  = 00000000.00000000
F24  = 00000000.00000000  F25  = 00000000.00000000  F26  = 00000000.00000000
F27  = 00000000.00000000  F28  = 00000000.00000000  F29  = 00000000.00000000
F30  = 00000000.00000000  FPCR = 00000000.00000000
```

continued

VM-0754A-AI

```
Thread index: 0001
------------------
Current capabilities:    System: 0000002C  QUORUM,RUN
                         User:   00000000
Permanent capabilities:  System: 0000002C  QUORUM,RUN
                         User:   00000000
Current affinities:      00000000
Permanent affinities:    00000000
Thread status:           00040011
       status2:          00000010

KTB address              8153DA80    HWPCB address            84026200
PKTA address             40015F98    Callback vector address  815BB780
Internal PID             00020013    Callback error           00000000
Extended PID             00000813    Current CPU id           00000000
State                       HIB      Flags                    00000000
Base priority                  8     Current priority               13
Waiting EF cluster             0     Event flag wait mask     7FFFFFFF
CPU since last quantum      0036     Mutex count                     0
ASTs active                 NONE

Current process registers
-------------------------
R0   = 00000000.00000001  R1   = FFFFFFFF.815D0880  R2   = 00000000.7BC1CFF0
R3   = 00000000.7BC1CFF0  R4   = 00000000.000CB740  R5   = 00000000.7BC22E38
R6   = 00000000.00000080  R7   = 00000000.00000040  R8   = 00000000.00000001
R9   = 00000000.00000000  R10  = 00000000.00000000  R11  = 00000000.00000004
R12  = 00000000.000CBC80  R13  = FFFFFFFF.810D0B20  R14  = 00000000.7BC230B0
R15  = 00000000.7BC65558  R16  = 00000000.00000001  R17  = 00000000.000C9BE8
R18  = 00000000.00000000  R19  = 00000000.00000000  R20  = FFFFFFFF.FFFFFFFE
R21  = 00000000.00000006  R22  = 00000000.00000000  R23  = 00000000.00000001
R24  = 00000000.000C9BE8  R25  = 00000000.00000000  R26  = FFFFFFFF.801270C8
R27  = FFFFFFFF.810CD888  R28  = 00000000.00000006  FP   = 00000000.000C9C20
PC   = FFFFFFFF.80001934  PS   = 00000000.0000001B
KSP  = 00000000.40003EF0  ESP  = 00000000.40008000  SSP  = 00000000.4000C000
USP  = 00000000.000C9C20  PTBR = 00000000.00004F65
AST{SR/EN}    = 0000000F  ASN  = 00000000.000000F7
F0   = 00000000.00000000  F1   = 00000000.00000000  F2   = 00000000.00000000
F3   = 00000000.00000000  F4   = 00000000.00000000  F5   = 00000000.00000000
F6   = 00000000.00000000  F7   = 00000000.00000000  F8   = 00000000.00000000
F9   = 00000000.00000000  F10  = 00000000.00000000  F11  = 00000000.00000000
F12  = 00000000.00000000  F13  = 00000000.00000000  F14  = 00000000.00000000
F15  = 00000000.00000000  F16  = 00000000.00000000  F17  = 00000000.00000000
F18  = 00000000.00000000  F19  = 00000000.00000000  F20  = 00000000.00000000
F21  = 00000000.00000000  F22  = 00000000.00000000  F23  = 00000000.00000000
F24  = 00000000.00000000  F25  = 00000000.00000000  F26  = 00000000.00000000
F27  = 00000000.00000000  F28  = 00000000.00000000  F29  = 00000000.00000000
F30  = 00000000.00000000  FPCR = 00000000.00000000

Process index: 0013   Name: ACME_SERVER   Extended PID: 00000413
----------------------------------------------------------------
Inner Mode Semaphore Address:   84026000
Owner:                              0000
Ownership Depth:                    0000
Tolerant count:                     0000
Flags:                              0000
History Buffer Is Empty

Process index: 0013   Name: ACME_SERVER   Extended PID: 00000413
----------------------------------------------------------------

Process header
--------------

First free P0 VA  00000000.00822000    Accumulated CPU time       0000004D
First free P1 VA  00000000.7AFCE000    Subprocess quota                 10
First free P2 VA  00000000.80000000    ASTs enabled                   KESU
Free page file pages            1565    ASN sequence #     0000000000000075
Page fault cluster size            4    AST limit                       200
Page table cluster size            1    Process header index           000D
Flags                       00000026    Backup address vector      0005C9A8
Direct I/O count                  17    PTs having locked WSLEs           3
Buffered I/O count                55    PTs having valid WSLEs           10
Limit on CPU time           00000000    Active page tables               10
Maximum page file count         2500    Maximum active PTs                8
Total page faults                345    Guaranteed fluid WS pages        20
File limit                       100    Extra dynamic WS entries       1529
Local event flag cluster 0 E0000001    Local event flag cluster 1 80000000
Timer queue limit                 64    Pagefile refcnt   00000000.000000F0
Page Table Base Register   00004F65    Virtual PT Base   FFFFFEFC.00000000
```

continued
VM-0755A-AI

```
Process index: 0013   Name: ACME_SERVER   Extended PID: 00000413
----------------------------------------------------------------

Working set information
-----------------------

First WSL entry          00000001   Current authorized working set size   3144
First locked entry       00000009   Default (initial) working set size    1572
First dynamic entry      00000010   Maximum working set allowed (quota)   3144
Last entry replaced      000001BC
Last entry in list       00000624


Working set list
----------------

           INDEX          ADDRESS           STATUS

          00000001   FFFFFEFD.BF6FC000    VALID PPT(L1) WSLOCK
          00000002   FFFFFEFD.BF000000    VALID PPT(L2) WSLOCK
          00000003   FFFFFEFC.001FE000    VALID PPT(L3) WSLOCK
          00000004   00000000.7FFA0000    VALID PROCESS MODIFIED WSLOCK
          00000005   00000000.7FFF0000    VALID PROCESS WSLOCK
          00000006   FFFFFFFF.83F62000    VALID PHD     WSLOCK
          00000007   FFFFFFFF.83F64000    VALID PHD     WSLOCK
          00000008   FFFFFFFF.83F66000    VALID PHD     WSLOCK

Locked entries:
          00000009   00000000.7AFE0000    VALID PROCESS WSLOCK
          0000000A   00000000.7AFE2000    VALID PROCESS WSLOCK
          0000000B   FFFFFFFF.84026000    VALID PHD     WSLOCK
          0000000C   00000000.7FFEE000    VALID PROCESS WSLOCK
          0000000D   00000000.40002000    VALID PROCESS WSLOCK
          0000000E   00000000.40014000    VALID PROCESS WSLOCK
          0000000F   00000000.40016000    VALID PROCESS WSLOCK

Dynamic entries:
          00000010   00000000.7FFCE000    VALID PROCESS
          00000011   FFFFFEFC.001EA000    VALID PPT(L3) WSLOCK
          00000012   00000000.7AFDC000    VALID PROCESS
          00000013   00000000.7FEB8000    VALID PROCESS
          00000014   00000000.7AFDE000    VALID PROCESS
          00000015   00000000.7FFD0000    VALID PROCESS MODIFIED
          00000016   00000000.7FFBA000    VALID PROCESS
          .
          .
          .
          000001B4   FFFFFEFC.00002000    VALID PPT(L3) WSLOCK
          000001B5   00000000.00806000    VALID PROCESS
          000001B6   00000000.006F2000    VALID PROCESS
          000001B7   00000000.006F4000    VALID PROCESS
          000001B8   00000000.00804000    VALID PROCESS
          000001B9   00000000.0081E000    VALID PROCESS
          000001BA   00000000.0080A000    VALID PROCESS
          000001BB   00000000.0080C000    VALID PROCESS
          000001BC   00000000.0081C000    VALID PROCESS

           ----  1128 entries not displayed
```

continued
VM-0756A-AI

```
Process index: 0013   Name: ACME_SERVER   Extended PID: 00000413
-------------------------------------------------------------------

Process section table information
---------------------------------

       Last entry allocated     0000000B
       First free entry         0000000B

Process section table
---------------------

 Index   Address   Section Address      CCB     Pagelets    VBN      Window    Refcnt  Flink Blink   Flags
-------- -------- -----------------   --------  --------  --------  --------  -------- ----- -----  --------------------
00000001 81EF1FD8 00000000.00138000   7FF961A0  0000005F  00000004  814EEB00  00000006  0009  0005  AMOD=KRNL
  File = DISK$X97D_R2Y:[VMS$COMMON.SYSLIB]VMS$VMS_ACMESHR.EXE;1

00000002 81EF1FB0 00000000.7B96A000   7FF96280  00000001  00000003  814C70C0  00000000  000A  000A  CRF WRT AMOD=KRNL
  File = DISK$X97D_R2Y:[VMS$COMMON.SYSLIB]TRACE.EXE;1

00000003 81EF1F88 00000000.00030000   7FF96020  000000B3  0000002F  814ED8C0  0000000C  0004  0004  AMOD=KRNL
  File = DISK$X97D_R2Y:[VMS$COMMON.SYSEXE]ACME_SERVER.EXE;1

.
.
.

00000009 81EF1E98 00000000.003A8000   7FF961A0  00000003  00000DD9  814EEB00  00000001  0008  0001  AMOD=KRNL
  File = DISK$X97D_R2Y:[VMS$COMMON.SYSLIB]VMS$VMS_ACMESHR.EXE;1

0000000A 81EF1E70 00000000.7B9FA000   7FF96280  00000013  00000345  814C70C0  00000000  0002  0002  CRF WRT AMOD=KRNL
  File = DISK$X97D_R2Y:[VMS$COMMON.SYSLIB]TRACE.EXE;1

0000000B 81EF1E48 00000000.7BA0A000   00000000  00000001  00000358  814C70C0  FFFFFFFF  000A  0002  CRF WRT AMOD=KRNL
  File = DISK$X97D_R2Y:[VMS$COMMON.SYSLIB]TRACE.EXE;1

Process index: 0013   Name: ACME_SERVER   Extended PID: 00000413
----------------------------------------------------------------

Process Region Table
--------------------

RDE Addr    Flink   Blink     T Link    Flags   Protect    Region Ident     Starting Address      Region Size       First Free VA
--------  -------- --------  -------- -------- --------  -----------------  -----------------  -----------------  -----------------
7FEBA328  7FEBA328 7FEBA328  00000000 0000000A 00000030  00000000.00000000  00000000.00000000  00000000.40000000  00000000.00822000
7FEBA360  7FE99960 7FE99960  00000000 0000001D 00000030  00000000.00000001  00000000.40168000  00000000.3FE98000  00000000.7AFCE000
7FEBA398  7FEBA398 7FEBA398  00000000 00000008 00000030  00000000.00000002  00000000.80000000  000006FB.80000000  00000000.80000000
7FE99960  7FEBA360 7FEBA360  00000000 00000004 00000030  00000000.00000010  00000000.40000000  00000000.00168000  00000000.40018000

Process index: 0013   Name: ACME_SERVER   Extended PID: 00000413
----------------------------------------------------------------

P0 space
--------

 Mapped Address      PTE Address           PTE        Type  Read Writ Bits GH PgTyp   Loc          Bak       RefCnt  Flink    Blink
----------------- ----------------- ----------------- ----- ---- ---- ---- - ------- ------ ----------------- ---- -------- --------

       --------           8 null pages:             VA   00000000.00000000          PTE  FFFFFEFC.00000000
                                                    -to- 00000000.0000FFFF          -to- FFFFFEFC.00000038

00000000.00010000 FFFFFEFC.00000040 0000376A.00160F09 VALID KESU NONE M-U- 0 PROCESS ACTIVE FF000000.00000000 0001 00000000 0000003B

       --------           7 null pages:             VA   00000000.00012000          PTE  FFFFFEFC.00000048
                                                    -to- 00000000.0001FFFF          -to- FFFFFEFC.00000078

00000000.00020000 FFFFFEFC.00000080 00005060.0016FF09 VALID KESU KESU M-U- 0 PROCESS ACTIVE FF000000.00000000 0001 00000000 00000093
00000000.00022000 FFFFFEFC.00000088 00005061.0016FF09 VALID KESU KESU M-U- 0 PROCESS ACTIVE FF000000.00000000 0001 00000000 00000094

       --------           6 null pages:             VA   00000000.00024000          PTE  FFFFFEFC.00000090
                                                    -to- 00000000.0002FFFF          -to- FFFFFEFC.000000B8

00000000.00030000 FFFFFEFC.000000C0 0000503D.00060F01 VALID KESU NONE --U- 0 PROCESS ACTIVE 00000003.00010000 0001 00000000 00000085
00000000.00032000 FFFFFEFC.000000C8 0000503E.00060F01 VALID KESU NONE --U- 0 PROCESS ACTIVE 00000003.00010000 0001 00000000 00000086
00000000.00034000 FFFFFEFC.000000D0 0000503F.00060F01 VALID KESU NONE --U- 0 PROCESS ACTIVE 00000003.00010000 0001 00000000 00000087
          .
          .
          .
```

continued
VM-0757A-AI

```
00000000.0081C000 FFFFFEFC.00002070 000038E4.0016FF09 VALID KESU KESU M-U- 0 PROCESS ACTIVE FF000000.00000000 0001 00000000 000001BC
00000000.0081E000 FFFFFEFC.00002078 000038E1.0016FF09 VALID KESU KESU M-U- 0 PROCESS ACTIVE FF000000.00000000 0001 00000000 000001B9
00000000.00820000 FFFFFEFC.00002080 00000000.0006FF00 DZERO KESU KESU --U- 0

        --------        1007 null pages:             VA   00000000.00822000         PTE  FFFFFEFC.00002088
                                                     -to- 00000000.00FFFFFF         -to- FFFFFEFC.00003FF8


        --------      129024 entries not in memory:  VA   00000000.01000000         PTE  FFFFFEFC.00004000
                                                     -to- 00000000.3FFFFFFF         -to- FFFFFEFC.000FFFF8


P1 space
--------

 Mapped Address      PTE Address           PTE        Type  Read Writ Bits GH PgTyp   Loc          Bak       RefCnt  Flink    Blink
----------------- ----------------- ----------------- ----- ---- ---- ---- - ------- ------ ----------------- ---- -------- --------

        --------           1 null page:              VA   00000000.40000000         PTE  FFFFFEFC.00100000

00000000.40002000 FFFFFEFC.00100008 000037DC.00101709 VALID KES- K--- MLK- 0 PROCESS ACTIVE FF000000.00000000 0001 00000000 0000000D
00000000.40004000 FFFFFEFC.00100010 00000000.00023700 DZERO KES- KE-- --E- 0
00000000.40006000 FFFFFEFC.00100018 00003861.00123709 VALID KES- KE-- M-E- 0 PROCESS ACTIVE FF000000.00000000 0001 00000000 000000BC
00000000.40008000 FFFFFEFC.00100020 00000000.00047F00 DZERO KESU KES- --S- 0
00000000.4000A000 FFFFFEFC.00100028 00000000.00047F00 DZERO KESU KES- --S- 0
00000000.4000C000 FFFFFEFC.00100030 00000000.00001100 DZERO K--- K--- --K- 0
00000000.4000E000 FFFFFEFC.00100038 00000000.0000FF00 DZERO KESU KESU --K- 0
00000000.40010000 FFFFFEFC.00100040 00000000.0000FF00 DZERO KESU KESU --K- 0
00000000.40012000 FFFFFEFC.00100048 00000000.0000FF00 DZERO KESU KESU --K- 0
00000000.40014000 FFFFFEFC.00100050 000037DD.0010FF09 VALID KESU KESU MLK- 0 PROCESS ACTIVE FF000000.00000000 0001 00000000 0000000E
00000000.40016000 FFFFFEFC.00100058 000037DE.00103F09 VALID KESU KE-- MLK- 0 PROCESS ACTIVE FF000000.00000000 0001 00000000 0000000F

        --------        1012 null pages:             VA   00000000.40018000         PTE  FFFFFEFC.00100060
                                                     -to- 00000000.407FFFFF         -to- FFFFFEFC.00101FF8


        --------      118784 entries not in memory:  VA   00000000.40800000         PTE  FFFFFEFC.00102000
                                                     -to- 00000000.7A7FFFFF         -to- FFFFFEFC.001E9FF8


        --------        1000 null pages:             VA   00000000.7A800000         PTE  FFFFFEFC.001EA000
                                                     -to- 00000000.7AFCFFFF         -to- FFFFFEFC.001EBF38

00000000.7AFD0000 FFFFFEFC.001EBF40 000038BF.0016FF09 VALID KESU KESU M-U- 0 PROCESS ACTIVE FF000000.00000000 0001 00000000 00000195
00000000.7AFD2000 FFFFFEFC.001EBF48 00003883.0016FF09 VALID KESU KESU M-U- 0 PROCESS ACTIVE FF000000.00000000 0001 00000000 0000011A
00000000.7AFD4000 FFFFFEFC.001EBF50 000038BE.0016FF09 VALID KESU KESU M-U- 0 PROCESS ACTIVE FF000000.00000000 0001 00000000 00000190
           .
           .
           .
00000000.7FFEE000 FFFFFEFC.001FFFB8 00003753.0010FF09 VALID KESU KESU MLK- 0 PROCESS ACTIVE FF000000.00000000 0001 00000000 0000000C
00000000.7FFF0000 FFFFFEFC.001FFFC0 00004FAB.10103F09 VALID KESU KE-- MLK- 0 PROCESS ACTIVE FF000000.00000000 0001 00000000 00000005

        --------           7 null pages:             VA   00000000.7FFF2000         PTE  FFFFFEFC.001FFFC8
                                                     -to- 00000000.7FFFFFFF         -to- FFFFFEFC.001FFFF8


P2 space
--------

 Mapped Address      PTE Address           PTE        Type  Read Writ Bits GH PgTyp   Loc          Bak       RefCnt  Flink    Blink
----------------- ----------------- ----------------- ----- ---- ---- ---- - ------- ------ ----------------- ---- -------- --------

        --------   937164800 entries not in memory:  VA   00000000.80000000         PTE  FFFFFEFC.00200000
                                                     -to- FFFFFEFB.FFFFFFFF         -to- FFFFFEFD.BEFFFFF8


PT space
--------

 Mapped Address      PTE Address           PTE        Type  Read Writ Bits GH PgTyp   Loc          Bak       RefCnt  Flink    Blink
----------------- ----------------- ----------------- ----- ---- ---- ---- - ------- ------ ----------------- ---- -------- --------
FFFFFEFC.00000000 FFFFFEFD.BF000000 00003784.40101309 VALID KE-- K--- MLK- 0 PPT(L3) ACTIVE FF000000.00000000 0001 000000F3 0000001F
FFFFFEFC.00002000 FFFFFEFD.BF000008 000038DC.40101309 VALID KE-- K--- MLK- 0 PPT(L3) ACTIVE FF000000.00000000 0001 00000006 000001B4

        --------         126 null pages:             VA   FFFFFEFC.00004000         PTE  FFFFFEFD.BF000010
                                                     -to- FFFFFEFC.000FFFFF         -to- FFFFFEFD.BF0003F8

FFFFFEFC.00100000 FFFFFEFD.BF000400 000037DB.40101309 VALID KE-- K--- MLK- 0 PPT(L3) ACTIVE FF000000.00000000 0001 00000004 0000009F

        --------         116 null pages:             VA   FFFFFEFC.00102000         PTE  FFFFFEFD.BF000408
                                                     -to- FFFFFEFC.001E9FFF         -to- FFFFFEFD.BF0007A0
```

continued

VM-0758A-AI

```
FFFFFEFC.001EA000 FFFFFEFD.BF0007A8 00003758.40101309 VALID KE-- K--- MLK- 0 PPT(L3) ACTIVE FF000000.00000000 0001 0000000B 00000011
FFFFFEFC.001EC000 FFFFFEFD.BF0007B0 00003755.40101309 VALID KE-- K--- MLK- 0 PPT(L3) ACTIVE FF000000.00000000 0001 00000024 000000A1
FFFFFEFC.001EE000 FFFFFEFD.BF0007B8 00003785.40101309 VALID KE-- K--- MLK- 0 PPT(L3) ACTIVE FF000000.00000000 0001 0000005F 00000022
FFFFFEFC.001F0000 FFFFFEFD.BF0007C0 0000387B.40101309 VALID KE-- K--- MLK- 0 PPT(L3) ACTIVE FF000000.00000000 0001 00000015 000000E5

       --------           6 null pages:             VA   FFFFFEFC.001F2000          PTE  FFFFFEFD.BF0007C8
                                                    -to- FFFFFEFC.001FDFFF          -to- FFFFFEFD.BF0007F0

FFFFFEFC.001FE000 FFFFFEFD.BF0007F8 00004FAD.40001309 VALID KE-- K--- -LK- 0 PPT(L3) ACTIVE FF000000.00000000 0001 0000000E 00000003

       --------         768 null pages:             VA   FFFFFEFC.00200000          PTE  FFFFFEFD.BF000800
                                                    -to- FFFFFEFC.007FFFFF          -to- FFFFFEFD.BF001FF8


       --------      914432 entries not in memory:  VA   FFFFFEFC.00800000          PTE  FFFFFEFD.BF002000
                                                    -to- FFFFFEFD.BEFFFFFF          -to- FFFFFEFD.BF6FBFF8

FFFFFEFD.BF000000 FFFFFEFD.BF6FC000 00004FAE.40001109 VALID K--- K--- -LK- 0 PPT(L2) ACTIVE FF000000.00000000 0001 00000008 00000002

       --------         893 null pages:             VA   FFFFFEFD.BF002000          PTE  FFFFFEFD.BF6FC008
                                                    -to- FFFFFEFD.BF6FBFFF          -to- FFFFFEFD.BF6FDBE8

FFFFFEFD.BF6FC000 FFFFFEFD.BF6FDBF0 00004F65.40000109 VALID K--- NONE -LK- 0 PPT(L1) ACTIVE 00000000.83F62000 0001 00000001 00000001


Process index: 0013   Name: ACME_SERVER   Extended PID: 00000413
----------------------------------------------------------------

ASB Address:        7B02E000
-----------

LTP_POOL: 7B030800            IMPURE:             7FFD00C4
BLN:                00002600      9728.
BID:                00000032        50.

FP:       7FFA5118 7FFD00C4
SP:       7FFA5118 7FFD00C4
FLAGS:              00000000
PERSONA_ID:                2
SAVED_ID:        1

IO_OPERATION/OLD_FAB:         00000000
P4_PARM:  00000880
STS:      00018292
EFN:      0000001D
STALL_STRUCT:       00000000
ERRAST:   00000000
SUCAST:   00000000
FAB:      7FFD1000
STACK:    7B02F200
STKTOP:   7B02E070
STKBOT:   7B02F200
STKLEN:             00001190      4496.
MODE_OFFSET:                  00000001        1.
SAVED_ASB:          00000000
BKP:                00002008  ASY_THREAD,STALL_WITH_PERSONA

          .
          .
          .

BDB Address:        7B028710
-----------

FLINK:              7B02726C            BID:                0C              12.
BLINK:              7B02726C            BLN:                1C              28.
FLGS:               00
USERS:              0000            0. BLB_PTR:  00000000
CACHE_VAL:00                0. BUFF_ID:  0000             0.
SIZE:               00000000            NUMB:               0000003B
ADDR:               00000000            VBN:                00000000
VBNSEQNO: 00000000            WAIT:               00000000
WK1:                00000000            CURBUFADR:00000000000FC000
REL_VBN:  00000000            PRE_CCTL: 00
ASB:                00000000
ALLOC_ADDR:         00000000            BI_BDB:             00000000
ALLOC_SIZE:         0000            0  AI_BDB:             00000000
VAL_VBNS: 00000000            POST_CCTL:00
IOSB:               00000000            WAIT_Q_FLINK:       00000000
                    00000000            WAIT_Q_BLINK:       00000000
REUSE_COUNT:        00000000            IDX_BKT_LEVEL:      00
```

continued

VM-0759A-AI

```
Process index: 0013   Name: ACME_SERVER   Extended PID: 00000413
-------------------------------------------------------------------

                           Process active channels
                           -----------------------

Channel    CCB     Window     Status    Device/file accessed
-------    ---     ------     ------    --------------------
  0010  7FEB8000  00000000              WFGLX0$DKB500:
  0020  7FEB8020  81AFEFC0              WFGLX0$DKB500:[VMS$COMMON.SYSEXE]ACME_SERVER.EXE;1
  0030  7FEB8040  81756700              WFGLX0$DKB500:[VMS$COMMON.SYSLIB]PTHREAD$RTL.EXE;1 (section file)
  0040  7FEB8060  81753E80              WFGLX0$DKB500:[VMS$COMMON.SYSLIB]LIBOTS.EXE;1 (section file)
  0050  7FEB8080  81753E00              WFGLX0$DKB500:[VMS$COMMON.SYSLIB]LIBRTL.EXE;1 (section file)
  0060  7FEB80A0  81755600              WFGLX0$DKB500:[VMS$COMMON.SYSLIB]CMA$TIS_SHR.EXE;1 (section file)
  0070  7FEB80C0  81756B00              WFGLX0$DKB500:[VMS$COMMON.SYSLIB]DECC$SHR.EXE;1 (section file)
  0080  7FEB80E0  81756680              WFGLX0$DKB500:[VMS$COMMON.SYSLIB]DPML$SHR.EXE;1 (section file)
  0090  7FEB8100  8175D3C0              WFGLX0$DKB500:[VMS$COMMON.SYSMSG]SHRIMGMSG.EXE;1 (section file)
  00A0  7FEB8120  8175CB00              WFGLX0$DKB500:[VMS$COMMON.SYSMSG]DECC$MSG.EXE;1 (section file)
  00B0  7FEB8140  00000000  Busy        MBA16:
  00C0  7FEB8160  81B01B80              WFGLX0$DKB500:[SYS50.SYSMGR]ACME$SERVER.LOG;30
  00D0  7FEB8180  81B02140              WFGLX0$DKB500:[VMS$COMMON.SYSLIB]VMS$VMS_ACMESHR.EXE;1
  00E0  7FEB81A0  81755340              WFGLX0$DKB500:[VMS$COMMON.SYSLIB]SECURESHR.EXE;1 (section file)
  00F0  7FEB81C0  817534C0              WFGLX0$DKB500:[VMS$COMMON.SYSLIB]SECURESHRP.EXE;1 (section file)
  0100  7FEB81E0  81753CC0              WFGLX0$DKB500:[VMS$COMMON.SYSLIB]PTD$SERVICES_SHR.EXE;1 (section file)
  0110  7FEB8200  817557C0              WFGLX0$DKB500:[VMS$COMMON.SYSLIB]CRFSHR.EXE;1 (section file)
  0120  7FEB8220  817572C0              WFGLX0$DKB500:[VMS$COMMON.SYSLIB]ADARTL.EXE;1 (section file)
  0130  7FEB8240  81756EC0              WFGLX0$DKB500:[VMS$COMMON.SYSLIB]CMA$RTL.EXE;1 (section file)
  0140  7FEB8260  817559C0              WFGLX0$DKB500:[VMS$COMMON.SYSLIB]TRACE.EXE;1 (section file)

  Total number of open channels : 20.


Process index: 0013   Name: ACME_SERVER   Extended PID: 00000413
----------------------------------------------------------------

                           Process activated images
                           ------------------------

   Image Name/Link Time/Section Type     Start     End        Type       IMCB    Sym Vect Maj,Minor ID   Base     End    ImageOff
--------------------------------------- -------- -------- ------------ -------- -------- ------------ -------- -------- --------
ACME_SERVER                             00010000 000705FF MAIN         7FE98060          113,12385697
  3-FEB-2001 22:56:22.00

SHRIMGMSG                               000B4000 000BA9FF MRGD     SHR 7FE99840 000B4000 113,12524133
  3-FEB-2001 23:11:29.25

DECC$MSG                                000BC000 000BFFFF MRGD     SHR 7FE98A30 000BC000 113,12609585
  3-FEB-2001 23:20:49.27

VMS$VMS_ACMESHR                         00108000 00389FFF MRGD         7FE992A0 0012DE80 113,12563930
  3-FEB-2001 23:15:50.06

SECURESHRP                              7B2B4000 7B335FFF GLBL PRT SHR 7FE99A20 7B2B9640   1,4
  3-FEB-2001 22:42:02.12
                System Resident Code                                                            80800000 808271FF 00030000
              Shareable Address Data                                                            7B2B4000 7B2B9FFF 00000000
                     Read-Write Data                                                            7B2C4000 7B2C59FF 00010000
            Shareable Read-Only Data                                                            7B2D4000 7B2D47FF 00020000
              Shareable Address Data                                                            7B314000 7B314717 00060000
                    Demand Zero Data                                                            7B324000 7B3241FF 00070000
                     Compressed Data                                                            7B334000 7B334BFF 00080000

          .
          .
          .

ADARTL                                  7C030000 7C07BFFF GLBL     SHR 7FE98B50 7C037320   1,3
  3-FEB-2001 22:50:26.28
              Shareable Address Data                                                            7C030000 7C0385FF 00000000
              Shareable Address Data                                                            7C03A000 7C03D5FF 00010000
                      Shareable Code                                                            7C03E000 7C0709FF 00020000
                     Read-Write Data                                                            7C072000 7C0727FF 00060000
            Shareable Read-Only Data                                                            7C074000 7C0745FF 00070000
                     Read-Write Data                                                            7C076000 7C0761FF 00080000
                    Demand Zero Data                                                            7C078000 7C0781FF 00090000
                     Compressed Data                                                            7C07A000 7C07AFFF 000A0000

SYS$PUBLIC_VECTORS                      81003E78 81005E37 GLBL         7FE98840 81003E78 113,12237208

SYS$BASE_IMAGE                          81019D90 8102C23F GLBL         7FE98720 81019D90 113,12239366

Total images = 19                       Pages allocated = 885
```

continued

VM-0760A-AI

```
Process index: 0013   Name: ACME_SERVER   Extended PID: 00000413
----------------------------------------------------------------

No buffer objects for this process

Process index: 0013   Name: ACME_SERVER   Extended PID: 00000413
----------------------------------------------------------------

The fandle vector is empty.

Process index: 0013   Name: ACME_SERVER   Extended PID: 00000413
----------------------------------------------------------------
                      PROCESS PERSONAE
                      ----------------

 ID    PSB      Refcnt          Flags            Username
----  --------  ------  -----------------------  ---------------
0001   815C8F00   005    PERMANENT                SYSTEM


Persona ID: 0001      PSB: 815C8F00         Username:  SYSTEM
----------------------------------------------------------------
Flags  : 00000001                 Refcount : 005
Mode   : User                     Noaudit  : 1
Account: <start>                  UIC      : [00001,000004]

Privileges:
     Authorized       :   000000208009D025
     Permanent        :   000000208009D025
     Working (Persona):   00000060D009D025
     Working (Image)  :   0000000000000000

Enabled rights:    0000000000000003    ( PERSONA,SYSTEM )


Rights Chain: PERSONA (Enabled) :

        ID         Flags
    ----------   ----------
     00010004     00000001


Rights Chain: SYSTEM (Enabled) :

        ID         Flags
    ----------   ----------
     80010001     00000000

Process index: 0013   Name: ACME_SERVER   Extended PID: 00000413
----------------------------------------------------------------

P1 Dynamic Storage Pool
-----------------------

        NPOOL address:                                     (None)
        Pool map address:                                  (None)
        Number of lookaside lists:                              0
        Granularity size:                                      16
        P1 pool available for image requests:            FFFFFD30
        P1 pool allowed for image requests:              00004600
        Variable list header:                   00000000.7FFF0188

Segment(s)
----------

         Start       End       Length
        --------    --------    --------
        7FE96000    7FEB5FFF    00020000

Dump of packets allocated from P1 Pool
--------------------------------------

   Packet type/subtype                              Start    Length                                 Header contents
-------------------------                          -------- --------            -----------------------------------------------------
LNM                                                7FE96000 00000080            00000000 00400080 7FE96FD8 00000000  ....Øoé...@.....
LNM                                                7FE96080 00000080            00000000 00400080 7FE96F7C 00000000  ....|oé...@.....
LNM                                                7FE96100 00000060            00000000 00400060 7FE97044 00000000  ....Dpé.`.@.....
          .
          .
          .
KFERES                                             7FE9A5F0 000000E0            00000008 026600E0 00000000 B7CE07D0  ‹.Î·....à.f.....
FREE_IMCB                                          7FE9A6D0 00000120            00000203 07660118 7FE99CD0 7FFD0698  ..‡.‹.é...f.....
KFERES                                             7FE9A7F0 000000E0            00000008 026600E0 00000000 B7CD9220   .Í·....à.f.....
```

continued
VM-0761A-AI

```
Summary of P1 Pool contents
---------------------------

    Packet type/subtype        Packet count      Packet bytes    Percent
---------------------------  ----------------  ----------------  --------
Unknown                      00000001          00000080            (0.7%)
RSHT                         00000001          00000810           (11.1%)
LNM                          0000000A          000008C0           (12.0%)

PGD                          00000026          00002740           (53.9%)
  KFERES                             0000000D          00000B20   (15.3%)
  IMCB                               00000013          00001560   (29.4%)
  FREE_IMCB                          00000006          000006C0    (9.3%)

MISC                         00000001          00000040            (0.3%)
  RDE                                00000001          00000040    (0.3%)

LNMC                         00000020          00001000           (22.0%)
  LNMC                               00000020          00001000   (22.0%)

Total space used: 000048D0 (18640.) bytes out of 00020000 (131072.) bytes
  in 00000053 (83.) packets

Total space utilization: 14.2%

Process index: 0013   Name: ACME_SERVER   Extended PID: 00000413
-----------------------------------------------------------------

Process has no TQEs
```

VM-0809A-AI

The SHOW PROCESS/ALL command displays information taken from the PCB and KTBs of process ACME_SERVER, then displays the process registers, inner mode semaphores, the process header and working set, the process section table, process regions, the page tables of the process, RMS data structures, information about I/O channels owned by the process, images activated by the process, process persona data structures, and process pool. You can also obtain these displays using the /PCB, /THREADS, /REGISTERS, /SEMAPHORE, /PHD, /WORKING_SET_LIST, /PST, /RDE, /PAGE=ALL, /RMS, /CHANNELS, /IMAGES=ALL, PERSONA/RIGHTS, and /POOL/HEADER qualifiers, respectively. This process had no locks, buffer objects, fast I/O handles, or TQEs to be displayed.

3. SDA> SHOW PROCESS/PAGE_TABLES/ADDRESS=805E7980

```
 PO page table
 -------------

 MAPPED ADDRESS      PTE ADDRESS           PTE        TYPE  READ WRIT BITS GH PGTYP   LOC          BAK       REFCNT  FLINK    BLINK


        --------            8 null pages:             VA    00000000.00000000          PTE  FFFFFFFC.00000000
                                                      -to-  00000000.0000E000          -to- FFFFFFFC.00000038

00000000.00010000 FFFFFFFC.00000040 000003E7.00160F09 VALID KESU NONE M-U- 0 PROCESS ACTIVE 03000000.00000000 0001 00000000 00000034

        --------            7 null pages:             VA    00000000.00012000          PTE  FFFFFFFC.00000048
                                                      -to-  00000000.0001E000          -to- FFFFFFFC.00000078

00000000.00020000 FFFFFFFC.00000080 0000046E.0016FF09 VALID KESU KESU M-U- 0 PROCESS ACTIVE 03000000.00000000 0001 00000000 00000037

        --------            7 null pages:             VA    00000000.00022000          PTE  FFFFFFFC.00000088
                                                      -to-  00000000.0002E000          -to- FFFFFFFC.000000B8

00000000.00030000 FFFFFFFC.000000C0 0000015C.00060F01 VALID KESU NONE --U- 0 PROCESS ACTIVE 00000002.00090000 0001 00000000 00000036

        --------            7 null pages:             VA    00000000.00032000          PTE  FFFFFFFC.000000C8
                                                      -to-  00000000.0003E000          -to- FFFFFFFC.000000F8

00000000.00040000 FFFFFFFC.00000100 0000014D.00163F09 VALID KESU KE-- M-U- 0 PROCESS ACTIVE 03000000.00000000 0001 00000000 00000032

        --------          991 null pages:             VA    00000000.00042000          PTE  FFFFFFFC.00000108
                                                      -to-  00000000.007FE000          -to- FFFFFFFC.00001FF8


        --------       130048 entries not in memory:  VA    00000000.00800000          PTE  FFFFFFFC.00002000
                                                      -to-  00000000.3FFFE000          -to- FFFFFFFC.000FFFF8
```

ZK–8864A–GE

This example displays the page tables of a process whose PCB address is 805E7980.

```
4. SDA> SHOW PROCESS/BUFFER_OBJECTS/FANDLES

Process index: 0022   Name: Milord_RTA1:   Extended PID: 00000062
-----------------------------------------------------------------

                           Process Buffer Objects
                           ----------------------

ADDRESS  ACMODE SEQUENCE  REFCNT    PID     PAGCNT     BASE PVA          BASE SVA
-------- ------ -------- -------- -------- -------- ----------------- -----------------
8151AE00 User   00000011 00000031 00010022 00000001 00000000.00084000 FFFFFFFF.7DE68000 S2_WINDOW
814A6CC0 User   00000012 00000009 00010022 00000001 00000000.80000000 FFFFFFFF.7DE66000 S2_WINDOW
814FBA00 User   00000013 00000009 00010022 00000001 00000000.80000000 FFFFFFFF.FFFFFFFF NOSVA
81512200 User   00000014 00000009 00010022 00000001 00000000.80028000 FFFFFFFF.7DE64000 S2_WINDOW
8151A8C0 User   00000015 00000009 00010022 00000001 00000000.80028000 FFFFFFFF.FFFFFFFF NOSVA
81438580 User   00000016 00000009 00010022 00000001 FFFFFEFB.FF800000 FFFFFFFF.7DE62000 S2_WINDOW
81464480 User   00000017 00000009 00010022 00000001 FFFFFEFB.FF800000 FFFFFFFF.FFFFFFFF NOSVA
81416F00 Kernel 00000018 00000001 00010022 00000001 00000000.7FF76000 FFFFFFFF.8120C000 NOQUOTA

                  Fandle Vector Header
                  --------------------

Address   Maxfix  Real_Size CCB buffer handle
-------- -------- --------- -----------------
7FF68290 00000043  00000880 00000018.81416F00

                         Fandles
                         -------

Address     IRP   fastio_done  Orgfun   Data bo handle     IOSA bo handle       DBYLEN
-------- -------- ----------- -------- ----------------- ----------------- -----------------
7FF682B0 815CEF40     set     00020031 00000016.81438580 00000011.8151AE00 00000000.00002000
7FF682D0 815CE4C0     set     00020030 00000016.81438580 00000011.8151AE00 00000000.00002000
7FF682F0 815CE200     set     00000031 00000016.81438580 00000011.8151AE00 00000000.00002000
7FF68310 815D4B80     set     00000030 00000016.81438580 00000011.8151AE00 00000000.00002000
7FF68330 815D65C0     set     00020031 00000015.8151A8C0 00000011.8151AE00 00000000.00002000
7FF68350 815D6880     set     00020030 00000015.8151A8C0 00000011.8151AE00 00000000.00002000

   .
   .
   .

7FF68810 815D6B40     set     00020031 00000013.814FBA00 00000011.8151AE00 00000000.00002000
7FF68830 815D5880     set     00020030 00000013.814FBA00 00000011.8151AE00 00000000.00002000

                    -----     00000013 free FVEs (IRP = 00000000)              VA   7FF68850
                                                                               -to- 7FF68A90

7FF68AB0 815D9840     set     00020031 00000017.81464480 00000011.8151AE00 00000000.00002000
7FF68AD0 815CD040     set     00020030 00000017.81464480 00000011.8151AE00 00000000.00002000
7FF68AF0 815CB480     set     00000031 00000017.81464480 00000011.8151AE00 00000000.00002000
```

The SHOW PROCESS/BUFFER_OBJECTS/FANDLES command displays all the buffered objects and fast I/O handles that a process has created.

```
5. SDA> SHOW PROCESS JOB_CONTROL/TQE

Process index: 000C   Name: JOB_CONTROL   Extended PID: 0000004C
----------------------------------------------------------------

                            Timer queue entries
                            -------------------

  TQE
address                Expiration Time                 Type
--------   ---------------------------------------   ------
81504080   00A05ABD.895F93C5 27-NOV-2001 11:17:17.37   TSD---
815026C0   00A05AC3.80D0E000 27-NOV-2001 12:00:00.00   TSA---
81502180   00A0C160.635594EF  7-APR-2002 02:00:00.12   TSA---
```

This example shows the timer queue entries for the process JOB_CONTROL. See Table 4–29 for an explanation of the Type codes.

SHOW RAD

Displays the settings and explanations of the RAD_SUPPORT system parameter fields, and the assignment of CPUs and memory to the Resource Affinity Domains (RADs). This command is only useful on platforms that support RADs. By default, the SHOW RAD command displays the settings of the RAD_SUPPORT system parameter fields.

Format

SHOW RAD [number|/ALL]

Parameter

number
Information on CPUs and memory for the specified RAD.

Qualifier

/ALL
Displays settings of the RAD_SUPPORT parameter fields and the CPU and memory assignments for all RADs.

Examples

1.
```
SDA> SHOW RAD

Resource Affinity Domains
-------------------------

    RAD information header address: FFFFFFFF.81032340
    Maximum RAD count:                        00000008
    RAD containing SYS$BASE_IMAGE:            00000000
    RAD support flags:                        0000004F

     3         2 2         1 1
     1         4 3         6 5         8 7         0
    +-----------+-----------+-----------+-----------+
    |..|..| skip|ss|gg|ww|pp|..|..|..|..|.p|fs|cr|ae|
    +-----------+-----------+-----------+-----------+
    |..|..|    0| 0| 0| 0| 0|..|..|..|..|.1|00|11|11|
    +-----------+-----------+-----------+-----------+

    Bit 0 = 1:          RAD support is enabled

    Bit 1 = 1:          Soft RAD affinity support is enabled
                        (Default scheduler skip count of 16 attempts)

    Bit 2 = 1:          System-space replication support is enabled

    Bit 3 = 1:          Copy on soft fault is enabled

    Bit 4 = 0:          Default RAD-based page allocation in use

                        Allocation Type              RAD choice
                        ---------------              ----------
                        Process-private pagefault    Home
                        Process creation or inswap   Random
                        Global pagefault             Random
                        System-space page allocation  Current

    Bit 5 = 0:          RAD debug feature is disabled
```

```
Bit 6 = 1:          Per-RAD non-paged pool is enabled
```

This example shows the settings of the RAD_SUPPORT system parameter fields.

2. ```
SDA> SHOW RAD 2
```

```
Resource Affinity Domain 0002
-----------------------------

CPU sets:

  Active      08 10 11
  Active      08 10 11
  Configure   08 09 10 11
  Potential   08 10 11

PFN ranges:

  Start PFN   End PFN     PFN count   Flags
  ---------   --------    ---------   -----
  01000000    0107FFE7    0007FFE8    000A  OpenVMS Base
  0107FFE8    0107FFFF    00000018    0009  Console Base

SYSPTBR:      01002A01

RAD data:     B817C000
```

This example shows information on the CPUs and memory for RAD 2.
```

SHOW RESOURCES

Displays information about all resources in the system or about a resource associated with a specific lock.

Format

SHOW RESOURCES {/ADDRESS=*n*|/ALL (d)
| /BRIEF|/CACHED|/CONTENTION [=ALL]
|/LOCKID=*lock-id* |/LIST|/NAME=*name*
|/OWNED|/STATUS= (*keyword* [,*keyword*...])}

Parameters

None.

Qualifiers

/ADDRESS=*n*
Displays information from the resource block at the specified address.

/ALL
Displays information from all resource blocks (RSBs) in the system. This is the default behavior of the SHOW RESOURCES command.

/BRIEF
Displays a single line of information for each resource.

/CACHED
Displays resource blocks that are no longer valid. The memory for these resources is saved so that later requests for resources can use them.

/CONTENTION [=ALL]
Displays only resources that have at least one lock on either the waiting or conversion queue. Unless you specify the ALL keyword, resources with locks on the waiting or conversion queues that are not participating in deadlock searches are ignored. (Locks not participating in deadlock searches are requested with either the LCK$M_NODLCKWT or LCK$M_NODLCKBLK flags.)

/LIST
Displays summary information for each resource, followed by a list of all locks associated with the resource.

/LOCKID=*lock-id*
Displays information on the resource associated with the lock with the specified *lock-id*.

/NAME=*name*
Displays information about the specific resource. *Name* may be the actual name of the resource, if it only contains uppercase letters, numerals, the underscore (_), dollar sign, colon (:), and some other printable characters, as for example, /NAME=MY_LOCK. If it contains other printable characters (including lowercase letters), you may need to enclose the name in quotation marks (""), as for example, /NAME="My_Lock/47". If it contains nonprintable characters, the name may be specified as a comma-separated list comprised of strings and hexadecimal

numbers, as for example, /NAME=("My_Lock",0C00,"/47") would specify the name "My_Lock<NUL><FF>/47". The hexadecimal number can be no more than 8 digits (4 bytes) in length. Nonprintable sequences or more than 4 bytes must be split into multiple hexadecimal numbers. The maximum length of a resource name is 32 characters.

/OWNED
Displays only owned resources.

/STATUS=(*keyword* [*,keyword...*])
Displays only resources that have the specified status bits set in the RSB$L_STATUS field. Status keywords are as follows:

Keyword	Meaning
2PC_IP	Indicates a two-phase convert operation in progress
BRL	Indicates byte range resource
CHK_BTR	Checks for better master
CVTFULRNG	Indicates full-range requests in convert queue
CVTSUBRNG	Indicates sub-range requests in convert queue
DIRENTRY	Indicates directory entry during failover
DIR_IP	Creates directory entry
DIR_RQD	Indicates directory entry required
INVPEND	Checks for value block invalidation
RBLD_ACT	Indicates lock rebuild active for this tree
RBLD_IP	Indicates rebuild operation in progress
RBLD_RQD	Indicates rebuild required for this resource tree
RM_ACCEPT	Accepts new master
RM_DEFLECT	Deflects remote interest
RM_IP	Indicates resource remaster in progress
RM_PEND	Indicates a pending resource remaster operation
RM_RBLD	Indicates to always rebuild resource tree
RM_WAIT	Blocks local activity
VALCUR	Indicates value block is current
VALINVLD	Indicates value block invalid
WTFULRNG	Indicates full-range requests in wait queue
WTSUBRNG	Indicates a sub-range requests in wait queue

Description

The SHOW RESOURCES command displays the information listed in Table 4–23 either for each resource in the system or for the specific resource associated with the specified **lock-id**, address, or name.

Table 4–23 Resource Information in the SHOW RESOURCES Display

Field	Contents
Address of RSB	Address of the resource block (RSB) that describes this resource.
GGMODE	Indication of the most restrictive mode in which a lock on this resource has been granted. Table 4–24 shows the values and their meanings. For information on conflicting and incompatible lock modes, see the *OpenVMS System Services Reference Manual*.
Status	The contents of the resource block status field.
Parent RSB	Address of the RSB that is the parent of this RSB. This field is 00000000 if the RSB itself is a parent block.
CGMODE	Indication of the most restrictive lock mode to which a lock on this resource is waiting to be converted. This does not include the mode for which the lock at the head of the conversion queue is waiting. See Table 4–24.
Sub-RSB count	Number of RSBs of which this RSB is the parent. This field is 0 if the RSB has no sub-RSBs.
FGMODE	Indication of the full-range grant mode. See Table 4–24.
Lock Count	The total count of all locks on the resource.
RQSEQNM	Sequence number of the request.
BLKAST count	Number of locks on this resource that have requested a blocking AST.
CSID	Cluster system identification number (CSID) and name of the node that owns the resource.
Resource	Dump of the name of this resource, as stored at the end of the RSB. The first two columns are the hexadecimal representation of the name, with the least significant byte represented by the rightmost two digits in the rightmost column. The third column contains the ASCII representation of the name, the least significant byte being represented by the leftmost character in the column. Periods in this column represent values that correspond to nonprinting ASCII characters.
Valblk	Hexadecimal dump of the 16-byte value block associated with this resource.
Length	Length in bytes of the resource name.
Mode	Processor mode of the namespace in which this RSB resides.
Owner	Owner of the resource. Certain resources, owned by the operating system, list “System” as the owner. Locks owned by a group have the number (in octal) of the owning group in this field.

(continued on next page)

Table 4–23 (Cont.) Resource Information in the SHOW RESOURCES Display

Field	Contents
Seqnum	Sequence number associated with the resource's value block. If the number indicates that the value block is not valid, the words "Not valid" appear to the right of the number.
Granted queue	List of locks on this resource that have been granted. For each lock in the list, SDA displays the number of the lock and the lock mode in which the lock was granted.
Conversion queue	List of locks waiting to be converted from one mode to another. For each lock in the list, SDA displays the number of the lock, the mode in which the lock was granted, and the mode to which the lock is to be converted.
Waiting queue	List of locks waiting to be granted. For each lock in the list, SDA displays the number of the lock and the mode requested for that lock.

Table 4–24 Lock Modes on Resources

Value[1]	Meaning
NL	Null mode
CR	Concurrent-read mode
CW	Concurrent-write mode
PR	Protected-read mode
PW	Protected-write mode
EX	Exclusive mode

[1]Values are shown in order from the least restrictive mode to the most restrictive.

Examples

1.
```
SDA>  SHOW RESOURCES
Resource database
-----------------

RSB:         FFFFFFFF.7FD47950  GGMODE:     PR  Status: VALID
Parent RSB:  00000000.00000000  CGMODE:     PR
Sub-RSB count:      0           FGMODE:     PR
Lock Count:         1           RQSEQNM:  0000
BLKAST count:       1           CSID: 00000000  (SWORKS)

Resource:          6D632445 48434143  CACHE$cm  Valblk: 00000000 00000000
 Length   24       525F534B 524F5753  SWORKS_R          00000000 00000000
 Kernel mode       000027DA 4E455641  AVENÚ'¯..
 System            00000000 00000000  ........  Seqnum: 00000000

Granted queue (Lock ID / Gr mode / Range):
 0100042F  PR 00000000-FFFFFFFF

Conversion queue (Lock ID / Gr mode / Range -> Rq mode / Range):
     *** EMPTY QUEUE ***

Waiting queue (Lock ID / Rq mode / Range):
     *** EMPTY QUEUE ***


Resource Database
-----------------
RSB:         FFFFFFFF.7FA66A50  GGMODE:     NL  Status: VALID
Parent RSB:  FFFFFFFF.7FD88350  CGMODE:     NL
Sub-RSB count:      0           FGMODE:     NL
Lock Count:         2           RQSEQNM:  004D
BLKAST count:       0           CSID: 00000000  (SWORKS)

Resource:          001E7324 42313146  F11B$s..  Valblk: 00000001 0000033A
 Length   10       00000000 00000000  ........          00000000 00000000
 Kernel mode       00000000 00000000  ........
 System            00000000 00000000  ........  Seqnum: 00000672

Granted queue (Lock ID / Gr mode / Range):
 69000F80  NL 00000000-FFFFFFFF        01001810  NL 00000000-FFFFFFFF

Conversion queue (Lock ID / Gr mode / Range -> Rq mode / Range):
     *** EMPTY QUEUE ***

Waiting queue (Lock ID / Rq mode / Range):
     *** EMPTY QUEUE ***

   .
   .
   .
```

The SHOW RESOURCES command displays information taken from the RSBs of all resources in the system. For instance, the RSB at FFFFFFFF.7FA66A50$_{16}$ is a parent block with no sub-RSBs.

```
2.SDA> SHOW RESOURCE/CONTENTION

  Resource Contention Information:
  --------------------------------
     RSB Address     Parent RSB Addr          Resource Name              LKB Address      PID     Node   Lockid  GR RQ  Queue
  ----------------- ----------------- ------------------------------- ----------------- -------- ------ -------- -- -- -------
  FFFFFFFF.7FAAC550 FFFFFFFF.7FB47A50 P.......
                                                                      FFFFFFFF.7FAEC350 00010027 SWORKS 04001158 PW    Granted
                                                                      FFFFFFFF.7FB34550 00000000 CMOS   08000E46 CR    Granted
                                                                      FFFFFFFF.7FA93250 00000000 CMOS   030015A3 CR    Granted
                                                                      FFFFFFFF.7FB3EA50 00000000 CMOS   09000DC0 CR    Granted
                                                                      FFFFFFFF.7FAE7B50 00000000 CMOS   080011C6 CR    Granted
                                                                      FFFFFFFF.7FA36050 00010023 SWORKS 060019F3 CR    Granted
                                                                      FFFFFFFF.7FA7BE50 00000000 CMOS   020016A1 NL    Granted
                                                                      FFFFFFFF.7FAAC650 00000000 SWORKS 010014AC NL    Granted
                                                                      FFFFFFFF.7FA62C50 00010028 SWORKS 020017C1 CR PW Convert
                                                                      FFFFFFFF.7FAF9950 00010024 SWORKS 040010E5 CR PW Convert
                                                                      FFFFFFFF.7FA33C50 00000000 CMOS   02001A36    PW Waiting
                                                                      FFFFFFFF.7FB14550 00000000 CMOS   0F00010E    PW Waiting

  FFFFFFFF.7FB39050 FFFFFFFF.7FB47A50 P...ö...
                                                                      FFFFFFFF.7FB3CC50 00010024 SWORKS 0B000DDC PW    Granted
                                                                      FFFFFFFF.7FAC0E50 00010023 SWORKS 03001400 CR    Granted
                                                                      FFFFFFFF.7FA74950 00000000 CMOS   030016DE CR    Granted
                                                                      FFFFFFFF.7FA4C050 00010026 SWORKS 020018CE CR    Granted
                                                                      FFFFFFFF.7FAC5050 00010022 SWORKS 070013C3 CR    Granted
                                                                      FFFFFFFF.7FB38450 00010025 SWORKS 09000E0E CR    Granted
                                                                      FFFFFFFF.7FACD450 00010028 SWORKS 0700134E CR    Granted
                                                                      FFFFFFFF.7FAD2250 00000000 CMOS   080012DF CR    Granted
                                                                      FFFFFFFF.7FAE0750 00000000 CMOS   0100120F NL    Granted
                                                                      FFFFFFFF.7FB37B50 00000000 SWORKS 01000E3D NL    Granted
                                                                      FFFFFFFF.7FB14A50 00010027 SWORKS 2500011C CR PR Convert
                                                                      FFFFFFFF.7FAD4950 00000000 CMOS   070012CA CR PR Convert
                                                                      FFFFFFFF.7FAC9550 00000000 CMOS   0900138D CR PR Convert
                                                                      FFFFFFFF.7FB03250 00000000 CMOS   0C001069 CR PR Convert
                                                                      FFFFFFFF.7FD70C50 00000000 CMOS   080005AF CR PR Convert

  FFFFFFFF.7FD7A250 00000000.00000000 †...T...&.à!....
                                                                      FFFFFFFF.7FDC5650 00010026 SWORKS 1A00084C PW    Granted
                                                                      FFFFFFFF.7FDF4950 00010020 SWORKS 010009A1    PW Waiting


  FFFFFFFF.7FD9A250 00000000.00000000 †...T...$.à!....
                                                                      FFFFFFFF.7FD07550 00010024 SWORKS 2E0004EB PW    Granted
                                                                      FFFFFFFF.7FDF4A50 00010020 SWORKS 010009A2    PW Waiting

  FFFFFFFF.7FD36450 FFFFFFFF.7FD0EC50 QMAN$JBC_ALIVE_01
                                                                      FFFFFFFF.7FD27050 00000000 CMOS   1A0002CA EX    Granted
                                                                      FFFFFFFF.7FD7B450 00000000 CMOS   050007D4    CR Waiting
```

ZK-9159A-AI

This example of the SHOW RESOURCES/CONTENTION commands shows all the resources for which there is contention, and which are to be included in dead lock searches.

```
3.SDA> SHOW RESOURCES/LIST

Resource Database
-----------------
   RSB Address     Parent RSB Addr          Resource Name            LKB Address      PID     Node   Lockid  GR RQ  Queue
----------------- ----------------- ------------------------------- ----------------- -------- ------ -------- -- -- -------
FFFFFFFE.DD058180 00000000.00000000 F11B$b$217$DKC200:                                         QTV11
                                                                    FFFFFFFE.DD04E580 00000000 MHERTZ 02000DDF CR    Granted

FFFFFFFE.DCF6F080 00000000.00000000 F11B$v$22$DKB12:                                           QTV11
                                                                    FFFFFFFE.DD063180 00000000 MHERTZ 0200122D CR    Granted

FFFFFFFE.DCFAC680 00000000.00000000 SYS$_$70$DKA302:                                           QTV11
                                                                    FFFFFFFE.DCF21180 00000000 MHERTZ 03001130 CR    Granted

FFFFFFFE.DCFBA580 FFFFFFFE.DCEFBC80 F11B$s.#..                                                 BACH
                                                                    FFFFFFFE.DD032380 00000000 MHERTZ 0D000C9F NL    Granted

FFFFFFFE.DD00E380 00000000.00000000 CACHE$cmRAVEN_BACKUPù...                                   MHERTZ
                                                                    FFFFFFFE.DCF54A80 00000000 B8OVEN 03000280 PR    Granted
                                                                    FFFFFFFE.DCEF8780 00000000 QTV9   12000C51 PR    Granted
                                                                    FFFFFFFE.DD029880 00000000 KHERTZ 07000A6B PR    Granted
                                                                    FFFFFFFE.DD002780 00000000 MHERTZ 16000829 PR    Granted

FFFFFFFE.DD060A80 00000000.00000000 SYS$_DSA71:                                                QTV11
                                                                    FFFFFFFE.DCF91580 00000000 MHERTZ 1A00115D CR    Granted

FFFFFFFE.DCF22B80 00000000.00000000 CACHE$cmB_PICCHUBCK Ú...                                   WHAMOO

FFFFFFFE.DCF57E80 00000000.00000000 $DSA7779_$SEQCMD                                           QTV9
                                                                    FFFFFFFE.DCF37D80 00000000 MHERTZ 0300011C PR    Granted

FFFFFFFE.DCFDD780 00000000.00000000 CACHE$cmPAGE_SWAP   Ü...                                   QTV11
                                                                    FFFFFFFE.DCFD3880 00000000 MHERTZ 0D00062A PR    Granted

        .
        .
        .

FFFFFFFE.DCFA6480 00000000.00000000 VCC$v$1$DUA126:                                            QTV11
                                                                    FFFFFFFE.DD053980 00000000 MHERTZ 23000E09 PR    Granted

FFFFFFFE.DCF9BA80 00000000.00000000 $DSA7778_$WATCHR                                           EBJB17
                                                                    FFFFFFFE.DCFFA280 00000000 MHERTZ 02000AF3    EX Waiting

FFFFFFFE.DCF50380 00000000.00000000 F11B$aRAVEN_BACKUPö...                                     KHERTZ
                                                                    FFFFFFFE.DCEED980 00000000 MHERTZ 01000025 PR    Granted

        .
        .
        .
                                                                                                                VM-0947A-AI
```

This example shows the output from the SHOW RESOURCES/LIST command.

SHOW RMD

Displays information contained in the reserved memory descriptors. Reserved memory is used within the system by memory-resident global sections.

Format

SHOW RMD [/QUALIFIERS]

Parameters

None.

Qualifiers

/ADDRESS=*n*
Displays a specific reserved memory descriptor entry, given its address.

/ALL
Displays information in all the reserved memory descriptors. This qualifier is the default.

Description

The SHOW RMD command displays information that resides in the reserved memory descriptors. Table 4–25 shows the fields and their meanings.

Table 4–25 RMD Fields

Field	Meaning
ADDRESS	Gives the address of the reserved memory descriptor.
NAME	Gives the name of the reserved memory descriptor.
GROUP	Gives the UIC group that owns the reserved memory. This is given as -S- for system global reserved memory.
RAD	Gives the required RAD for the reserved memory. Displays "Any" if no RAD specified.
PFN	Gives starting page number of the reserved memory.
COUNT	Gives the number of pages reserved.
IN_USE /ERROR	Gives the number of pages in use. If an error occurred when the reserved memory was being allocated, the error condition code is displayed in parentheses. A second line, giving the text of the error, is also displayed in this case.
ZERO_PFN	Gives the next page number to be zeroed.
FLAGS	Gives the settings of flags for specified reserved memory descriptor as a hexadecimal number, then displays key flag bits by name. The names may use multiple lines in the display.

Example

```
SDA> SHOW RMD

Reserved Memory Descriptor List
-------------------------------
                                                             In_Use
Address  Name                Group RAD    PFN     Count     (Error)  Zero_PFN  Flags
-------- ------------------- ----- ---- -------- --------  --------  -------- ------------------------------
814199C0 LARGE               00022 Any  00000000 000004E2  00000000  00000000 000000E0 Group Page_Tables
                                                                                      GBLSec
81419940 LARGE               00022 Any  00000000 00138800 (0000244C) 00000000 000001A0 Error Group GBLSec
         Error = %SYSTEM-F-INSFLPGS, insufficient Fluid Pages available
81419AC0 SMALL               00011 0001 00000180 00000001  00000000  00000180 000000E1 Alloc Group
                                                                                      Page_Tables GBLSec
81419A40 SMALL               00011 0001 00000E00 00000080  00000000  00000E00 000000A1 Alloc Group GBLSec
```

This example shows the default output of a SHOW RMD command.

SHOW RMS

Displays the RMS data structures selected by the SET RMS command to be included in the default display of the SHOW PROCESS/RMS command.

Format

SHOW RMS

Parameters

None.

Qualifiers

None.

Description

The SHOW RMS command lists the names of the data structures selected for the default display of the SHOW PROCESS/RMS command.

For a description of the significance of the options listed in the SHOW RMS display, see the description of the SET RMS command and Table 4–2.

For an illustration of the information displayed by the SHOW PROCESS/RMS command, see the examples included in the description of the SHOW PROCESS command.

Examples

1.
```
SDA>  SHOW RMS

RMS Display Options:  IFB,IRB,IDX,BDB,BDBSUM,ASB,CCB,WCB,FCB,FAB,RAB,NAM,
XAB,RLB,BLB,BLBSUM,GBD,GBH,FWA,GBDSUM,JFB,NWA,RU,DRC,SFSB,GBSB

Display RMS structures for all IFI values.
```

   The SHOW RMS command displays the full set of options available for display by the SHOW PROCESS/RMS command. SDA, by default, selects the full set of RMS options at the beginning of an analysis.

2.
```
SDA>  SET RMS=(IFAB=1,CCB,WCB)
SDA>  SHOW RMS

RMS Display Options:  IFB,CCB,WCB

Display RMS structures only for IFI =0001
```

   The SET RMS command establishes the IFB, CCB, and WCB as the structures to be displayed, and only for the file whose internal File Identifer has the value 1, when the SHOW PROCESS/RMS command is issued. The SHOW RMS command verifies this selection of RMS options.

SHOW RSPID

Displays information about response IDs (RSPIDs) of all System Communications Services (SCS) connections or, optionally, about a specific SCS connection.

Format

SHOW RSPID [/CONNECTION=*cdt-address*]

Parameters

None.

Qualifier

/CONNECTION=cdt-address

Displays RSPID information for the specific SCS connection whose connection descriptor table (CDT) address is provided in *cdt-address*. You can find the *cdt-address* for any active connection on the system in the **CDT summary page** display of the SHOW CONNECTIONS command. CDT addresses are also stored in many individual data structures related to SCS connections. These data structures include class driver request packets (CDRPs) and unit control blocks (UCBs) for class drivers that use SCS and cluster system blocks (CSBs) for the connection manager.

Description

Whenever a local system application (SYSAP) requires a response from a remote SYSAP, a unique number, called an RSPID, is assigned to the response by the local system. The RSPID is transmitted in the original request (as a means of identification), and the remote SYSAP returns the same RSPID in its response to the original request.

The SHOW RSPID command displays information taken from the response descriptor table (RDT), which lists the currently open local requests that require responses from SYSAPs at a remote node. For each RSPID, SDA displays the following information:

- RSPID value
- Address of the class driver request packet (CDRP), which generally represents the original request
- Address of the CDT that is using the RSPID
- Name of the local process using the RSPID
- Remote node from which a response is required (and has not yet been received)

Examples

1. SDA> SHOW RSPID

```
    --- Summary of Response Descriptor Table (RDT) 805E6F18 ---

RSPID      CDRP Address     CDT Address     Local Process Name      Remote Node
-----      ------------     -----------     ------------------      -----------

39D00000     8062CC80        805E8710       VMS$VMScluster          VANDQ1
EE210001     80637260        805E8C90       VMS$DISK_CL_DRVR        ROMRDR
EE240002     806382E0        805E8DF0       VMS$DISK_CL_DRVR        VANDQ1
EE440003     806393E0        805E8F50       VMS$TAPE_CL_DRVR        VANDQ1
5DB90004     80636BC0        805E8870       VMS$VMScluster          ROMRDR
5C260005     80664040        805E8870       VMS$VMScluster          ROMRDR
38F80006     80664A80        805E8710       VMS$VMScluster          VANDQ1
```

This example shows the default output for the SHOW RSPID command.

2. SDA> SHOW RSPID/CONNECTION=805E8F50

```
    --- Summary of Response Descriptor Table (RDT) 805E6F18 ---

RSPID      CDRP Address     CDT Address     Local Process Name      Remote Node
-----      ------------     -----------     ------------------      -----------

EE440003     806393E0        805E8F50       VMS$TAPE_CL_DRVR        VANDQ1
```

This example shows the output for a SHOW RSPID/CONNECTION command.

SHOW SHM_CPP

Displays information about the shared memory common property partitions (CPPs). The default display shows a single-page summary that includes a single line for each CPP.

Format

SHOW SHM_CPP [/ QUALIFIERS]

Parameters

None.

Qualifiers

/ADDRESS=*n*
Displays a detailed page of information about an individual shared memory CPP given the address of the SHM_CPP structure.

/ALL
Displays a detailed page of information about each shared memory CPP.

/IDENT=*n*
Displays a detailed page of information about an individual shared memory CPP.

/PFN [=*option*]
Displays PFN data in addition to the basic SHM_CPP. The default is all lists (free, bad, untested), plus the PFN database pages and the complete range of PFNs in the CPP.

To display only the complete range of PFNs in the CPP, use the keyword *ALL_FRAGMENTS* with the /PFN qualifier:

```
/PFN = ALL_FRAGMENTS
```

To display only the bad page list, use the keyword *BAD* with the /PFN qualifier:

```
/PFN = BAD
```

To display only the free page list, use the keyword *FREE* with the /PFN qualifier:

```
/PFN = FREE
```

To display the PFNs containing the PFN database, use the keyword *PFNDB* with the /PFN qualifier:

```
/PFN = PFNDB
```

To display only the untested page list, use the keyword *UNTESTED* with the /PFN qualifier:

```
/PFN = UNTESTED
```

To display multiple lists, you can combine keywords with the /PFN qualifier:

```
/PFN = (x,y)
```

If you specify /PFN without /ALL, /IDENT, or /ADDRESS, then the system displays the PFN lists from the last shared memory CPP accessed.

Examples

1.
```
SDA> SHOW SHM_CPP

Summary of Shared Memory Common Property Partitions
---------------------------------------------------

Base address of SHM_CPP array:               FFFFFFFF.7F2BA140
Maximum number of SHM_CPP entries:                    00000007
Size of each SHM_CPP:                                 00000240
Maximum fragment count per SHM_CPP:                   00000010

Valid CPP count:                                      00000001

 ID   SHM_CPP address     MinPFN   MaxPFN    Page count  Free pages    Flags
---- -----------------   -------- --------    --------    --------    --------
  -- SHM_CPP IDs 0000 to 0002: VALID flag clear --

0003 FFFFFFFF.7F2BA800   00060000 0007FFFF    00020000    0001FCF7    00000001  VALID

  -- SHM_CPP IDs 0004 to 0006: VALID flag clear --
```

This example shows the default output for the SHOW SHM_CPP command.

2.
```
SDA> SHOW SHM_CPP/IDENT=3

Shared Memory CPP 0003
----------------------

SHM_CPP address:         FFFFFFFF.7F2BA800

  Version:                        00000001   Flags:                    00000001  VALID
  Size:                  00000000.000000C0   Page count:               00020000
  Actual fragment count:          00000001   Minimum PFN:              00060000
  Maximum fragment count:         00000010   Maximum PFN:              0007FFFF

  Length of free page list:       0001FCF7
  Length of bad page list:        00000000
  Length of untested page list:   00000000

PMAP array for PFN database pages

    PMAP    Start PFN   PFN count
    -----   --------    --------
       0.   00060053    00000280

PMAP array for all fragments

    PMAP    Start PFN   PFN count
    -----   --------    --------
       0.   00060000    00020000

GLock address:           FFFFFFFF.7F2BA8C0   Handle:        80000000.00010D19

  GLock name:            SHM_CPP00000003     Flags:                          00
  Owner count:                          00   Owner node:                     00
  Node sequence:                      0000   Owner:                      000000
  IPL:                                  08   Previous IPL:                   00
  Wait bitmask:          00000000.00000000   Timeout:                  00249F00
  Thread ID:             00000000.00000000

Connected GNode bitmask: FFFFFFFF.7F2BA900

  Valid bits:                     00000004   State:         00000000.00000000
  Unit count:                         0001   Unit size:                QUADWORD

  Unit bitmask:
       ........ ........ ........ .......7   00000000
```

```
Ranges of free pages

    Range   Start PFN   PFN count
    -----   --------    --------
       1.    000602F6    00000002
       2.    0006030B    0001FCF5
```

This example shows the details for a single SHM_CPP.

SHOW SHM_REG

Displays information about shared memory regions. The default display shows a single page summary that includes a single line for each region.

Format

SHOW SHM_REG [/ QUALIFIERS] [name]

Parameter

name
Detailed page of information about the named region.

Qualifiers

/ADDRESS=*n*
Displays a detailed page of information about an individual region given the address of the SHM_REG structure.

/ALL
Displays a detailed page of information about each region.

/IDENT=*n*
Displays a detailed page of information about the specified region.

Examples

```
 1. SDA>SHOW SHM_REG

    Summary of Shared Memory Regions
    --------------------------------
Base address of SHM_REG array:             FFFFFFFF.7F2BB140
Maximum number of SHM_REG entries:                  00000040
Size of each SHM_REG:                               00000208
Base address of SHM_DESC array:            FFFFFFFF.7F2DC000

Valid region count:                                 00000009

 ID   SHM_REG address               Region Tag                 SysVA / GSTX     Flags
---- ----------------- --------------------------------------- ----------------- --------
0000 FFFFFFFF.7F2BB140 SYS$GALAXY_MANAGEMENT_DATABASE         FFFFFFFF.7F234000 00000001  VALID
0001 FFFFFFFF.7F2BB348 SYS$SHARED_MEMORY_PFN_DATABASE         FFFFFFFE.00000000 00000001  VALID
0002 FFFFFFFF.7F2BB550 SMCI$SECTION_PBA_04001                     -<None>-      00000001  VALID
0003 FFFFFFFF.7F2BB758 GLX$CPU$BALANCER$SYSGBL                         0000013F 00000005  VALID SHARED_CONTEXT_VALID
0004 FFFFFFFF.7F2BB960 SMCI$CHANNEL_PBA_0_1                   FFFFFFFF.8F3AE000 00000001  VALID
0005 FFFFFFFF.7F2BBB68 SMCI$CHANNEL_PBA_0_2                   FFFFFFFF.8FAEE000 00000001  VALID
0006 FFFFFFFF.7F2BBD70 SMCI$CHANNEL_PBA_1_2                   -<Not Attached>-  00000001  VALID
0007 FFFFFFFF.7F2BBF78 LAN$SHM_REG                            FFFFFFFF.7F20C000 00000009  VALID ATTACH_DETACH
0008 FFFFFFFF.7F2BC180 GLX$CPU_BAL_GLOCK  $000006                      00000140 00000005  VALID SHARED_CONTEXT_VALID

  -- SHM_REG IDs 0009 to 003F: never used --
```

This example shows the summary of all shared memory regions in the system.

2. SDA> SHOW SHM_REG SMCI$CHANNEL_PBA_0_1

```
SHM_REG address:          FFFFFFFF.7F2BB960

  Version:                         00000001   Flags:                   00000001  VALID
  Index/Sequence:             0004/00000003   Size:           00000000.00000120

  Region tag:             SMCI$CHANNEL_PBA_0_1
  Creation time:          31-MAR-1999 14:11:11.37

SHM_DESC address:         FFFFFFFF.7F2DC200

  Version:                         00000001   Flags:                   00000005  ATTACHED SYS_VA_VALID
  System VA:              FFFFFFFF.8F3AE000   Virtual size:   00000000.00274000
  I/O ref count:          00000000.00000000
  Index/Sequence:             0004/00000003   Context:        FFFFFFFF.80F42480
  Callback:               FFFFFFFF.8F38E5C0   SYS$PBDRIVER+185C0

MMAP address:             FFFFFFFF.7F2BB9E0

  Level count:                         0001   Flags:                       0001  VALID
  Top page count:                  00000001   Virtual size:   00000000.00274000
  PFN list page count:             00000001   First PFN:               000602D4
  Data page count:                 00000009

GLock address:            FFFFFFFF.7F2BBA80   Handle:         80000000.00010F51

  GLock name:             SHM_REG00000004     Flags:                         00
  Owner count:                           00   Owner node:                    00
  Node sequence:                       0000   Owner:                     000000
  IPL:                                   08   Previous IPL:                  00
  Wait bitmask:           00000000.00000000   Timeout:                 002DC6C0
  Thread ID:              00000000.00000000

Attached GNode bitmask:  FFFFFFFF.7F2BBAC0

  Valid bits:                      00000004   State:          00000000.00000012  AUTO_LOCK SET_COUNT
  Unit count:                          0001   Unit size:               QUADWORD
  Lock IPL:                              08   Saved IPL:               00000008
  Count of bits set:               00000002

  Unit bitmask:
       ........ ........ ........ .......3   00000000

I/O in progress bitmask: FFFFFFFF.7F2BBAF8

  Valid bits:                      00000004   State:          00000000.00000012  AUTO_LOCK SET_COUNT
  Unit count:                          0001   Unit size:               QUADWORD
  Lock IPL:                              08   Saved IPL:               00000000
  Count of bits set:               00000000

  Unit bitmask:
       ........ ........ ........ .......0   00000000

SHM_CPP bitmask:          FFFFFFFF.7F2BBB30

  Valid bits:                      00000007   State:          00000000.00000000
  Unit count:                          0001   Unit size:               QUADWORD

  Unit bitmask:
       ........ ........ ........ ......08   00000000)
```

This example shows the details for a single shared memory region.

SHOW SPINLOCKS

Displays the multiprocessing synchronization data structures.

Format

SHOW SPINLOCKS {[name] | /ADDRESS=*expression* | /INDEX=*expression*}
[/COUNTS | /OWNED | /DYNAMIC | /STATIC
| /PCB | /PORT | /CACHED_PCB | /MAILBOX] [{/BRIEF | /FULL}]

Parameter

name
Name of the spinlock to be displayed. Device spinlock names are of the form node$lock, where node indicates the OpenVMS Cluster node name and lock indicates the device and controller identification (for example, HAETAR$DUA). If there is no OpenVMS Cluster node name, the dollar sign ($) is also skipped (for example, DUA). This parameter cannot be used to identify mailbox, PCB, or cached PCB spinlocks.

Qualifiers

/ADDRESS=expression
Displays the spinlock at the address specified in *expression*. You can use the /ADDRESS qualifier to display a specific device spinlock; however, the name of the spinlock is listed as "Unknown" in the display.

/BRIEF
Produces a condensed display of the spinlock information displayed by default by the SHOW SPINLOCKS command, including the following: address, spinlock name or device name, IPL or device IPL, rank, ownership depth, and CPU ID of the owner CPU. If the system under analysis was executing with full-checking multiprocessing enabled (according to the setting of the MULTIPROCESSING or SYSTEM_CHECK system parameter), then the number of waiting CPUs and interlock status are also displayed.

/CACHED_PCB
Displays all PCB-specific spinlocks associated with PCBs of deleted processes.

/COUNTS
Produces a display of Spin, Wait, and Acquire counts for each spinlock (only if full-checking multiprocessing is enabled).

/DYNAMIC
Displays information for all dynamic spinlocks in the system (device, port, mailbox, PCB, and cached PCB spinlocks).

/FULL
Displays full descriptive and diagnostic information for each displayed spinlock.

/INDEX=expression
Displays the static spinlock whose index is specified in *expression*. You can only use the /INDEX qualifier to display a named static spinlock.

/MAILBOX
Displays all mailbox-specific spinlocks.

/OWNED
Displays information for all spinlocks owned by the SDA current CPU. If a processor does not own any spinlocks, SDA displays the following message:

```
No spinlocks currently owned by CPU xx
```

The *xx* represents the CPU ID of the processor.

/PCB
Displays all PCB-specific spinlocks.

/PORT
Displays all port spinlocks.

/STATIC
Displays information for all static spinlocks in the system.

Description

The SHOW SPINLOCKS command displays status and diagnostic information about the multiprocessing synchronization structures known as **spinlocks**.

A **static spinlock** is a spinlock whose data structure is permanently assembled into the system. Static spinlocks are accessed as indexes into a vector of longword addresses called the **spinlock vector**, the address of which is contained in SMP$AR_SPNLKVEC. Table 4–26 lists the static spinlocks.

A **dynamic spinlock** is a spinlock that is created based on the configuration of a particular system. One such dynamic spinlock is the device lock SYSMAN creates when configuring a particular device. This device lock synchronizes access to the device's registers and certain UCB fields. The system creates a dynamic spinlock by allocating space from nonpaged pool, rather than assembling the lock into the system as it does in creating a static spinlock. Other types of dynamic spinlocks are: port spinlocks, mailbox spinlocks, PCB and cached PCB spinlocks.

See the *Writing OpenVMS Alpha Device Drivers in C* for a full discussion of the role of spinlocks in maintaining synchronization of kernel-mode activities in a multiprocessing environment.

Table 4–26 Static Spinlocks

Name	Description
QUEUEAST	Spinlock for queuing ASTs at IPL 6
FILSYS	Spinlock on file system structures
LCKMGR	Spinlock on all lock manager structures
IOLOCK8/SCS	Spinlock for executing a driver fork process at IPL 8
TX_SYNCH	Transaction processing spinlock
TIMER	Spinlock for adding and deleting timer queue entries and searching the timer queue

(continued on next page)

Table 4–26 (Cont.) Static Spinlocks

Name	Description
PORT	Template structure for dynamic spinlocks for ports with multiple devices
IO_MISC	Miscellaneous short-term I/O spinlocks
MMG	Spinlock on memory management, PFN database, swapper, modified page writer, and creation of per-CPU database structures
SCHED	Spinlock on some process data structures and the scheduler database.
IOLOCK9	Spinlock for executing a driver fork process at IPL 9
IOLOCK10	Spinlock for executing a driver fork process at IPL 10
IOLOCK11	Spinlock for executing a driver fork process at IPL 11
MAILBOX	Spinlock for sending messages to the permanent system (OPCOM, JOBCTL, and so on) mailboxes
POOL	Spinlock on nonpaged pool database
PERFMON	Spinlock for I/O performance monitoring
INVALIDATE	Spinlock for system space translation buffer (TB) invalidation
HWCLK	Spinlock on hardware clock database, including the quadword containing the due time of the first timer queue entry (EXE$GQ_1ST_TIME) and the quadword containing the system time (EXE$GQ_SYSTIME)
MEGA	Spinlock for serializing access to fork-wait queue
EMB/MCHECK	Spinlock for allocating and releasing error-logging buffers and synchronizing certain machine error handling

For each spinlock in the system, SHOW SPINLOCKS provides the following information:

- Name of the spinlock (or device name for the device lock)
- Address of the spinlock data structure (SPL)
- The owning CPU's CPU ID
- IPL at which allocation of the lock is synchronized on a local processor
- Number of nested acquisitions of the spinlock by the processor owning the spinlock (Ownership Depth)
- Rank of the spinlock
- Timeout interval for spinlock acquisition (in terms of 10 milliseconds)
- Shared array (shared spinlock context block pointer)
- Number of processors waiting to obtain the spinlock
- Interlock (synchronization mutex used when full-checking multiprocessing is enabled)

The last two items (CPUs waiting and Interlock) are only displayed if full-checking multiprocessing is enabled.

SHOW SPINLOCKS/BRIEF produces a condensed display of this same information, excluding the share array and timeout interval.

SHOW SPINLOCKS/COUNTS displays only the Spin, Wait, and Acquire counts for each spinlock.

If the system under analysis was executing with full-checking multiprocessing enabled, SHOW SPINLOCKS/FULL adds to the spinlock display the Spin, Wait, and Acquire counts and the last sixteen PCs at which the lock was acquired or released. If applicable, SDA also displays the PC of the last release of multiple, nested acquisitions of the lock.

If no spinlock name, address, or index is given, then information is displayed for all applicable spinlocks.

Examples

1. SDA> SHOW SPINLOCKS

```
System static spinlock structures
---------------------------------
EMB                                     Address        810AE300
Owner CPU ID         None               IPL            0000001F
Ownership Depth    FFFFFFFF             Rank           00000000
Timeout Interval   000186A0             Share Array    00000000
CPUs Waiting       00000000             Interlock        Free

MCHECK                                  Address        810AE300
Owner CPU ID         None               IPL            0000001F
Ownership Depth    FFFFFFFF             Rank           00000000
Timeout Interval   000186A0             Share Array    00000000
CPUs Waiting       00000000             Interlock        Free

MEGA                                    Address        810AE400
Owner CPU ID         None               IPL            0000001F
Ownership Depth    FFFFFFFF             Rank           00000002
Timeout Interval   000186A0             Share Array    00000000
CPUs Waiting       00000000             Interlock        Free

HWCLK                                   Address        810AE500
Owner CPU ID         None               IPL            00000016
Ownership Depth    FFFFFFFF             Rank           00000004
Timeout Interval   000186A0             Share Array    00000000
CPUs Waiting       00000000             Interlock        Free

    .
    .
    .
System dynamic spinlock structures
----------------------------------
QTV14$OPA                               Address        8103FB00
Owner CPU ID         None               DIPL           00000015
Ownership Depth    FFFFFFFF             Rank           FFFFFFFF
Timeout Interval   000186A0             Share Array    00000000
CPUs Waiting       00000000             Interlock        Free

QTV14$MBA                               Address        810AE900
Owner CPU ID         None               IPL            0000000B
Ownership Depth    FFFFFFFF             Rank           0000000C
Timeout Interval   000186A0             Share Array    00000000
CPUs Waiting       00000000             Interlock        Free

QTV14$NLA                               Address        810AE900
Owner CPU ID         None               IPL            0000000B
Ownership Depth    FFFFFFFF             Rank           0000000C
Timeout Interval   000186A0             Share Array    00000000
CPUs Waiting       00000000             Interlock        Free

QTV14$PKA                               Address        814AA100
Owner CPU ID         None               DIPL           00000015
Ownership Depth    FFFFFFFF             Rank           FFFFFFFF
Timeout Interval   000186A0             Share Array    00000000
CPUs Waiting       00000000             Interlock        Free
    .
    .
    .
```

This excerpt illustrates the default output of the SHOW SPINLOCKS command.

2. SDA> SHOW SPINLOCKS/BRIEF

```
System static spinlock structures
---------------------------------

          Spinlock                            Owner     CPUs
Address     Name      IPL    Rank     Depth    CPU     Waiting Interlock
-------- ------------ ---- -------- -------- -------- -------- ---------
810AE300 EMB          001F 00000000 FFFFFFFF   None   00000000   Free
810AE300 MCHECK       001F 00000000 FFFFFFFF   None   00000000   Free
810AE400 MEGA         001F 00000002 FFFFFFFF   None   00000000   Free
810AE500 HWCLK        0016 00000004 FFFFFFFF   None   00000000   Free
810AE600 INVALIDATE   0015 00000006 FFFFFFFF   None   00000000   Free
810AE700 PERFMON      000F 00000008 FFFFFFFF   None   00000000   Free
810AE800 POOL         000B 0000000A FFFFFFFF   None   00000000   Free
810AE900 MAILBOX      000B 0000000C FFFFFFFF   None   00000000   Free
810AEA00 IOLOCK11     000B 0000000E FFFFFFFF   None   00000000   Free
810AEB00 IOLOCK10     000A 0000000F FFFFFFFF   None   00000000   Free
810AEC00 IOLOCK9      0009 00000010 FFFFFFFF   None   00000000   Free
810AED00 SCHED        0008 00000012 00000000 00000000 00000001   Free
810AEE00 MMG          0008 00000014 FFFFFFFF   None   00000000   Free
810AEF00 IO_MISC      0008 00000016 FFFFFFFF   None   00000000   Free
810AF000 PORT         0008 00000017 FFFFFFFF   None   00000000   Free
810AF100 TIMER        0008 00000018 00000000 00000000 00000000   Free
810AF200 TX_SYNCH     0008 00000019 FFFFFFFF   None   00000000   Free
810AF300 SCS          0008 0000001A FFFFFFFF   None   00000000   Free
810AF400 LCKMGR       0008 0000001B FFFFFFFF   None   00000000   Free
810AF500 FILSYS       0008 0000001C FFFFFFFF   None   00000000   Free
810AF600 QUEUEAST     0006 0000001E FFFFFFFF   None   00000000   Free


System dynamic spinlock structures
----------------------------------

            Device                            Owner     CPUs
Address      Name     DIPL   Rank     Depth    CPU     Waiting Interlock
-------- ------------ ---- -------- -------- -------- -------- ---------
8103FB00 QTV14$OPA    0015 FFFFFFFF FFFFFFFF   None   00000000   Free
810AE900 QTV14$MBA    000B 0000000C FFFFFFFF   None   00000000   Free
810AE900 QTV14$NLA    000B 0000000C FFFFFFFF   None   00000000   Free
814AA100 QTV14$PKA    0015 FFFFFFFF FFFFFFFF   None   00000000   Free

   .
   .
   .
```

This excerpt illustrates the condensed form of the display produced in the first example.

3. SDA> SHOW SPINLOCKS/FULL SCHED

```
System static spinlock structures
---------------------------------
SCHED                                 Address       810AED00
Owner CPU ID       00000000           IPL           00000008
Ownership Depth    00000000           Rank          00000012
Timeout Interval   002DC6C0           Share Array   00000000
CPUs Waiting       00000001           Interlock       Free

Spins              00000000.0458E8DC  Busy waits    00252E8D
Acquires           00000000.01279BE0
```

```
Spinlock SPL$C_SCHED was last acquired or released from:
(Most recently)               8004AD00 EXE$SWTIMER_FORK_C+00170
       .                      8004B1D4 EXE$SWTIMER_FORK_C+00644
       .                      8004AD00 EXE$SWTIMER_FORK_C+00170
       .                      8004B1D4 EXE$SWTIMER_FORK_C+00644
       .                      8004AD00 EXE$SWTIMER_FORK_C+00170
       .                      8004B1D4 EXE$SWTIMER_FORK_C+00644
       .                      8004AD00 EXE$SWTIMER_FORK_C+00170
       .                      8004B1D4 EXE$SWTIMER_FORK_C+00644
       .                      8004AD00 EXE$SWTIMER_FORK_C+00170
       .                      80136A2C SCH$INTERRUPT+0070C
       .                      80117580 SCH$IDLE_C+002A0
       .                      8004B230 EXE$SWTIMER_FORK_C+006A0
       .                      8004AFC4 EXE$SWTIMER_FORK_C+00434
       .                      80117360 SCH$IDLE_C+00080
       .                      8012E5F4 EXE$HIBER_INT_C+00074
(Least recently)              80132150 EXE$SCHDWK_C+00110

Last release of multiple acquisitions occurred at:
                              80262A54 EXE$CHECK_VERSION_C+009F4
```

This display shows the detailed information on the SCHED spinlock, including the PC history.

SHOW STACK

Displays the location and contents of the process stacks (of the SDA current process) and the system stack.

Format

SHOW STACK {range | /ALL | [/EXECUTIVE | /INTERRUPT | /KERNEL | /PHYSICAL | /SUPERVISOR | /SYSTEM | /USER]} {/LONG | /QUAD (d)}

Parameter

range
Range of memory locations you want to display in stack format. You can express a **range** using the following syntax:

m:n	Range of addresses from *m* to *n*
m;n	Range of addresses starting at *m* and continuing for *n* bytes

Qualifiers

/ALL
Displays the locations and contents of the four process stacks for the SDA current process and the system stack.

/EXECUTIVE
Shows the executive stack for the SDA current process.

/INTERRUPT
Shows the system stack and is retained for compatibility with OpenVMS VAX. The interrupt stack does not exist in OpenVMS Alpha.

/KERNEL
Shows the kernel stack for the SDA current process.

/LONG
Displays longword width stacks. If you do not specify this qualifier, SDA by default displays quadword width stacks.

/PHYSICAL
Treats the start and end addresses in the given range as physical addresses. This qualifier is only relevant when a range is specified. By default, SDA treats range addresses as virtual addresses.

/QUAD
Displays quadword width stacks. This is the default.

/SUPERVISOR
Shows the supervisor stack for the SDA current process.

/SYSTEM
Shows the system stack.

/USER
Shows the user stack for the SDA current process.

Description

The SHOW STACK command, by default, displays the stack that was in use when the system failed, or, in the analysis of a running system, the current operating stack. For a process that became the SDA current process as the result of a SET PROCESS command, the SHOW STACK command by default shows its current operating stack.

The various qualifiers to the command allow display of any of the four per-process stacks for the SDA current process, as well as the system stack for the SDA current CPU. In addition, any given range can be displayed in stack format.

You can define SDA process and CPU context by using the SET CPU, SHOW CPU, SHOW CRASH, SET PROCESS, and SHOW PROCESS commands as indicated in their command descriptions. A complete discussion of SDA context control appears in Section 2.5.

SDA provides the following information in each stack display:

Section	Contents
Identity of stack	SDA indicates whether the stack is a process stack (user, supervisor, executive, or kernel) or the system stack.
Stack pointer	The stack pointer identifies the top of the stack. The display indicates the stack pointer by the symbol **SP =>**.
Stack address	SDA lists all the addresses that the operating system has allocated to the stack. The stack addresses are listed in a column that increases in increments of 8 bytes (one quadword) unless you specify the /LONG qualifier, in which case addresses are listed in increments of 4 (one longword).
Stack contents	SDA lists the contents of the stack in a column to the right of the stack addresses.
Symbols	SDA attempts to display the contents of a location symbolically, using a symbol and an offset. If the stack is being displayed in quadword width and the location cannot be symbolized as a quadword, SDA attempts to symbolize the least significant longword and then the most significant longword. If the address cannot be symbolized, this column is left blank.
Canonical stack	When displaying the kernel stack of a noncurrent process in a crash dump, SDA identifies the stack locations used by the scheduler to store the register contents of the process.
Mechanism array Signal array Exception frame	When displaying the current stack in a FATALEXCPT, INVEXCEPTN, SSRVEXCEPT, or UNXSIGNAL bugcheck, SDA identifies the stack locations used to store registers and other key data for these structures.

If a stack is empty, the display shows the following:

```
SP =>  (STACK IS EMPTY)
```

Example

```
SDA>  SHOW STACK
Current Operating Stack (SYSTEM):
                       FFFFFFFF.8244BD08  FFFFFFFF.800600FC  SCH$REPORT_EVENT_C+000FC
                       FFFFFFFF.8244BD10  00000000.00000002
                       FFFFFFFF.8244BD18  00000000.00000005
                       FFFFFFFF.8244BD20  FFFFFFFF.8060C7C0
                SP =>  FFFFFFFF.8244BD28  FFFFFFFF.8244BEE8
                       FFFFFFFF.8244BD30  FFFFFFFF.80018960  EXE$HWCLKINT_C+00260
                       FFFFFFFF.8244BD38  00000000.000001B8
                       FFFFFFFF.8244BD40  00000000.00000050
                       FFFFFFFF.8244BD48  00000000.00000210  UCB$N_RSID+00002
                       FFFFFFFF.8244BD50  00000000.00000000
                       FFFFFFFF.8244BD58  00000000.00000000
                       FFFFFFFF.8244BD60  FFFFFFFF.804045D0  SCH$GQ_IDLE_CPUS
                       FFFFFFFF.8244BD68  FFFFFFFF.8041A340  EXE$GL_FKWAITFL+00020
                       FFFFFFFF.8244BD70  00000000.00000250  UCB$T_MSGDATA+00034
                       FFFFFFFF.8244BD78  00000000.00000001
CHF$IS_MCH_ARGS        FFFFFFFF.8244BD80  00000000.0000002B
CHF$PH_MCH_FRAME       FFFFFFFF.8244BD88  FFFFFFFF.8244BFB0
CHF$IS_MCH_DEPTH       FFFFFFFF.8244BD90  80000000.FFFFFFFD  G
CHF$PH_MCH_DADDR       FFFFFFFF.8244BD98  00000000.00001600  CTL$C_CLIDATASZ+00060
CHF$PH_MCH_ESF_ADDR    FFFFFFFF.8244BDA0  FFFFFFFF.8244BF40
CHF$PH_MCH_SIG_ADDR    FFFFFFFF.8244BDA8  FFFFFFFF.8244BEE8
CHF$IH_MCH_SAVR0       FFFFFFFF.8244BDB0  FFFFFFFF.8041FB00  SMP$RELEASEL+00640
CHF$IH_MCH_SAVR1       FFFFFFFF.8244BDB8  00000000.00000000
CHF$IH_MCH_SAVR16      FFFFFFFF.8244BDC0  00000000.0000000D
CHF$IH_MCH_SAVR17      FFFFFFFF.8244BDC8  0000FFF0.00007E04
CHF$IH_MCH_SAVR18      FFFFFFFF.8244BDD0  00000000.00000000
CHF$IH_MCH_SAVR19      FFFFFFFF.8244BDD8  00000000.00000001
CHF$IH_MCH_SAVR20      FFFFFFFF.8244BDE0  00000000.00000000
CHF$IH_MCH_SAVR21      FFFFFFFF.8244BDE8  FFFFFFFF.805AE4B6  SISR+0006E
CHF$IH_MCH_SAVR22      FFFFFFFF.8244BDF0  00000000.00000001
CHF$IH_MCH_SAVR23      FFFFFFFF.8244BDF8  00000000.00000010
CHF$IH_MCH_SAVR24      FFFFFFFF.8244BE00  00000000.00000008
CHF$IH_MCH_SAVR25      FFFFFFFF.8244BE08  00000000.00000010
CHF$IH_MCH_SAVR26      FFFFFFFF.8244BE10  00000000.00000001
CHF$IH_MCH_SAVR27      FFFFFFFF.8244BE18  00000000.00000000
CHF$IH_MCH_SAVR28      FFFFFFFF.8244BE20  FFFFFFFF.804045D0  SCH$GQ_IDLE_CPUS
                       FFFFFFFF.8244BE28  30000000.00000300  UCB$L_PI_SVA
                       FFFFFFFF.8244BE30  FFFFFFFF.80040F6C  EXE$REFLECT_C+00950
                       FFFFFFFF.8244BE38  18000000.00000300  UCB$L_PI_SVA
                       FFFFFFFF.8244BE40  FFFFFFFF.804267A0  EXE$CONTSIGNAL+00228
                       FFFFFFFF.8244BE48  00000000.7FFD00A8  PIO$GW_IIOIMPA
                       FFFFFFFF.8244BE50  00000003.00000000
                       FFFFFFFF.8244BE58  FFFFFFFF.8003FC20  EXE$CONNECT_SERVICES_C+00920
                       FFFFFFFF.8244BE60  FFFFFFFF.8041FB00  SMP$RELEASEL+00640
                       FFFFFFFF.8244BE68  00000000.00000000
                       FFFFFFFF.8244BE70  FFFFFFFF.8042CD50  SCH$WAIT_PROC+00060
                       FFFFFFFF.8244BE78  00000000.0000000D
                       FFFFFFFF.8244BE80  0000FFF0.00007E04
                       FFFFFFFF.8244BE88  00000000.00000000
                       FFFFFFFF.8244BE90  00000000.00000001
                       FFFFFFFF.8244BE98  00000000.00000000
                       FFFFFFFF.8244BEA0  FFFFFFFF.805AE4B6  SISR+0006E
                       FFFFFFFF.8244BEA8  00000000.00000001
                       FFFFFFFF.8244BEB0  00000000.00000010
                       FFFFFFFF.8244BEB8  00000000.00000008
                       FFFFFFFF.8244BEC0  00000000.00000010
                       FFFFFFFF.8244BEC8  00000000.00000001
                       FFFFFFFF.8244BED0  00000000.00000000
                       FFFFFFFF.8244BED8  FFFFFFFF.804045D0  SCH$GQ_IDLE_CPUS
                       FFFFFFFF.8244BEE0  00000000.00000001
```

```
CHF$L_SIG_ARGS         FFFFFFFF.8244BEE8  0000000C.00000005
CHF$L_SIG_ARG1         FFFFFFFF.8244BEF0  FFFFFFFC.00010000  SYS$K_VERSION_08
                       FFFFFFFF.8244BEF8  00000300.FFFFFFFC  UCB$L_PI_SVA
                       FFFFFFFF.8244BF00  00000002.00000001
                       FFFFFFFF.8244BF08  00000000.0000000C
                       FFFFFFFF.8244BF10  00000000.00000000
                       FFFFFFFF.8244BF18  00000000.FFFFFFFC
                       FFFFFFFF.8244BF20  00000008.00000000
                       FFFFFFFF.8244BF28  00000000.00000001
                       FFFFFFFF.8244BF30  00000008.00000000
                       FFFFFFFF.8244BF38  00000000.FFFFFFFC
INTSTK$Q_R2            FFFFFFFF.8244BF40  FFFFFFFF.80404668  SCH$GL_ACTIVE_PRIORITY
INTSTK$Q_R3            FFFFFFFF.8244BF48  FFFFFFFF.8042F280  SCH$WAIT_KERNEL_MODE
INTSTK$Q_R4            FFFFFFFF.8244BF50  FFFFFFFF.80615F00
INTSTK$Q_R5            FFFFFFFF.8244BF58  00000000.00000000
INTSTK$Q_R6            FFFFFFFF.8244BF60  FFFFFFFF.805AE000
INTSTK$Q_R7            FFFFFFFF.8244BF68  00000000.00000000
INTSTK$Q_PC            FFFFFFFF.8244BF70  00000000.FFFFFFFC
INTSTK$Q_PS            FFFFFFFF.8244BF78  30000000.00000300  UCB$L_PI_SVA
                       FFFFFFFF.8244BF80  FFFFFFFF.80404668  SCH$GL_ACTIVE_PRIORITY
                       FFFFFFFF.8244BF88  00000000.7FFD00A8  PIO$GW_IIOIMPA
                       FFFFFFFF.8244BF90  00000000.00000000
                       FFFFFFFF.8244BF98  FFFFFFFF.8042CD50  SCH$WAIT_PROC+00060
                       FFFFFFFF.8244BFA0  00000000.00000044
                       FFFFFFFF.8244BFA8  FFFFFFFF.80403C30  SMP$GL_FLAGS
Prev SP (8244BFB0) =>  FFFFFFFF.8244BFB0  FFFFFFFF.8042CD50  SCH$WAIT_PROC+00060
                       FFFFFFFF.8244BFB8  00000000.00000000
                       FFFFFFFF.8244BFC0  FFFFFFFF.805EE040
                       FFFFFFFF.8244BFC8  FFFFFFFF.8006DB54  PROCESS_MANAGEMENT_NPRO+0DB54
                       FFFFFFFF.8244BFD0  FFFFFFFF.80404668  SCH$GL_ACTIVE_PRIORITY
                       FFFFFFFF.8244BFD8  FFFFFFFF.80615F00
                       FFFFFFFF.8244BFE0  FFFFFFFF.8041B220  SCH$RESOURCE_WAIT
                       FFFFFFFF.8244BFE8  00000000.00000044
                       FFFFFFFF.8244BFF0  FFFFFFFF.80403C30  SMP$GL_FLAGS
                       FFFFFFFF.8244BFF8  00000000.7FF95E00
```

The SHOW STACK command displays a system stack. The data shown before the stack pointer may not be valid. The mechanism array, signal array, and exception frame symbols displayed on the left appear only for INVEXCEPTN, FATALEXCPT, UNXSIGNAL, and SSRVEXCEPT bugchecks.

SHOW SUMMARY

Displays a list of all active processes and the values of the parameters used in swapping and scheduling these processes.

Format

SHOW SUMMARY [/IMAGE | /PROCESS_NAME=*process_name*
| /THREAD | /USER=username]

Parameters

None.

Qualifiers

/IMAGE
Causes SDA to display, if possible, the name of the image being executed within each process.

/PROCESS_NAME=*process_name*
Displays only processes with the specified process name. You can use wildcards in *process_name*, in which case SDA displays all matching processes. The default action is for SDA to display data for all processes, regardless of process name.

/THREAD
Displays information on all the current threads associated with the current process.

/USER=*username*
Displays only the processes of the specified user. You can use wildcards in *username*, in which case SDA displays processes of all matching users. The default action is for SDA to display data for all processes, regardless of user name.

Description

The SHOW SUMMARY command displays the information in Table 4–27 for each active process in the system.

Table 4–27 Process Information in the SHOW SUMMARY Display

Column	Contents
Extended PID	The 32-bit number that uniquely identifies the process.
Indx	Index of this process into the PCB array.
Process name	Name assigned to the process.
Username	Name of the user who created the process.
State	Current state of the process. Table 4–28 shows the 14 states and their meanings.

(continued on next page)

Table 4–27 (Cont.) Process Information in the SHOW SUMMARY Display

Column	Contents
Pri	Current scheduling priority of the process.
PCB/KTB	Address of the process control block or address of the kernel thread block.
PHD	Address of the process header.
Wkset	Number (in decimal) of pages currently in the process working set.

Table 4–28 Current State Information

State	Meaning
COM	Computable and resident in memory
COMO	Computable, but outswapped
CUR *nn*	Currently executing on CPU ID *nn*
CEF	Waiting for a common event flag
LEF	Waiting for a local event flag
LEFO	Outswapped and waiting for a local event flag
HIB	Hibernating
HIBO	Hibernating and outswapped
SUSP	Suspended
SUSPO	Suspended and outswapped
PFW	Waiting for a page that is not in memory (page-fault wait)
FPG	Waiting to add a page to its working set (free-page wait)
COLPG	Waiting for a page collision to be resolved (collided-page wait); this usually occurs when several processes cause page faults on the same shared page
MWAIT	Miscellaneous wait
RWxxx	Waiting for system resource *xxx*
TBS	Waiting "To Be Scheduled" by class scheduler
TBSO	Waiting "To Be Scheduled" and outswapped
TBS_P	"To Be Scheduled" state is pending
TBSPO	"To Be Scheduled" state is pending and outswapped
WTBYT	Waiting for BYTCNT quota
WTTQE	Waiting for TQCNT quota

Example

```
SDA>  SHOW SUMMARY
Current process summary
-----------------------
 Extended Indx Process name    Username    State   Pri PCB/KTB    PHD    Wkset
-- PID -- ---- --------------- ----------- ------- --- -------- -------- ------
 00000041 0001 SWAPPER                      HIB     16 80C641D0 80C63E00   0
 00000045 0005 IPCACP          SYSTEM       HIB     10 80DC0780 81266000  39
 00000046 0006 ERRFMT          SYSTEM       HIB      8 80DC2240 8126C000  57
 00000047 0007 OPCOM           SYSTEM       HIB      8 80DC3340 81272000  31
 00000048 0008 AUDIT_SERVER    AUDIT$SERVER HIB     10 80D61280 81278000 152
 00000049 0009 JOB_CONTROL     SYSTEM       HIB     10 80D620C0 8127E000  50
 0000004A 000A SECURITY_SERVER SYSTEM       HIB     10 80DC58C0 81284000 253
 0000004B 000B TP_SERVER       SYSTEM       HIB     10 80DC8900 8128A000  75
 0000004C 000C NETACP          DECNET       HIB     10 80DBFE00 8125A000  78
 0000004D 000D EVL             DECNET       HIB      6 80DCA080 81290000  76
 0000004E 000E REMACP          SYSTEM       HIB      8 80DE4E00 81296000  14
 00000050 0010 DECW$SERVER_0   SYSTEM       HIB      8 80DEF940 812A2000 739
 00000051 0011 DECW$LOGINOUT   <login>      LEF      4 80DF0F00 812A8000 273
 00000052 0012 SYSTEM          SYSTEM       LEF      9 80D772C0 81260000  75
```

The SHOW SUMMARY command describes all active processes in the system at the time of the system failure. Note that there was no process in the CUR state at the time of the failure.

SHOW SYMBOL

Displays the hexadecimal value of a symbol and, if the value is equal to an address location, the contents of that location.

Format

SHOW SYMBOL [/ALL [/ALPHA | /VALUE]] symbol-name

Parameter

symbol-name
Name of the symbol to be displayed. You must provide a **symbol-name** unless you specify the /ALL qualifier.

Qualifiers

/ALL
Displays information on all symbols whose names begin with the characters specified in **symbol-name**. If no symbol name is given, all symbols are displayed.

/ALPHA
When used with the /ALL qualifier, displays the symbols sorted only in alphabetical order. The default is to display the symbols twice, sorted alphabetically and then by value.

When used with a wildcard symbol name, displays the symbols in alphabetical order. This is the default action.

/VALUE
When used with the /ALL qualifier, displays the symbols sorted only in value order. The default is to display the symbols twice, sorted alphabetically and then by value.

When used with a wildcard symbol name, displays the symbols in value order.

Description

The SHOW SYMBOL command with the /ALL qualifier outputs all symbols whose names begin with the characters specified in **symbol-name** in both alphabetical order and in value order. If no **symbol-name** is given, all symbols are output.

The SHOW SYMBOL/ALL command is useful for determining the values of symbols that belong to a symbol set, as illustrated in the second example below.

The SHOW SYMBOL command without the /ALL qualifier allows for standard wildcards in the **symbol-name** parameter. By default, matching symbols are displayed only in alphabetical order. If you specify SHOW SYMBOL/VALUE, then matching symbols are output sorted by value. If you specify SHOW SYMBOL/ALPHA/VALUE, then matching symbols are displayed twice, sorted alphabetically and then by value.

The SHOW SYMBOL command without the /ALL qualifier and no wildcards in the **symbol-name** parameter outputs the value associated with the given symbol.

When displaying any symbol value, SDA also treats the value as an address and attempts to obtain the contents of the location. If successful, the contents are also displayed.

Examples

1.
```
SDA>  SHOW SYMBOL G
G = FFFFFFFF.80000000 :  6BFA8001.201F0104
```

The SHOW SYMBOL command evaluates the symbol G as FFFFFFFF.80000000$_{16}$ and displays the contents of address FFFFFFFF.80000000$_{16}$ as 6BFA8001.201F0104$_{16}$.

2.
```
SDA>  SHOW SYMBOL/ALL BUG
Symbols sorted by name
----------------------
BUG$L_BUGCHK_FLAGS          = FFFFFFFF.804031E8 : 00000000.00000001
BUG$L_FATAL_SPSAV           = FFFFFFFF.804031F0 : 00000000.00000001
BUG$REBOOT                  = FFFFFFFF.8042E320 : 00000000.00001808
BUG$REBOOT_C                = FFFFFFFF.8004F4D0 : 47FB041D.47FD0600

   .
   .
   .
Symbols sorted by value
----------------------
BUG$REBOOT_C                = FFFFFFFF.8004F4D0 :47FB041D.47FD0600
BUG$L_BUGCHK_FLAGS          = FFFFFFFF.804031E8 :00000000.00000001
BUG$L_FATAL_SPSAV           = FFFFFFFF.804031F0 :00000000.00000001
BUG$REBOOT                  = FFFFFFFF.8042E320 :00000000.00001808
   .
   .
   .
```

This example shows the display produced by the SHOW SYMBOL/ALL command. SDA searches its symbol table for all symbols that begin with the string “BUG” and displays the symbols and their values. Although certain values equate to memory addresses, it is doubtful that the contents of those addresses are actually relevant to the symbol definitions in this instance.

SHOW TQE

Displays the entries in the timer queue. The default output is a summary display of all timer queue entries (TQEs) in chronological order.

Format

SHOW TQE [/ADDRESS=*n*][/ALL][/BACKLINK][/PID=*n*]
[/ROUTINE=*n*]

Parameters

None.

Qualifiers

/ADDRESS=*n*
Outputs a detailed display of the TQE at the specified address.

/ALL
Outputs a detailed display of all TQEs.

/BACKLINK
Outputs the display of TQEs, either detailed (/ALL) or brief (default), in reverse order, starting at the entry furthest into the future.

/PID=*n*
Limits the display to the TQEs that affect the process with the specified *internal* PID. The PID format required is the entire internal PID, including both the process index and the sequence number, and not the extended PID or process index alone, as used elsewhere in SDA. You can also display TQEs specific to a process using SHOW PROCESS/TQE.

/ROUTINE=*n*
Limits the display to the TQEs for which the specified address is the fork PC.

Description

The SHOW TQE command allows the timer queue to be displayed. By default a summary display of all TQEs is output in chronological order, beginning with the next entry to become current.

The /ADDRESS, /PID, and /ROUTINE qualifiers are mutually exclusive. The /ADDRESS and /BACKLINK qualifiers are mutually exclusive.

In the summary display, the TQE type is given as a six-character code, as in Table 4–29.

Table 4–29 TQE Types in Summary TQE Display

Column	Symbol	Meaning
1	T	Timer ($SETIMR) entry
	S	System subroutine entry
	W	Scheduled wakeup ($SCHDWK) entry
2	S	Single-shot entry
	R	Repeated entry
3	D	Delta time
	A	Absolute time
4	C	CPU time
	–	Elapsed time
5	E	Extended format (64-bit TQE)
	–	32-bit TQE
6	N	TQE not to be deallocated at AST completion
	–	TQE to be deallocated at AST completion

Examples

1. SDA> SHOW TQE

```
Timer queue entries
-------------------

System time:    15-NOV-2001 15:09:06.92
First TQE time: 15-NOV-2001 15:09:06.92
```

```
  TQE                                                    PID/
address              Expiration Time               Type   routine
--------  ----------------------------------------  ------  --------
815AB8C0  00A0516F.EF279B0F 15-NOV-2001 15:09:06.92  SSD---  835FCC48  TCPIP$INTERNET_SERVICES+9EC48
812CB3C0  00A0516F.EF279B0F 15-NOV-2001 15:09:06.92  SRD---  812CCEC8  SYS$PPPDRIVER+0EEC8
81514140  00A0516F.EF29FD5F 15-NOV-2001 15:09:06.94  TSD---  0001000F  SECUURITY_SERVER
815C8040  00A0516F.EF2B2E87 15-NOV-2001 15:09:06.95  SRD---  81361BA0  SYS$LTDRIVER+31BA0
8148CF98  00A0516F.EF2C52AD 15-NOV-2001 15:09:06.95  SRD---  812786B0  LAN$CREATE_LAN+000B0
81318290  00A0516F.EF2FDC84 15-NOV-2001 15:09:06.98  SRD---  813187B8  PWIPDRIVER+047B8
814FB080  00A0516F.EF3238D0 15-NOV-2001 15:09:06.99  TSD---  0001000F  SECURITY_SERVER
8140FF40  00A0516F.EF32851A 15-NOV-2001 15:09:06.99  TSD---  0001000F  SECURITY_SERVER
...
81503100  00A05177.0AED8000 15-NOV-2001 16:00:00.00  TSA---  0001000C  JOB_CONTROL
815030C0  00A0C160.63CD14D9  7-APR-2002 02:00:00.91  TSA---  0001000C  JOB_CONTROL
```

This example shows the summary display of all TQEs.

2.

```
SDA> SHOW TQE/ADDRESS=8131F5C0

Timer queue entry 8131F5C0
--------------------------

TQE Address:                     8131F5C0   Type:                    00000005  SYSTEM_SUBROUTINE REPEAT
    FLink:                       8129C6D8   BLink:                   83975948
    Requestor process ID:        00000000   Access Mode:             00000000

    Expiration time:     009EADD2.417463F4   30-MAY-2000 15:14:47.31  +67860
    Delta repeat time:   00000000.00989680            0 00:00:01.00

    Fork PC:                     811FDCD0   NETDRIVER+190D0
    Fork R3:             00000000.00000000
    Fork R4:             FFFFFFFF.8131DB00
```

This example shows the detailed display for a single TQE.

SHOW WORKING_SET_LIST, SHOW WSL

Displays the system working set list and retains the current process context.

Format

SHOW WORKING_SET_LIST or SHOW WSL [={GPT | SYSTEM | LOCKED | *n*}]

Parameters

None.

Qualifiers

None.

Description

The SHOW WORKING_SET_LIST command displays the contents of requested entries in the system working set list. If you do not specify an option, all working set list entries are displayed. Table 4–30 shows the options available with SHOW WORKING_SET_LIST. The SHOW WORKING_SET_LIST command is equivalent to the SHOW PROCESS/SYSTEM/WORKING_SET_LIST command, but the SDA current process context returns to the prior process upon completion. See the SHOW PROCESS command and Table 4–18 for more information.

Table 4–30 Options for the SHOW WORKING_SET_LIST Command

Options	Results
GPT	Displays only working set list entries for global page table pages
SYSTEM	Displays only working set list entries for pageable system pages
LOCKED	Displays only working set list entries for pageable system pages that are locked in the system working set
n	Displays a specific working set entry, where *n* is the working set list index (WSLX) of the entry of interest

SPAWN

Creates a subprocess of the process currently running SDA, copying the context of the current process to the subprocess and, optionally, executing a specified command within the subprocess.

Format

SPAWN [/qualifier[,...]] [command]

Parameter

command
Name of the command that you want the subprocess to execute.

Qualifiers

/INPUT=filespec
Specifies an input file containing one or more command strings to be executed by the spawned subprocess. If you specify a command string with an input file, the command string is processed before the commands in the input file. When processing is complete, the subprocess is terminated.

/NOLOGICAL_NAMES
Specifies that the logical names of the parent process are not to be copied to the subprocess. The default behavior is that the logical names of the parent process are copied to the subprocess.

/NOSYMBOLS
Specifies that the DCL global and local symbols of the parent process are not to be passed to the subprocess. The default behavior is that these symbols are passed to the subprocess.

/NOTIFY
Specifies that a message is to be broadcast to SYS$OUTPUT when the subprocess either completes processing or aborts. The default behavior is that such a message is not sent to SYS$OUTPUT.

/NOWAIT
Specifies that the system is not to wait until the subprocess is completed before allowing more commands to be specified. This qualifier allows you to specify new commands while the spawned subprocess is running. If you specify /NOWAIT, use /OUTPUT to direct the output of the subprocess to a file to prevent more than one process from simultaneously using your terminal.

The default behavior is that the system waits until the subprocess is completed before allowing more commands to be specified.

/OUTPUT=filespec
Specifies an output file to which the results of the SPAWN operation are written. To prevent output from the spawned subprocess from being displayed while you are specifying new commands, specify an output other than SYS$OUTPUT whenever you specify /NOWAIT. If you omit the /OUTPUT qualifier, output is written to the current SYS$OUTPUT device.

/PROCESS=*process-name*
Specifies the name of the subprocess to be created. The default name of the subprocess is *USERNAME_n*, where *USERNAME* is the user name of the parent process. The variable *n* represents the subprocess number.

Example

```
SDA>  SPAWN
$  MAIL
   .
   .
   .
$  DIR
   .
   .
   .
$  LO
   Process SYSTEM_1 logged out at 5-JAN-1993 15:42:23.59
SDA>
```

This example uses the SPAWN command to create a subprocess that issues DCL commands to invoke the Mail utility. The subprocess then lists the contents of a directory before logging out to return to the parent process executing SDA.

UNDEFINE

Removes the specified symbol from SDA's symbol table.

Format

UNDEFINE symbol

Parameter

symbol
The name of the symbol to be deleted from SDA's symbol table. A symbol name is required.

Qualifiers

None.

VALIDATE PFN_LIST

Validates that the page counts on lists are correct.

Format

VALIDATE PFN_LIST {/ALL (d) | [/BAD | /FREE | /MODIFIED | /PRIVATE | /UNTESTED | /ZERO]}

Parameters

None.

Qualifiers

/ALL
Validates all the PFN lists: bad, free, modified, zeroed free pages, and private pages.

/BAD
Validates the bad page list.

/FREE
Validates the free page list.

/MODIFIED
Validates the modified page list.

/PRIVATE
Validates all private page lists.

/UNTESTED
Validates the untested page list that was set up for deferred memory testing.

/ZERO
Validates the zeroed free page list.

Description

The VALIDATE PFN_LIST command validates the specified PFN list by counting the number of entries in the list and comparing that to the running count of entries for each list maintained by the system.

Examples

1.
```
SDA> VALIDATE PFN_LIST
Free page list validated: 1433 pages
        (excluding zeroed free page list with expected size 103 pages)
Zeroed free page list validated: 103 pages
Modified page list validated: 55 pages
Bad page list validated: 0 pages
Untested page list validated: 0 pages
Private page list at 81486340 validated: 2 pages
```

2.
```
SDA> VALIDATE PFN_LIST/FREE
Free page list validated: 1433 pages
        (excluding zeroed free page list with expected size 103 pages)
```

VALIDATE QUEUE

Validates the integrity of the specified queue by checking the pointers in the queue.

Format

VALIDATE QUEUE [address]
[/BACKLINK | /LIST | /PHYSICAL |
/QUADWORD | /SELF_RELATIVE | /SINGLY_LINKED]

Parameter

address
Address of an element in a queue.

If you specify the period (.) as the **address**, SDA uses the last evaluated expression as the queue element's address.

If you do not specify an **address**, the VALIDATE QUEUE command determines the address from the last issued VALIDATE QUEUE command in the current SDA session.

If you do not specify an **address**, and no queue has previously been specified, SDA displays the following error message:

```
%SDA-E-NOQUEUE, no queue has been specified for validation
```

Qualifiers

/BACKLINK
Allows doubly linked lists to be validated from the tail of the queue. If the queue is found to be broken when validated from the head of the queue, you can use /BACKLINK to narrow the list of corrupted entries.

/LIST
Displays the address of each element in the queue.

/PHYSICAL
Allows validation of queues whose header and links are physical addresses.

/QUADWORD
Allows the validate operation to occur on queues with linked lists of quadword addresses.

/SELF_RELATIVE
Specifies that the selected queue is a self-relative queue.

/SINGLY_LINKED
Allows validation of queues that have no backward pointers.

Description

The VALIDATE QUEUE command uses the forward and, optionally, backward pointers in each element of the queue to make sure that all such pointers are valid and that the integrity of the queue is intact. If the queue is intact, SDA displays the following message:

```
Queue is complete, total of n elements in the queue
```

In these messages, *n* represents the number of entries the VALIDATE QUEUE command has found in the queue.

If SDA discovers an error in the queue, it displays one of the following error messages:

```
Error in forward queue linkage at address nnnnnnnn after tracing x elements
Error comparing backward link to previous structure address (nnnnnnnn)
Error occurred in queue element at address oooooooo after tracing pppp elements
```

These messages can appear frequently when you use the VALIDATE QUEUE command within an SDA session that is analyzing a running system. In a running system, the composition of a queue can change while the command is tracing its links, thus producing an error message.

If there are no entries in the queue, SDA displays this message:

```
The queue is empty
```

Examples

1. ```
   SDA>  VALIDATE QUEUE/SELF_RELATIVE IOC$GQ_POSTIQ
   Queue is complete, total of 159 elements in the queue
   ```

   This example validates the self-relative queue IOC$GQ_POSTIQ. The validation is successful and the system determines that there are 159 IRPs in the list.

2. ```
   SDA> VALIDATE QUEUE/QUADWORD FFFFFFFF80D0E6C0/LIST
   Entry      Address              Flink                  Blink
   -----      -------              ------                 -----
   Header     FFFFFFFF80D0E6C0     FFFFFFFF80D03780       FFFFFFFF80D0E800
       1.     FFFFFFFF80D0E790     FFFFFFFF80D0E7C0       FFFFFFFF80D0E6C0
       2.     FFFFFFFF80D0E800     FFFFFFFF80D0E6C0       FFFFFFFF80D0E7C0
   Queue is complete, total of 3 elements in the queue
   ```

   This example shows the validation of quadword elements in a list.

3. ```
   SDA> VALIDATE QUEUE/SINGLY_LINKED EXE$GL_NONPAGED+4
   Queue is zero-terminated, total of 95 elements in the queue
   ```

   This example shows the validation of singly linked elements in the queue. The forward link of the final element is zero instead of being a pointer back to the queue header.
   ```

VALIDATE SHM_CPP

Validates all the shared memory common property partitions (CPPs) and the counts and ranges of attached PFNs; optionally, it can validate the contents of the database for each PFN.

Format

VALIDATE SHM_CPP [/QUALIFIERS]

Parameters

None.

Qualifiers

/ADDRESS=*n*
Validates the counts and ranges for a single shared memory CPP given the address of the SHM_CPP structure.

/ALL
Validates all the shared memory CPPs. This is the default.

/IDENT=*n*
Validates the counts and ranges for a single shared memory CPP.

/PFN
Validates the PFN database contents for each attached PFN. The default is all lists (free, bad, untested) plus the PFN database pages and the complete range of PFNs in the CPP.

To validate only the complete range of PFNs in the CPP, use the keyword *ALL_FRAGMENTS* with the /PFN qualifier:

```
/PFN = ALL_FRAGMENTS
```

To validate only the bad page list, use the keyword *BAD* with the /PFN qualifier:

```
/PFN = BAD
```

To validate only the free page list, use the keyword *FREE* with the /PFN qualifier:

```
/PFN = FREE
```

To validate the PFNs containing the PFN database, use the keyword *PFNDB* with the /PFN qualifier:

```
/PFN = PFNDB
```

To validate only the untested page list, use the keyword *UNTESTED* with the /PFN qualifier:

```
/PFN = UNTESTED
```

To validate multiple lists, you can combine keywords for use with the /PFN qualifier:

```
/PFN = (x,y)
```

If you specify the /PFN without /ALL, /IDENT, or /ADDRESS, then the system validates the PFN lists from the last shared memory CPP.

Example

```
SDA> SHOW SHM_CPP
Not validating SHM_CPP 0000 at FFFFFFFF.7F2BA140, VALID flag clear

Not validating SHM_CPP 0001 at FFFFFFFF.7F2BA380, VALID flag clear

Not validating SHM_CPP 0002 at FFFFFFFF.7F2BA5C0, VALID flag clear

Validating SHM_CPP 0003 at FFFFFFFF.7F2BA800 ...

    Validating counts and ranges in the free page list ...
    ... o.k.

    Not validating the bad page list, list is empty

    Not validating the untested page list, list is empty

Not validating SHM_CPP 0004 at FFFFFFFF.7F2BAA40, VALID flag clear

Not validating SHM_CPP 0005 at FFFFFFFF.7F2BAC80, VALID flag clear

Not validating SHM_CPP 0006 at FFFFFFFF.7F2BAEC0, VALID flag clear
```

This example shows the default output for the VALIDATE SHM_CPP command.

VALIDATE TQE

Validates all the data structures associated with timer queue entries (TQEs).

Format

VALIDATE TQE

Parameters

None.

Qualifiers

None.

Description

TQEs are linked together with index blocks that point to TQEs or to another level of index block. VALIDATE TQE checks that all the index blocks are correctly linked together.

Example

```
SDA> VALIDATE TQE
Validating time index buckets...
    ... o.k.
Validating ID index buckets...
    ... o.k.
Validating 1st time...
    ... o.k.
Validating counts...
    ... o.k.
```

This example shows the output from a successful VALIDATE TQE command.

5 SDA CLUE Extension Commands

This chapter presents an overview of the SDA CLUE (Crash Log Utility Extractor) extension commands, how to display information using these commands, and how to use SDA CLUE with DOSD. This chapter also describes the SDA CLUE commands.

5.1 Overview of SDA CLUE Extensions

SDA CLUE (Crash Log Utility Extractor) commands automate the analysis of crash dumps and maintain a history of all fatal bugchecks on either a standalone or cluster system. You can use SDA CLUE commands in conjunction with SDA to collect and decode additional dump file information not readily accessible through standard SDA commands. SDA CLUE extension commands can summarize information provided by certain standard SDA commands and provide additional detail for some SDA commands. For example, SDA CLUE extension commands can quickly provide detailed extended QIO processor (XQP) summaries. You can also use SDA CLUE commands interactively on a running system to help identify performance problems.

You can use all CLUE commands when analyzing crash dumps; the only CLUE commands that are not allowed when analyzing a running system are CLUE CRASH, CLUE ERRLOG, CLUE HISTORY, and CLUE STACK.

When you reboot the system after a system failure, you automatically invoke SDA by default. To facilitate better crash dump analysis, SDA CLUE commands automatically capture and archive summary dump file information in a CLUE listing file.

A startup command procedure initiates commands that do the following:

- Invoke SDA
- Issue an SDA CLUE HISTORY command
- Create a listing file called CLUE$*nodename_ddmmyy_hhmm.LIS*

The CLUE HISTORY command adds a one-line summary entry to a history file and saves the following output from SDA CLUE commands in the listing file:

- Crash dump summary information
- System configuration
- Stack decoder
- Page and swap files

- Memory management statistics
- Process DCL recall buffer
- Active XQP processes
- XQP cache header

The contents of this CLUE list file can help you analyze a system failure. If these files accumulate more space than the threshold allows (default is 5000 blocks), the oldest files are deleted until the threshold limit is reached. You can also customize this list file using the CLUE$MAX_BLOCK logical name.

For additional information on the contents of the CLUE listing file, see the reference section on CLUE HISTORY.

It is important to remember that CLUE$*nodename_ddmmyy_hhmm.LIS* contains only an overview of the crash dump and does not always contain enough information to determine the cause of the crash. The dump itself should always be saved using the procedures described in Section 2.2.2 and Section 2.2.3.

To inhibit the running of CLUE at system startup, define the logical CLUE$INHIBIT in the SYLOGICALS.COM file as /SYS TRUE.

5.2 Displaying Data Using SDA CLUE Commands

To invoke a CLUE command, enter the command at the SDA prompt. For example:

```
SDA> CLUE CONFIG
```

5.3 Using SDA CLUE with DOSD

DOSD (Dump Off System Disk) allows you to write the system dump file to a device other than the system disk. For SDA CLUE to be able to correctly find the dump file to be analyzed after a system crash, you need to perform the following steps:

1. Modify the command procedure SYS$MANAGER:SYCONFIG.COM to add the system logical name CLUE$DOSD_DEVICE to point to the device where the dump file resides. You need to supply only the physical or logical device name without a file specification.
2. Modify the command procedure SYS$MANAGER:SYCONFIG.COM to mount systemwide the device where the dump file resides. Otherwise, SDA CLUE cannot access and analyze the dump file.

In the following example, the dump file has been placed on device 3DUA25, which has the label DMP$DEV. You need to add the following commands to SYS$MANAGER:SYCONFIG.COM:

```
$mount/system/noassist $3$dua25: dmp$dev dmp$dev
$define/system clue$dosd_device dmp$dev
```

5.4 Listing of SDA CLUE Extension Commands

This section describes the following SDA CLUE extension commands:

CLUE CALL_FRAME
CLUE CLEANUP
CLUE CONFIG
CLUE CRASH
CLUE ERRLOG
CLUE FRU
CLUE HISTORY
CLUE MCHK
CLUE MEMORY
CLUE PROCESS
CLUE REGISTER
CLUE SG
CLUE STACK
CLUE SYSTEM
CLUE VCC
CLUE XQP

CLUE CALL_FRAME

Displays key information, such as the PC of the caller, from the active call frames at time of the crash.

Format

CLUE CALL_FRAME [/CPU [cpu-id | ALL]
| /PROCESS [/ADDRESS=*n* | INDEX=*n*
| /IDENTIFICATION=*n* | process-name | ALL]]

Parameters

ALL
When used with /CPU, it requests information about all CPUs in the system. When used with /PROCESS, it requests information about all processes that exist in the system.

cpu-id
When used with /CPU, it gives the number of the CPU for which information is to be displayed. Use of the **cpu-id** parameter causes the CLUE CALL_FRAME command to perform an implicit SET CPU command, making the indicated CPU the current CPU for subsequent SDA commands.

process-name
When used with /PROCESS, it gives the name of the process for which information is to be displayed. Use of the **process-name** parameter, the /ADDRESS qualifier, the /INDEX qualifier, or the /IDENTIFICATION qualifier causes the CLUE CALL_FRAME command to perform an implicit SET PROCESS command, making the indicated process the current process for subsequent SDA commands. You can determine the names of the processes in the system by issuing a SHOW SUMMARY command.

The **process-name** can contain up to 15 letters and numerals, including the underscore (_) and dollar sign ($). If it contains any other characters, you must enclose the **process-name** in quotation marks (" ").

Qualifiers

/ADDRESS=*n*
Specifies the PCB address of the desired process when used with CLUE CALL_FRAME/PROCESS.

/CPU [cpu-id | ALL]
Indicates that the call frame for a CPU is required. Specify the CPU by its number or use ALL to indicate all CPUs.

/IDENTIFICATION=*n*
Specifies the identification of the desired process when used with CLUE CALL_FRAME/PROCESS.

/INDEX=*n*
Specifies the index of the desired process when used with CLUE CALL_FRAME/PROCESS.

/PROCESS [process-name | ALL]
Indicates that the call frame for a process is required. The process should be specified with either one of the qualifiers /ADDRESS, /IDENTIFICATION, or /INDEX, or by its name, or by using ALL to indicate all processes.

Description

The CLUE CALL_FRAME command displays call chain information for a process or a CPU. The process context calls work on both the running system and dump file; the CPU context calls only on dump files.

If neither /CPU nor /PROCESS is specified, the parameter (CPU-id or process-name) is ignored and the call frame for the SDA current process is displayed.

Examples

1.
```
SDA>CLUE CALL/PROCESS IPCACP
Call Chain:   Process index: 000B   Process name: IPCACP  PCB: 8136EF00
-----------------------------------------------------------------------
Procedure Frame  Procedure Entry                          Return Address
---------------  ----------------------------------       ---------------------------
7FFA1CA0  Null   800C8C90  SCH$WAIT_PROC_C
7FFA1D00  Stack  800D9250  SYS$HIBER_C                    0003045C  IPCACP+0003045C
7FFA1D50  Stack  00030050  IPCACP+00030050                800D11C8  EXE$CMKRNL_C+000D8
7FFA1E60  Null   800B6120  EXE$BLDPKTSWPR_C
7FFA1E78  Null   800B6120  EXE$BLDPKTSWPR_C
7FFA1EC0  Null   80248120  NSA$CHECK_PRIVILEGE_C
7FFA1F00  Null   80084640  EXE$CMODEXECX_C
7FFA1F70  Stack  800D10F0  EXE$CMKRNL_C                   80084CC8  EXE$CMODKRNL_C+00198
7B01FAB0  Stack  00030010  IPCACP+00030010                83EA3454  SYS$IMGSTA_C+00154
7B01FB10  Stack  83EA3300  SYS$IMGSTA_C                   83D99CC4  EXE$PROC_IMGACT_C+00384
7B01FBA0  Stack  83D99BA0  EXE$PROC_IMGACT_C+00260        83D99B9C  EXE$PROC_IMGACT_C+0025C
```

In this example, the CLUE CALL_FRAME command displays the call frame from the process IPCACP.

2.
```
SDA>CLUE CALL/CPU ALL
Call Chain:   Process index: 0000   Process name: NULL    PCB: 827377C0   (CPU 0)
--------------------------------------------------------------------------------
Procedure Frame  Procedure Entry                          Return Address
---------------  ----------------------------------       ---------------------------
8F629D28  Null   80205E00  SYS$SCS+05E00
8F629D68  Null   8020A850  SCS$REC_MSGREC_C
8F629D98  Null   914A5340  SYS$PBDRIVER+07340
8F629DB8  Null   914A4FD0  SYS$PBDRIVER+06FD0
8F629DE0  Stack  914AACF0  SYS$PBDRIVER+0CCF0             914AE5CC  SYS$PBDRIVER+105CC
8F629E50  Stack  914AE418  SYS$PBDRIVER+10418             800503B0  EXE_STD$QUEUE_FORK_C+00350
8F629F88  Null   800E95F4  SCH$WAIT_ANY_MODE_C
8F629FD0  Stack  800D0F80  SCH$IDLE_C                     800E92D0  SCH$INTERRUPT+00BB0

Call Chain:   Process index: 0000   Process name: NULL    PCB: 827377C0   (CPU 2)
--------------------------------------------------------------------------------
Procedure Frame  Procedure Entry                          Return Address
---------------  --------------------------------         ---------------------------
90FCBF88  Null   800E95F4  SCH$WAIT_ANY_MODE_C
90FCBFC8  Null   800E95F4  SCH$WAIT_ANY_MODE_C
90FCBFD0  Stack  800D0F80  SCH$IDLE_C                     800E92D0  SCH$INTERRUPT+00BB0
```

```
Call Chain:   Process index: 0000   Process name: NULL    PCB: 827377C0   (CPU 6)
---------------------------------------------------------------------------------
Procedure Frame  Procedure Entry                          Return Address
---------------  ------------------------------          ---------------------------
90FCBF88  Null   800E95FA  SCH$WAIT_ANY_MORE_c
90FD9F88  Null   800E95F4  SCH$WAIT_ANY_MODE_C
90FD9FD0  Stack  800D0F80  SCH$IDLE_C                    800E92D0  SCH$INTERRUPT+00BB0
```

In this example, CLUE/CPU ALL shows the call frame for all CPUs.

CLUE CLEANUP

Performs housekeeping operations to conserve disk space.

Format

CLUE CLEANUP

Parameters

None.

Qualifiers

None.

Description

CLUE CLEANUP performs housekeeping operations to conserve disk space. To avoid filling up the system disk with listing files generated by CLUE, CLUE CLEANUP is run during system startup to check the overall disk space used by all CLUE$*.LIS files.

If the CLUE$COLLECT:CLUE$*.LIS files occupy more space than the logical CLUE$MAX_BLOCKS allows, then the oldest files are deleted until the threshold is reached. If this logical name is not defined, a default value of 5,000 disk blocks is assumed. A value of zero disables housekeeping and no check on the disk space is performed.

Example

```
SDA>  CLUE CLEANUP
%CLUE-I-CLEANUP, housekeeping started...
%CLUE-I-MAXBLOCK, maximum blocks allowed 5000 blocks
%CLUE-I-STAT, total of 4 CLUE files, 192 blocks.
```

In this example, the CLUE CLEANUP command displays that the total number of blocks of disk space used by CLUE files does not exceed the maximum number of blocks allowed. No files are deleted.

CLUE CONFIG

Displays the system, memory, and device configurations.

Format

CLUE CONFIG

Parameters

None.

Qualifiers

None.

Description

CLUE CONFIG displays the system, memory, and device configurations.

Example

```
SDA> CLUE CONFIG
System Configuration:
---------------------
System Information:
System Type    AlphaServer 4100 5/400 4MB            Primary CPU ID 00
Cycle Time     2.5 nsec (400 MHz)                    Pagesize       8192 Byte

Memory Configuration:
Cluster    PFN Start    PFN Count         Range (MByte)        Usage
 #00           0          256         0.0 MB -     2.0 MB    Console
 #01         256        32510         2.0 MB -   255.9 MB    System
 #02       32766            2       255.9 MB -   256.0 MB    Console

Per-CPU Slot Processor Information:
CPU ID         00                        CPU State    rc,pa,pp,cv,pv,pmv,pl
CPU Type       EV56  Pass 2 (21164A)     Halt Request "Default, No Action"
PAL Code       1.19-12                   Halt PC      00000000.20000000
CPU Revision   ....                      Halt PS      00000000.00001F00
Serial Number  ..........                Halt Code    "Bootstrap or Powerfail"
Console Vers   V5.0-47

CPU ID         02                        CPU State    pa,pp,cv,pv,pmv,pl
CPU Type       EV56  Pass 2 (21164A)     Halt Request "Default, No Action"
PAL Code       1.19-12                   Halt PC      00000000.00000000
CPU Revision   ....                      Halt PS      00000000.00000000
Serial Number  ..........                Halt Code    "Bootstrap or Powerfail"
Console Vers   V5.0-47

Adapter Configuration:
----------------------
TR Adapter     ADP               Hose Bus   BusArrayEntry     Node CSR           Vec/IRQ Port Slot Device Name / HW-Id
-- ----------- ----------------- ---- ----------------------- ---- ---------------------- ---- ---- ---------------------------
 1 KA1605      FFFFFFFF.8120FB40    0 GLOBAL_BUS
 2 MC_BUS      FFFFFFFF.8120FF00    7 MC_BUS
                                        FFFFFFFF.81210150    4 FFFFFFFF.85BB8000             4 KA1605_PCI
                                        FFFFFFFF.81210268    1 00000000.00000000             1 KA1605_MEMORY
 3 PCI         FFFFFFFF.81210300   60 PCI
                                        FFFFFFFF.81210550    8 FFFFFFFF.85BC2000  900        1 MERCURY
                                        FFFFFFFF.81210588   10 FFFFFFFF.85DEA000  980 GQA:   2 S3 Trio32/64
                                        FFFFFFFF.812105C0   18 FFFFFFFF.85DEC000  9C0 EWA:   3 DC21140 - 100 mbit NI (Tulip)
                                        FFFFFFFF.812105F8   20 FFFFFFFF.85DEE000  A00 PKA:   4 Qlogic ISP1020 SCSI-2
                                        FFFFFFFF.81210630   28 FFFFFFFF.85DF0000  A40 PKB:   5 FWD SCSI (KZPSA)
 4 EISA        FFFFFFFF.81210800   60 EISA
                                        FFFFFFFF.81210A18    0 FFFFFFFF.85BC4000    0        0 System Board
 5 XBUS        FFFFFFFF.81210DC0   60 XBUS
                                        FFFFFFFF.81210F98    0 FFFFFFFF.85BC4000    0        0 EISA_SYSTEM_BOARD
                                        FFFFFFFF.81210FD0    1 FFFFFFFF.85BC4000    6 DVA:   1 Floppy
                                        FFFFFFFF.81211008    2 FFFFFFFF.85BC4000    7 LRA:   2 Line Printer (parallel port)
                                        FFFFFFFF.812110B0    5 FFFFFFFF.85BC4000   11 IIA:   5 I2C bus driver
```

VM-0011A-AI

CLUE CRASH

Displays a crash dump summary.

Format

CLUE CRASH

Parameters

None.

Qualifiers

None.

Description

CLUE CRASH displays a crash dump summary, which includes the following items:

- Bugcheck type
- Current process and image
- Failing PC and PS
- Executive image section name and offset
- General registers
- Failing instructions
- Exception frame, signal and mechanism arrays (if available)
- CPU state information (spinlock related bugchecks only)

Example

```
SDA>  CLUE CRASH
Crash Time:         30-AUG-1996 13:13:46.83
Bugcheck Type:      SSRVEXCEPT, Unexpected system service exception
Node:               SWPCTX  (Standalone)
CPU Type:           DEC 3000 Model 400
VMS Version:        X6AF-FT2
Current Process:    SYSTEM
Current Image:      $31$DKB0:[SYS0.][SYSMGR]X.EXE;1
Failing PC:         00000000.00030078    SYS$K_VERSION_01+00078
Failing PS:         00000000.00000003
Module:             X
Offset:             00030078
```

```
Boot Time:          30-AUG-1996 09:06:22.00
System Uptime:                0 04:07:24.83
Crash/Primary CPU:  00/00
System/CPU Type:    0402
Saved Processes:    18
Pagesize:           8 KByte (8192 bytes)
Physical Memory:    64 MByte (8192 PFNs, contiguous memory)
Dumpfile Pagelets:  98861 blocks
Dump Flags:         olddump,writecomp,errlogcomp,dump_style
Dump Type:          raw,selective
EXE$GL_FLAGS:       poolpging,init,bugdump
Paging Files:       1 Pagefile and 1 Swapfile installed

Stack Pointers:
KSP = 00000000.7FFA1C98   ESP = 00000000.7FFA6000   SSP = 00000000.7FFAC100
USP = 00000000.7AFFBAD0

General Registers:
R0  = 00000000.00000000   R1  = 00000000.7FFA1EB8   R2  = FFFFFFFF.80D0E6C0
R3  = FFFFFFFF.80C63460   R4  = FFFFFFFF.80D12740   R5  = 00000000.000000C8
R6  = 00000000.00030038   R7  = 00000000.7FFA1FC0   R8  = 00000000.7FFAC208
R9  = 00000000.7FFAC410   R10 = 00000000.7FFAD238   R11 = 00000000.7FFCE3E0
R12 = 00000000.00000000   R13 = FFFFFFFF.80C6EB60   R14 = 00000000.00000000
R15 = 00000000.009A79FD   R16 = 00000000.000003C4   R17 = 00000000.7FFA1D40
R18 = FFFFFFFF.80C05C38   R19 = 00000000.00000000   R20 = 00000000.7FFA1F50
R21 = 00000000.00000000   R22 = 00000000.00000001   R23 = 00000000.7FFF03C8
R24 = 00000000.7FFF0040   AI  = 00000000.00000003   RA  = FFFFFFFF.82A21080
PV  = FFFFFFFF.829CF010   R28 = FFFFFFFF.8004B6DC   FP  = 00000000.7FFA1CA0
PC  = FFFFFFFF.82A210B4   PS  = 18000000.00000000

Exception Frame:
R2  = 00000000.00000003   R3  = FFFFFFFF.80C63460   R4  = FFFFFFFF.80D12740
R5  = 00000000.000000C8   R6  = 00000000.00030038   R7  = 00000000.7FFA1FC0
PC  = 00000000.00030078   PS  = 00000000.00000003

Signal Array:                          64-bit Signal Array:
Arg Count    = 00000005                Arg Count      =          00000005
Condition    = 0000000C                Condition      = 00000000.0000000C
Argument #2  = 00010000                Argument #2    = 00000000.00010000
Argument #3  = 00000000                Argument #3    = 00000000.00000000
Argument #4  = 00030078                Argument #4    = 00000000.00030078
Argument #5  = 00000003                Argument #5    = 00000000.00000003

Mechanism Array:
Arguments    = 0000002C                Establisher FP = 00000000.7AFFBAD0
Flags        = 00000000                Exception FP   = 00000000.7FFA1F00
Depth        = FFFFFFFD                Signal Array   = 00000000.7FFA1EB8
Handler Data = 00000000.00000000       Signal64 Array = 00000000.7FFA1ED0
R0  = 00000000.00020000   R1  = 00000000.00000000   R16 = 00000000.00020004
R17 = 00000000.00010050   R18 = FFFFFFFF.FFFFFFFF   R19 = 00000000.00000000
R20 = 00000000.7FFA1F50   R21 = 00000000.00000000   R22 = 00000000.00010050
R23 = 00000000.00000000   R24 = 00000000.00010051   R25 = 00000000.00000000
R26 = FFFFFFFF.8010ACA4   R27 = 00000000.00010050   R28 = 00000000.00000000

System Registers:
Page Table Base Register (PTBR)                         00000000.00001136
Processor Base Register (PRBR)                          FFFFFFFF.80D0E000
Privileged Context Block Base (PCBB)                    00000000.003FE080
System Control Block Base (SCBB)                        00000000.000001DC
Software Interrupt Summary Register (SISR)              00000000.00000000
Address Space Number (ASN)                              00000000.0000002F
AST Summary / AST Enable (ASTSR_ASTEN)                  00000000.0000000F
Floating-Point Enable (FEN)                             00000000.00000000
Interrupt Priority Level (IPL)                          00000000.00000000
Machine Check Error Summary (MCES)                      00000000.00000000
Virtual Page Table Base Register (VPTB)                 FFFFFFFC.00000000
```

```
Failing Instruction:
SYS$K_VERSION_01+00078:         LDL            R28,(R28)

Instruction Stream (last 20 instructions):
SYS$K_VERSION_01+00028:         LDQ            R16,#X0030(R13)
SYS$K_VERSION_01+0002C:         LDQ            R27,#X0048(R13)
SYS$K_VERSION_01+00030:         LDA            R17,(R28)
SYS$K_VERSION_01+00034:         JSR            R26,(R26)
SYS$K_VERSION_01+00038:         LDQ            R26,#X0038(R13)
SYS$K_VERSION_01+0003C:         BIS            R31,SP,SP
SYS$K_VERSION_01+00040:         BIS            R31,R26,R0
SYS$K_VERSION_01+00044:         BIS            R31,FP,SP
SYS$K_VERSION_01+00048:         LDQ            R28,#X0008(SP)
SYS$K_VERSION_01+0004C:         LDQ            R13,#X0010(SP)
SYS$K_VERSION_01+00050:         LDQ            FP,#X0018(SP)
SYS$K_VERSION_01+00054:         LDA            SP,#X0020(SP)
SYS$K_VERSION_01+00058:         RET            R31,(R28)
SYS$K_VERSION_01+0005C:         BIS            R31,R31,R31
SYS$K_VERSION_01+00060:         LDA            SP,#XFFE0(SP)
SYS$K_VERSION_01+00064:         STQ            FP,#X0018(SP)
SYS$K_VERSION_01+00068:         STQ            R27,(SP)
SYS$K_VERSION_01+0006C:         BIS            R31,SP,FP
SYS$K_VERSION_01+00070:         STQ            R26,#X0010(SP)
SYS$K_VERSION_01+00074:         LDA            R28,(R31)
SYS$K_VERSION_01+00078:         LDL            R28,(R28)
SYS$K_VERSION_01+0007C:         BEQ            R28,#X000007
SYS$K_VERSION_01+00080:         LDQ            R26,#XFFE8(R27)
SYS$K_VERSION_01+00084:         BIS            R31,R26,R0
SYS$K_VERSION_01+00088:         BIS            R31,FP,SP
```

CLUE ERRLOG

Extracts the error log buffers from the dump file and places them into the binary file called CLUE$ERRLOG.SYS.

Format

CLUE ERRLOG [/OLD]

Parameters

None.

Qualifier

/OLD
Dumps the errorlog buffers into a file using the old errorlog format. The default action, if /OLD is not specified, is to dump the errorlog buffers in the common event header format.

Description

CLUE ERRLOG extracts the error log buffers from the dump file and places them into the binary file called CLUE$ERRLOG.SYS.

These buffers contain messages not yet written to the error log file at the time of the failure. When you analyze a failure on the same system on which it occurred, you can run the Error Log utility on the actual error log file to see these error log messages. When analyzing a failure from another system, use the CLUE ERRLOG command to create a file containing the failing system's error log messages just prior to the failure. System failures are often triggered by hardware problems, so determining what, if any, hardware errors occurred prior to the failure can help you troubleshoot a failure.

You can define the logical CLUE$ERRLOG to any file specification if you want error log information written to a file other than CLUE$ERRLOG.SYS.

Note

You need at least DECevent V2.9 to analyze the new common event header (CEH) format file. The old format file can be analyzed by ANALYZE/ERROR or any version of DECevent.

Example

```
SDA>  CLUE ERRLOG

Sequence  Date        Time
--------  ----------- -----------
     128  11-MAY-1994 00:39:31.30
     129  11-MAY-1994 00:39:32.12
     130  11-MAY-1994 00:39:44.83
     131  11-MAY-1994 00:44:38.97 * Crash Entry
```

In addition to writing the error log buffers into CLUE$ERRLOG.SYS, the CLUE ERRLOG command displays the sequence, date, and time of each error log buffer extracted from the dump file.

CLUE FRU

Outputs the Field Replacement Unit (FRU) table to a file for display by DECevent.

Format

CLUE FRU

Parameters

None.

Qualifiers

None.

Description

The FRU command extracts the FRU table into an output file (CLUE$FRU.SYS), which can then be displayed by DECevent. This command works on the running system, as well as on dump files.

CLUE HISTORY

Updates history file and generates crash dump summary output.

Format

CLUE HISTORY [/qualifier]

Parameters

None.

Qualifier

/OVERRIDE
Allows execution of this command even if the dump file has already been analyzed (DMP$V_OLDDUMP bit set).

Description

This command updates the history file pointed to by the logical name CLUE$HISTORY with a one-line entry and the major crash dump summary information. If CLUE$HISTORY is not defined, a file CLUE$HISTORY.DAT in your default directory will be created.

In addition, a listing file with summary information about the system failure is created in the directory pointed to by CLUE$COLLECT. The file name is of the form CLUE$*node_ddmmyy_hhmm*.LIS where the timestamp (*hhmm*) corresponds to the system failure time and not the time when the file was created.

The listing file contains summary information collected from the following SDA commands:

- CLUE CRASH
- CLUE CONFIG
- CLUE MEMORY/FILES
- CLUE MEMORY/STATISTIC
- CLUE PROCESS/RECALL
- CLUE XQP/ACTIVE

Refer to the reference section for each of these commands to see examples of the displayed information.

The logical name CLUE$FLAG controls how much information is written to the listing file.

- Bit 0—Include crash dump summary
- Bit 1—Include system configuration
- Bit 2—Include stack decoding information
- Bit 3—Include page and swap file usage
- Bit 4—Include memory management statistics
- Bit 5—Include process DCL recall buffer

- Bit 6—Include active XQP process information
- Bit 7—Include XQP cache header

If this logical name is undefined, all bits are set by default internally and all information is written to the listing file. If the value is zero, no listing file is generated. The value has to be supplied in hexadecimal form (for example, DEFINE CLUE$FLAG 81 will include the crash dump summary and the XQP cache header information).

If the logical name CLUE$SITE_PROC points to a valid and existing file, it will be executed as the final step of the CLUE HISTORY command (for example, automatic saving of the dump file during system startup). If used, this file should contain only valid SDA commands.

Refer to Chapter 2, Section 2.2.3 for more information on site-specific command files.

CLUE MCHK

This command is obsolete.

Format

CLUE MCHK

Parameters

None.

Qualifiers

None.

Description

The CLUE MCMK command has been withdrawn. Issuing the command produces the following output, explaining the correct way to obtain MACHINECHECK information from a crash dump.

```
Please use the following commands in order to extract the errorlog buffers
from the dumpfile header and analyze the machine check entry:

$ analyze/crash sys$system:sysdump.dmp
SDA> clue errlog
SDA> exit
$ diagnose clue$errlog
```

CLUE MEMORY

Displays memory- and pool-related information.

Format

CLUE MEMORY [/qualifier[,...]]

Parameters

None.

Qualifiers

/FILES
Displays information about page and swap file usage.

/FREE [/FULL]
Validates and displays dynamic nonpaged free packet list queue.

/GH [/FULL]
Displays information about the granularity hint regions.

/LAYOUT
Decodes and displays much of the system virtual address space layout.

/LOOKASIDE
Validates the lookaside list queue heads and counts the elements for each list.

/STATISTIC
Displays systemwide performance data such as page fault, I/O, pool, lock manager, MSCP, and file system cache.

Description

The CLUE MEMORY command displays memory- and pool-related information.

Examples

1.
```
SDA> CLUE MEMORY/FILES
Paging File Usage (blocks):
---------------------------

Swapfile (Index   1)                    Device                  DKA0:
   PFL Address      FFFFFFFF.81531340   UCB Address      FFFFFFFF.814AAF00
   Free Blocks                  44288   Bitmap           FFFFFFFF.815313E0
   Total Size (blocks)          44288   Flags              inited,swap_file
   Total Write Count                0   Total Read Count                  0
   Smallest Chunk (pages)        2768   Largest Chunk (pages)          2768
   Chunks GEQ 64 Pages              1   Chunks LT 64 Pages                0

Pagefile (Index 254)                    Device                  DKA0:
   PFL Address      FFFFFFFF.8152E440   UCB Address      FFFFFFFF.814AAF00
   Free Blocks                1056768   Bitmap           FFFFFFFF.6FB16008
   Total Size (blocks)        1056768   Flags                        inited
   Total Write Count                0   Total Read Count                  0
   Smallest Chunk (pages)       66048   Largest Chunk (pages)         66048
   Chunks GEQ 64 Pages              1   Chunks LT 64 Pages                0

   Summary:  1 Pagefile and 1 Swapfile installed
```

```
Total Size of all Swap Files:           44288 blocks
Total Size of all Paging Files:       1056768 blocks
Total Committed Paging File Usage:     344576 blocks
```

This example shows the display produced by the CLUE MEMORY/FILES command.

2.
```
SDA>  CLUE MEMORY/FREE/FULL
Non-Paged Dynamic Storage Pool - Variable Free Packet Queue:
------------------------------------------------------------

CLASSDR  FFFFFFFF.80D157C0 :    64646464 64646464 00000040 80D164C0  ÀdÑ.@...dddddddd

CLASSDR  FFFFFFFF.80D164C0 :    64646464 64646464 00000080 80D17200  .rÑ.....dddddddd

CLASSDR  FFFFFFFF.80D17200 :    64646464 64646464 00000080 80D21AC0  À.Ò.....dddddddd

CLASSDR  FFFFFFFF.80D21AC0 :    64646464 64646464 00000080 80D228C0  À(Ò.....dddddddd

VCC      FFFFFFFF.80D228C0 :    801CA5E8 026F0040 00000040 80D23E40  @>Ò.@...@.o.è¥..

CLASSDR  FFFFFFFF.80D23E40 :    64646464 64646464 00000040 80D24040  @@Ò.@...dddddddd

CLASSDR  FFFFFFFF.80D24040 :    64646464 64646464 00000040 80D26FC0  ÀoÒ.@...dddddddd

CLASSDR  FFFFFFFF.80D26FC0 :    64646464 64646464 00000080 80D274C0  ÀtÒ.....dddddddd

CLASSDR  FFFFFFFF.80D274C0 :    64646464 64646464 00000040 80D2E200  .âÒ.@...dddddddd

CLASSDR  FFFFFFFF.80D2E200 :    64646464 64646464 00000080 80D2E440  @äÒ.....dddddddd

CLASSDR  FFFFFFFF.80D2E440 :    64646464 64646464 00000040 80D2F000  .Ò.@...dddddddd

CLASSDR  FFFFFFFF.80D2F000 :    64646464 64646464 00000080 80D2F400  .ôÒ.....dddddddd
   .
   .
   .
CLASSDR  FFFFFFFF.80E91D40 :    64646464 64646464 00000500 80E983C0  À.é.....dddddddd

CLASSDR  FFFFFFFF.80E983C0 :    64646464 64646464 00031C40 00000000  ....@...dddddddd

Free Packet Queue, Status: Valid, 174 elements

   Largest free chunk:        00031C40 (hex)    203840 (dec)  bytes
   Total free dynamic space:  0003D740 (hex)    251712 (dec)  bytes
```

The CLUE MEMORY/FREE/FULL command validates and displays dynamic nonpaged free packet list queue.

3.
```
SDA>  CLUE MEMORY/GH/FULL
Granularity Hint Regions - Huge Pages:
--------------------------------------

Execlet Code Region                                              Pages/Slices
   Base/End VA     FFFFFFFF.80000000 FFFFFFFF.80356000  Current Size  427/   427
   Base/End PA     00000000.00400000 00000000.00756000  Free             /     0
   Total Size      00000000.00356000            3.3 MB  In Use           /   427
   Bitmap VA/Size  FFFFFFFF.80D17CC0 00000000.00000040  Initial Size  512/   512
   Slice Size      00000000.00002000                    Released       85/    85
   Next free Slice 00000000.000001AB
```

```
   Image                              Base              End           Length
   SYS$PUBLIC_VECTORS              FFFFFFFF.80000000  FFFFFFFF.80001A00  00001A00
   SYS$BASE_IMAGE                  FFFFFFFF.80002000  FFFFFFFF.8000D400  0000B400
   SYS$CNBTDRIVER                  FFFFFFFF.8000E000  FFFFFFFF.8000F000  00001000
   SYS$NISCA_BTDRIVER              FFFFFFFF.80010000  FFFFFFFF.8001FA00  0000FA00
   SYS$ESBTDRIVER                  FFFFFFFF.80020000  FFFFFFFF.80022400  00002400
   SYS$OPDRIVER                    FFFFFFFF.80024000  FFFFFFFF.80027C00  00003C00
   SYSTEM_DEBUG                    FFFFFFFF.80028000  FFFFFFFF.80050200  00028200
   SYSTEM_PRIMITIVES               FFFFFFFF.80052000  FFFFFFFF.80089000  00037000
   SYSTEM_SYNCHRONIZATION          FFFFFFFF.8008A000  FFFFFFFF.80095400  0000B400
   ERRORLOG                        FFFFFFFF.80096000  FFFFFFFF.80099200  00003200
   SYS$CPU_ROUTINES_0402           FFFFFFFF.8009A000  FFFFFFFF.800A3A00  00009A00
   EXCEPTION_MON                   FFFFFFFF.800A4000  FFFFFFFF.800BC800  00018800
   IO_ROUTINES_MON                 FFFFFFFF.800BE000  FFFFFFFF.800E2000  00024000
   SYSDEVICE                       FFFFFFFF.800E2000  FFFFFFFF.800E5C00  00003C00
   PROCESS_MANAGEMENT_MON          FFFFFFFF.800E6000  FFFFFFFF.8010B000  00025000
   SYS$VM                          FFFFFFFF.8010C000  FFFFFFFF.80167200  0005B200
   SHELL8K                         FFFFFFFF.80168000  FFFFFFFF.80169200  00001200
   LOCKING                         FFFFFFFF.8016A000  FFFFFFFF.8017BE00  00011E00
   MESSAGE_ROUTINES                FFFFFFFF.8017C000  FFFFFFFF.80182A00  00006A00
   LOGICAL_NAMES                   FFFFFFFF.80184000  FFFFFFFF.80186C00  00002C00
   F11BXQP                         FFFFFFFF.80188000  FFFFFFFF.80190400  00008400
   SYSLICENSE                      FFFFFFFF.80192000  FFFFFFFF.80192400  00000400
   IMAGE_MANAGEMENT                FFFFFFFF.80194000  FFFFFFFF.80197A00  00003A00
   SECURITY                        FFFFFFFF.80198000  FFFFFFFF.801A0E00  00008E00
   SYSGETSYI                       FFFFFFFF.801A2000  FFFFFFFF.801A3A00  00001A00
   SYS$TRANSACTION_SERVICES        FFFFFFFF.801A4000  FFFFFFFF.801C5000  00021000
   SYS$UTC_SERVICES                FFFFFFFF.801C6000  FFFFFFFF.801C7000  00001000
   SYS$VCC_MON                     FFFFFFFF.801C8000  FFFFFFFF.801D4E00  0000CE00
   SYS$IPC_SERVICES                FFFFFFFF.801D6000  FFFFFFFF.80214A00  0003EA00
   SYSLDR_DYN                      FFFFFFFF.80216000  FFFFFFFF.80219200  00003200
   SYS$MME_SERVICES                FFFFFFFF.8021A000  FFFFFFFF.8021B000  00001000
   SYS$TTDRIVER                    FFFFFFFF.8021C000  FFFFFFFF.8022FE00  00013E00
   SYS$PKCDRIVER                   FFFFFFFF.80230000  FFFFFFFF.80240400  00010400
   SYS$DKDRIVER                    FFFFFFFF.80242000  FFFFFFFF.80251600  0000F600
   RMS                             FFFFFFFF.80252000  FFFFFFFF.802C5E00  00073E00
   SYS$GXADRIVER                   FFFFFFFF.802C6000  FFFFFFFF.802CE000  00008000
   SYS$ECDRIVER                    FFFFFFFF.802CE000  FFFFFFFF.802D1000  00003000
   SYS$LAN                         FFFFFFFF.802D2000  FFFFFFFF.802D8E00  00006E00
   SYS$LAN_CSMACD                  FFFFFFFF.802DA000  FFFFFFFF.802E6600  0000C600
   SYS$MKDRIVER                    FFFFFFFF.802E8000  FFFFFFFF.802F1C00  00009C00
   SYS$YRDRIVER                    FFFFFFFF.802F2000  FFFFFFFF.802F9600  00007600
   SYS$SODRIVER                    FFFFFFFF.802FA000  FFFFFFFF.802FF000  00005000
   SYS$INDRIVER                    FFFFFFFF.80300000  FFFFFFFF.8030EA00  0000EA00
   NETDRIVER                       FFFFFFFF.80310000  FFFFFFFF.80310200  00000200
   NETDRIVER                       FFFFFFFF.80312000  FFFFFFFF.80329E00  00017E00
   SYS$IMDRIVER                    FFFFFFFF.8032A000  FFFFFFFF.8032EA00  00004A00
   SYS$IKDRIVER                    FFFFFFFF.80330000  FFFFFFFF.8033AC00  0000AC00
   NDDRIVER                        FFFFFFFF.8033C000  FFFFFFFF.8033F800  00003800
   SYS$WSDRIVER                    FFFFFFFF.80340000  FFFFFFFF.80341600  00001600
   SYS$CTDRIVER                    FFFFFFFF.80342000  FFFFFFFF.8034D200  0000B200
   SYS$RTTDRIVER                   FFFFFFFF.8034E000  FFFFFFFF.80351800  00003800
   SYS$FTDRIVER                    FFFFFFFF.80352000  FFFFFFFF.80354200  00002200

Execlet Data Region                                                    Pages/Slices
   Base/End VA     FFFFFFFF.80C00000 FFFFFFFF.80CC0000  Current Size   96/  1536
   Base/End PA     00000000.00800000 00000000.008C0000  Free             /    11
   Total Size      00000000.000C0000            0.7 MB  In Use           /  1525
   Bitmap VA/Size  FFFFFFFF.80D17D00 00000000.00000100  Initial Size  128/  2048
   Slice Size      00000000.00000200                    Released       32/   512
   Next free Slice 00000000.000005F5
```

```
      Image                                Base               End          Length
      SYS$PUBLIC_VECTORS          FFFFFFFF.80C00000  FFFFFFFF.80C05000  00005000
      SYS$BASE_IMAGE              FFFFFFFF.80C05000  FFFFFFFF.80C25E00  00020E00
      SYS$CNBTDRIVER              FFFFFFFF.80C25E00  FFFFFFFF.80C26200  00000400
      SYS$NISCA_BTDRIVER          FFFFFFFF.80C26200  FFFFFFFF.80C29400  00003200
      SYS$ESBTDRIVER              FFFFFFFF.80C29400  FFFFFFFF.80C29800  00000400
      SYS$OPDRIVER                FFFFFFFF.80C29800  FFFFFFFF.80C2A200  00000A00
      SYSTEM_DEBUG                FFFFFFFF.80C2A200  FFFFFFFF.80C4E400  00024200
      SYSTEM_PRIMITIVES           FFFFFFFF.80C4E400  FFFFFFFF.80C58200  00009E00
      SYSTEM_SYNCHRONIZATION      FFFFFFFF.80C58200  FFFFFFFF.80C5A000  00001E00
      ERRORLOG                    FFFFFFFF.80C5A000  FFFFFFFF.80C5A600  00000600
      SYS$CPU_ROUTINES_0402       FFFFFFFF.80C5A600  FFFFFFFF.80C5CA00  00002400
      EXCEPTION_MON               FFFFFFFF.80C5CA00  FFFFFFFF.80C64C00  00008200
      IO_ROUTINES_MON             FFFFFFFF.80C64C00  FFFFFFFF.80C6AA00  00005E00
      SYSDEVICE                   FFFFFFFF.80C6AA00  FFFFFFFF.80C6B600  00000C00
      PROCESS_MANAGEMENT_MON      FFFFFFFF.80C6B600  FFFFFFFF.80C72600  00007000
      SYS$VM                      FFFFFFFF.80C72600  FFFFFFFF.80C79000  00006A00
      SHELL8K                     FFFFFFFF.80C79000  FFFFFFFF.80C7A000  00001000
      LOCKING                     FFFFFFFF.80C7A000  FFFFFFFF.80C7BA00  00001A00
      MESSAGE_ROUTINES            FFFFFFFF.80C7BA00  FFFFFFFF.80C7D000  00001600
      LOGICAL_NAMES               FFFFFFFF.80C7D000  FFFFFFFF.80C7E200  00001200
      F11BXQP                     FFFFFFFF.80C7E200  FFFFFFFF.80C7FA00  00001800
      SYSLICENSE                  FFFFFFFF.80C7FA00  FFFFFFFF.80C7FE00  00000400
      IMAGE_MANAGEMENT            FFFFFFFF.80C7FE00  FFFFFFFF.80C80600  00000800
      SECURITY                    FFFFFFFF.80C80600  FFFFFFFF.80C83000  00002A00
      SYSGETSYI                   FFFFFFFF.80C83000  FFFFFFFF.80C83200  00000200
      SYS$TRANSACTION_SERVICES    FFFFFFFF.80C83200  FFFFFFFF.80C89E00  00006C00
      SYS$UTC_SERVICES            FFFFFFFF.80C89E00  FFFFFFFF.80C8A200  00000400
      SYS$VCC_MON                 FFFFFFFF.80C8A200  FFFFFFFF.80C8BC00  00001A00
      SYS$IPC_SERVICES            FFFFFFFF.80C8BC00  FFFFFFFF.80C91000  00005400
      SYSLDR_DYN                  FFFFFFFF.80C91000  FFFFFFFF.80C92200  00001200
      SYS$MME_SERVICES            FFFFFFFF.80C92200  FFFFFFFF.80C92600  00000400
      SYS$TTDRIVER                FFFFFFFF.80C92600  FFFFFFFF.80C94C00  00002600
      SYS$PKCDRIVER               FFFFFFFF.80C94C00  FFFFFFFF.80C96A00  00001E00
      SYS$DKDRIVER                FFFFFFFF.80C96A00  FFFFFFFF.80C99800  00002E00
      RMS                         FFFFFFFF.80C99800  FFFFFFFF.80CAAC00  00011400
      RECOVERY_UNIT_SERVICES      FFFFFFFF.80CAAC00  FFFFFFFF.80CAB000  00000400
      SYS$GXADRIVER               FFFFFFFF.80CAB000  FFFFFFFF.80CAF000  00004000
      SYS$ECDRIVER                FFFFFFFF.80CAF000  FFFFFFFF.80CAFC00  00000C00
      SYS$LAN                     FFFFFFFF.80CAFC00  FFFFFFFF.80CB0800  00000C00
      SYS$LAN_CSMACD              FFFFFFFF.80CB0800  FFFFFFFF.80CB1800  00001000
      SYS$MKDRIVER                FFFFFFFF.80CB1800  FFFFFFFF.80CB3000  00001800
      SYS$YRDRIVER                FFFFFFFF.80CB3000  FFFFFFFF.80CB3C00  00000C00
      SYS$SODRIVER                FFFFFFFF.80CB3C00  FFFFFFFF.80CB4E00  00001200
      SYS$INDRIVER                FFFFFFFF.80CB4E00  FFFFFFFF.80CB5E00  00001000
      NETDRIVER                   FFFFFFFF.80CB5E00  FFFFFFFF.80CB8800  00002A00
      SYS$IMDRIVER                FFFFFFFF.80CB8800  FFFFFFFF.80CB9400  00000C00
      SYS$IKDRIVER                FFFFFFFF.80CB9400  FFFFFFFF.80CBAA00  00001600
      NDDRIVER                    FFFFFFFF.80CBAA00  FFFFFFFF.80CBB400  00000A00
      SYS$WSDRIVER                FFFFFFFF.80CBB400  FFFFFFFF.80CBBC00  00000800
      SYS$CTDRIVER                FFFFFFFF.80CBBC00  FFFFFFFF.80CBD800  00001C00
      SYS$RTTDRIVER               FFFFFFFF.80CBD800  FFFFFFFF.80CBE200  00000A00
      SYS$FTDRIVER                FFFFFFFF.80CBE200  FFFFFFFF.80CBEA00  00000800
      11 free Slices              FFFFFFFF.80CBEA00  FFFFFFFF.80CC0000  00001600

   S0/S1 Executive Data Region                                         Pages/Slices
      Base/End VA     FFFFFFFF.80D00000 FFFFFFFF.80ECA000  Current Size  229/   229
      Base/End PA     00000000.00900000 00000000.00ACA000  Free             /     0
      Total Size      00000000.001CA000            1.7 MB  In Use           /   229
      Bitmap VA/Size  FFFFFFFF.80D17E00 00000000.00000020  Initial Size  229/   229
      Slice Size      00000000.00002000                    Released        0/     0
      Next free Slice 00000000.00000007
```

```
   Item                                  Base               End           Length
   System Header                  FFFFFFFF.80D00000  FFFFFFFF.80D0A000  0000A000
   Error Log Allocation Buffers   FFFFFFFF.80D0A000  FFFFFFFF.80D0C000  00002000
   Nonpaged Pool (initial size)   FFFFFFFF.80D0E000  FFFFFFFF.80ECA000  001BC000

Resident Image Code Region                                             Pages/Slices
   Base/End VA     FFFFFFFF.80400000 FFFFFFFF.80C00000  Current Size 1024/  1024
   Base/End PA     00000000.00C00000 00000000.01400000  Free             /   223
   Total Size      00000000.00800000            8.0 MB  In Use           /   801
   Bitmap VA/Size  FFFFFFFF.80D17E20 00000000.00000080  Initial Size 1024/  1024
   Slice Size      00000000.00002000                    Released       0/     0
   Next free Slice 00000000.00000321

   Image                                 Base               End           Length
   LIBRTL                         FFFFFFFF.80400000  FFFFFFFF.8049EA00  0009EA00
   LIBOTS                         FFFFFFFF.804A0000  FFFFFFFF.804AEC00  0000EC00
   CMA$TIS_SHR                    FFFFFFFF.804B0000  FFFFFFFF.804B2600  00002600
   DPML$SHR                       FFFFFFFF.804B4000  FFFFFFFF.8050B600  00057600
   DECC$SHR                       FFFFFFFF.8050C000  FFFFFFFF.80657000  0014B000
   SECURESHRP                     FFFFFFFF.80658000  FFFFFFFF.80676000  0001E000
   SECURESHR                      FFFFFFFF.80676000  FFFFFFFF.8068C000  00016000
   SECURESHR                      FFFFFFFF.8068C000  FFFFFFFF.8068C200  00000200
   LBRSHR                         FFFFFFFF.8068E000  FFFFFFFF.806A3E00  00015E00
   DECW$TRANSPORT_COMMON          FFFFFFFF.806A4000  FFFFFFFF.806B0C00  0000CC00
   CDE$UNIX_ROUTINES              FFFFFFFF.806B2000  FFFFFFFF.806C1E00  0000FE00
   DECW$XLIBSHR                   FFFFFFFF.806C2000  FFFFFFFF.80781C00  000BFC00
   DECW$XTLIBSHRR5                FFFFFFFF.80782000  FFFFFFFF.807C7600  00045600
   DECW$XMLIBSHR12                FFFFFFFF.807C8000  FFFFFFFF.8096AE00  001A2E00
   DECW$MRMLIBSHR12               FFFFFFFF.8096C000  FFFFFFFF.80994200  00028200
   DECW$DXMLIBSHR12               FFFFFFFF.80996000  FFFFFFFF.80A40400  000AA400
   223 free Slices                FFFFFFFF.80A42000  FFFFFFFF.80C00000  001BE000

S2 Executive Data Region                                               Pages/Slices
   Base/End VA     FFFFFFFE.00000000 FFFFFFFE.00050000  Current Size   40/     8
   Base/End PA     00000000.00350000 00000000.003A0000  Free             /     0
   Total Size      00000000.00050000            0.3 MB  In Use           /     8
   Bitmap VA/Size  FFFFFFFF.80D17EA0 00000000.00000008  Initial Size   40/     8
   Slice Size      00000000.0000A000                    Released       0/     0
   Next free Slice 00000000.00000008

   Item                                  Base               End           Length
   PFN Database                   FFFFFFFE.00000000  FFFFFFFE.00050000  00050000
```

The CLUE MEMORY/GH/FULL command displays data structures that describe granularity hint regions and huge pages.

4.
```
SDA>  CLUE MEMORY/LAYOUT
System Virtual Address Space Layout:
------------------------------------
   Item                                  Base              End          Length
System Virtual Base Address      FFFFFEFE.00000000
PFN Database                     FFFFFEFE.00000000  FFFFFEFE.00280000  00280000
Permanent Mapping of System L1PT  FFFFFEFE.00280000  FFFFFEFE.00282000  00002000
Global Page Table (GPT)          FFFFFEFE.00282000  FFFFFEFE.0089CD38  0061AD38
Resource Hash Table              FFFFFFFF.6FC1A000  FFFFFFFF.6FC22000  00008000
Lock ID Table                    FFFFFFFF.6FC22000  FFFFFFFF.70000000  003DE000
Execlet Code Region              FFFFFFFF.80000000  FFFFFFFF.80800000  00800000
Resident Image Code Region       FFFFFFFF.80800000  FFFFFFFF.81000000  00800000
System Header                    FFFFFFFF.81400000  FFFFFFFF.8140E000  0000E000
Error Log Allocation Buffers     FFFFFFFF.8140E000  FFFFFFFF.81414000  00006000
Nonpaged Pool (initial size)     FFFFFFFF.81414000  FFFFFFFF.817C8000  003B4000
Nonpaged Pool Expansion Area     FFFFFFFF.817C8000  FFFFFFFF.82664000  00E9C000
Execlet Data Region              FFFFFFFF.81000000  FFFFFFFF.81400000  00400000
Fork Buffers Secondary to Primary FFFFFFFF.8268C000  FFFFFFFF.8268E000  00002000
Erase Pattern Buffer Page        FFFFFFFF.8268E000  FFFFFFFF.82690000  00002000
363 Balance Slots, 33 pages each  FFFFFFFF.826A0000  FFFFFFFF.88436000  05D96000
Paged Pool                       FFFFFFFF.88436000  FFFFFFFF.887E4000  003AE000
System Control Block (SCB)       FFFFFFFF.887E4000  FFFFFFFF.887EC000  00008000
Restart Parameter Block (HWRPB)   FFFFFFFF.88832000  FFFFFFFF.88832B48  00000B48
Erase Pattern Page Table Page    FFFFFFFF.82690000  FFFFFFFF.82692000  00002000
Posix Cloning Parent Page Mapping FFFFFFFF.88B1E000  FFFFFFFF.88B20000  00002000
Posix Cloning Child Page Mapping  FFFFFFFF.88B20000  FFFFFFFF.88B22000  00002000
Swapper Process Kernel Stack     FFFFFFFF.88B56000  FFFFFFFF.88B5A000  00004000
Swapper Map                      FFFFFFFF.88B60000  FFFFFFFF.88B82000  00022000
Idle Loop’s Mapping of Zero Pages FFFFFFFF.88C5E000  FFFFFFFF.88C60000  00002000
PrimCPU Machine Check Logout Area FFFFFFFF.88C60400  FFFFFFFF.88C60800  00000400
PrimCPU Sys Context Kernel Stack  FFFFFFFF.88C58000  FFFFFFFF.88C5C000  00004000
Tape Mount Verification Buffer   FFFFFFFF.88C62000  FFFFFFFF.88C66000  00004000
Mount Verification Buffer        FFFFFFFF.88C66000  FFFFFFFF.88C68000  00002000
Demand Zero Optimization Page    FFFFFFFF.88E68000  FFFFFFFF.88E6A000  00002000
Executive Mode Data Page         FFFFFFFF.88E6A000  FFFFFFFF.88E6C000  00002000
System Space Expansion Region    FFFFFFFF.8C000000  FFFFFFFF.FFDF0000  73DF0000
System Page Table Window         FFFFFFFF.FFDF0000  FFFFFFFF.FFFF0000  00200000
N/A Space                        FFFFFFFF.FFFF0000  FFFFFFFF.FFFFFFFF  00010000
```

The CLUE MEMORY/LAYOUT command decodes and displays the sytem virtual address space layout.

5. SDA> CLUE MEMORY/LOOKASIDE

```
Non-Paged Dynamic Storage Pool - Lookaside List Queue Information:
------------------------------------------------------------------
Listhead Addr: FFFFFFFF.80C50400   Size:   64   Status: Valid, 11 elements
Listhead Addr: FFFFFFFF.80C50408   Size:  128   Status: Valid, 1 element
Listhead Addr: FFFFFFFF.80C50410   Size:  192   Status: Valid, 29 elements
Listhead Addr: FFFFFFFF.80C50418   Size:  256   Status: Valid, 3 elements
Listhead Addr: FFFFFFFF.80C50420   Size:  320   Status: Valid, 7 elements
Listhead Addr: FFFFFFFF.80C50428   Size:  384   Status: Valid, 1 element
Listhead Addr: FFFFFFFF.80C50430   Size:  448   Status: Valid, 1 element
Listhead Addr: FFFFFFFF.80C50438   Size:  512   Status: Valid, 1 element
Listhead Addr: FFFFFFFF.80C50440   Size:  576   Status: Valid, 6 elements
Listhead Addr: FFFFFFFF.80C50448   Size:  640   Status: Valid, 1 element
Listhead Addr: FFFFFFFF.80C50450   Size:  704   Status: Valid, 5 elements
Listhead Addr: FFFFFFFF.80C50458   Size:  768   Status: Valid, 1 element
Listhead Addr: FFFFFFFF.80C50460   Size:  832   Status: Valid, empty
Listhead Addr: FFFFFFFF.80C50468   Size:  896   Status: Valid, 1 element
Listhead Addr: FFFFFFFF.80C50470   Size:  960   Status: Valid, 1 element
Listhead Addr: FFFFFFFF.80C50478   Size: 1024   Status: Valid, 6 elements
Listhead Addr: FFFFFFFF.80C50480   Size: 1088   Status: Valid, 1 element
Listhead Addr: FFFFFFFF.80C50488   Size: 1152   Status: Valid, 1 element
Listhead Addr: FFFFFFFF.80C50490   Size: 1216   Status: Valid, 1 element
Listhead Addr: FFFFFFFF.80C50498   Size: 1280   Status: Valid, 2 elements
Listhead Addr: FFFFFFFF.80C504A0   Size: 1344   Status: Valid, 2 elements
Listhead Addr: FFFFFFFF.80C504A8   Size: 1408   Status: Valid, 1 element
Listhead Addr: FFFFFFFF.80C504B0   Size: 1472   Status: Valid, 1 element
Listhead Addr: FFFFFFFF.80C504B8   Size: 1536   Status: Valid, 1 element
Listhead Addr: FFFFFFFF.80C504C0   Size: 1600   Status: Valid, 1 element
Listhead Addr: FFFFFFFF.80C504C8   Size: 1664   Status: Valid, 1 element
Listhead Addr: FFFFFFFF.80C504D0   Size: 1728   Status: Valid, 1 element
Listhead Addr: FFFFFFFF.80C504D8   Size: 1792   Status: Valid, 1 element
Listhead Addr: FFFFFFFF.80C504E0   Size: 1856   Status: Valid, empty
Listhead Addr: FFFFFFFF.80C504E8   Size: 1920   Status: Valid, empty
Listhead Addr: FFFFFFFF.80C504F0   Size: 1984   Status: Valid, 1 element
Listhead Addr: FFFFFFFF.80C504F8   Size: 2048   Status: Valid, 1 element
Listhead Addr: FFFFFFFF.80C50500   Size: 2112   Status: Valid, 1 element
Listhead Addr: FFFFFFFF.80C50508   Size: 2176   Status: Valid, 15 elements
Listhead Addr: FFFFFFFF.80C50510   Size: 2240   Status: Valid, empty
Listhead Addr: FFFFFFFF.80C50518   Size: 2304   Status: Valid, 1 element
   .
   .
   .
   Total free space:  00016440 (hex)    91200 (dec)  bytes
```

The CLUE MEMORY/LOOKASIDE command summarizes the state of nonpageable lookaside lists. For each list, an indication of whether the queue is well formed is given. If a queue is not well formed or is invalid, messages indicating what is wrong with the queue are displayed. This command is analogous to the SDA command VALIDATE QUEUE.

These messages can also appear frequently when you use the VALIDATE QUEUE command within an SDA session that is analyzing a running system. In a running system, the composition of a queue can change while the command is tracing its links, thus producing an error message.

6.
```
SDA>  CLUE MEMORY/STATISTIC
Memory Management Statistics:
-----------------------------
Pagefaults:                          Non-Paged Pool:
Total Page Faults          1060897    Successful Expansions           32
Total Page Reads            393414    Unsuccessful Expansions          0
I/O's to read Pages         163341    Failed Pages Accumulator         0
Modified Pages Written         121    Total Alloc Requests         55596
I/O's to write Mod Pages        19    Failed Alloc Requests            0
Demand Zero Faults          281519
Global Valid Faults         378701    Paged Pool:
Modified Faults             236189    Total Failures                   0
Read Faults                      0    Failed Pages Accumulator         0
Execute Faults               28647    Total Alloc Requests         10229
                                      Failed Alloc Requests            0

Direct I/O                  591365    Cur Mapped Gbl Sections        653
Buffered I/O                589652    Max Mapped Gbl Sections        654
Split I/O                      213    Cur Mapped Gbl Pages         12193
Hits                         83523    Max Mapped Gbl Pages         12196
Logical Name Transl        1805476    Maximum Processes               46
Dead Page Table Scans            0    Sched Zero Pages Created         0

Distributed Lock Manager:          Local        Incoming        Outgoing
$ENQ New Lock Requests            674059               0               0
$ENQ Conversion Requests          497982               0               0
$DEQ Dequeue Requests             671626               0               0
Blocking ASTs                         26               0               0
Directory Functions                                    0               0
Deadlock Messages                                      0               0

$ENQ Requests that Wait        822    Deadlock Searches Performed      0
$ENQ Requests not Queued         3    Deadlocks Found                  0

MSCP Statistics:                      Total IOs                        0
Count of VC Failures             0    Split IOs                        0
Count of Hosts Served            0    IOs that had to Wait (Buf)       0
Count of Disks Served           10    Requests in MemWait Queue        0
MSCP_BUFFER (SYSGEN)           128    Max Req ever in MemWait          0
MSCP_CREDITS (SYSGEN)            8

File System Cache:     Current SYSGEN Param       Hits      Misses Hitrate
File Header Cache     (ACP_HDRCACHE  = 726)     196207        1214   99.3%
Storage Bitmap Cache  (ACP_MAPCACHE  = 181)         38           9   80.8%
Directory Data Cache  (ACP_DIRCACHE  = 726)     153415         199   99.8%
Directory LRU         (ACP_DINDXCACHE= 181)     138543         106   99.9%
FID Cache             (ACP_FIDCACHE  =  64)        119           6   95.2%
Extent Cache          (ACP_EXTCACHE  =  64)        229           9   96.2%
Quota Cache           (ACP_QUOCACHE  = 365)          0           0    0.0%

Volume Synch Locks             958    Window Turns                  1464
Volume Synch Locks Wait          0    Currently Open Files           630
Dir/File Synch Locks        432071    Total Count of OPENs         52903
Dir/file Synch Locks Wait      746    Total Count of ERASE QIOs      186
Access Locks                151648
Free Space Cache Wait        12608

Global Pagefile Quota       785957    GBLPAGFIL (SYSGEN) Limit    786688
```

The CLUE MEMORY/STATISTIC command displays systemwide performance data such as page fault, I/O, pool, lock manager, MSCP, and file system cache statistics.

CLUE PROCESS

Displays process-related information from the current process context.

Format

CLUE PROCESS [/qualifier[,...]]

Parameters

None.

Qualifiers

/BUFFER [/ALL]
Displays the buffer objects for the current process. If the /ALL qualifier is specified, then the buffer objects for all processes (that is, all existing buffer objects) are displayed.

/LAYOUT
Displays the process P1 virtual address space layout.

/LOGICAL
Displays the process logical names and equivalence names, if they can be accessed.

/RECALL
Displays the DCL recall buffer, if it can be accessed.

Description

The CLUE PROCESS command displays process-related information from the current process context. Much of this information is in pageable address space and thus may not be present in a dump file.

Examples

1.
```
SDA>  CLUE PROCESS/LOGICAL

Process Logical Names:
----------------------
   "SYS$OUTPUT" = "_CLAWS$LTA5004:"
   "SYS$OUTPUT" = "_CLAWS$LTA5004:"
   "SYS$DISK" = "WORK1:"
   "BACKUP_FILE" = "_$65$DUA6"
   "SYS$PUTMSG" = "...À...À.."
   "SYS$COMMAND" = "_CLAWS$LTA5004:"
   "TAPE_LOGICAL_NAME" = "_$1$MUA3:"
   "TT" = "LTA5004:"
   "SYS$INPUT" = "_$65$DUA6:"
   "SYS$INPUT" = "_CLAWS$LTA5004:"
   "SYS$ERROR" = "21C00303.LOG"
   "SYS$ERROR" = "_CLAWS$LTA5004:"
   "ERROR_FILE" = "_$65$DUA6"
```

The CLUE PROCESS/LOGICAL command displays logical names for each running process.

2.
```
SDA>  CLUE PROCESS/RECALL
Process DCL Recall Buffer:
--------------------------
Index  Command
  1    ana/sys
  2    @login
  3    mc sysman io auto /log
  4    show device d
  5    sea <.x>*.lis clue$
  6    tpu <.x>*0914.lis
  7    sh log *hsj*
  8    xd <.x>.lis
  9    mc ess$ladcp show serv
 10    tpu clue_cmd.cld
 11    ana/sys
```

The CLUE PROCESS/RECALL command displays a listing of the DCL commands that have been executed most recently.

CLUE REGISTER

Displays the active register set for the crash CPU. The CLUE REGISTER command is valid only when analyzing crash dumps.

Format

CLUE REGISTER

Parameters

None.

Qualifiers

None.

Description

The CLUE REGISTER command displays the active register set of the crash CPU. It also identifies any known data structures, symbolizes any system virtual addresses, interprets the processor status (PS), and attempts to interpret R0 as a condition code.

Example

```
SDA> CLUE REGISTER

Current Registers:   Process index: 0042   Process name: BATCH_3   PCB: 817660C0   (CPU 1)
-----------------------------------------------------------------------------------------
   R0  =  00000000.00000000
   R1  =  FFFFFFFF.814A2C80   MP_CPU  (CPU Id 1)
   R2  =  00000000.00000000
   R3  =  00000000.23D6BBEE
   R4  =  00000000.00000064
   R5  =  FFFFFFFF.831F8000   PHD
   R6  =  00000000.12F75475
   R7  =  00000000.010C7A70
   R8  =  00000000.00000001
   R9  =  00000000.00000000
   R10 =  00000000.00000000
   R11 =  FFFFFFFF.814A2C80   MP_CPU  (CPU Id 1)
   R12 =  FFFFFFFF.810AA5E0   SYSTEM_SYNCHRONIZATION+293E0
   R13 =  FFFFFFFF.810AC408   SMP$TIMEOUT
   R14 =  FFFFFFFF.810AED00   SMP$GL_SCHED
   R15 =  00000000.7FFA1DD8
   R16 =  00000000.0000078C
   R17 =  00000000.00000000
   R18 =  FFFFFFFF.810356C0   SYS$CPU_ROUTINES_2208+1D6C0
   R19 =  FFFFFFFF.81006000   EXE$GR_SYSTEM_DATA_CELLS
   R20 =  FFFFFFFF.80120F00   SCH$QEND_C+00080
   R21 =  00000000.00000000
   R22 =  FFFFFFFF.00000000
   R23 =  00000000.00000000
   R24 =  00000000.00000000
   AI  =  FFFFFFFF.81006000   EXE$GR_SYSTEM_DATA_CELLS
   RA  =  00000000.00000000
   PV  =  00000000.00000000
   R28 =  FFFFFFFF.810194A0   EXE$GL_TIME_CONTROL
```

```
FP  =  00000000.7FFA1F90
PC  =  FFFFFFFF.800863A8   SMP$TIMEOUT_C+00068
PS  =  18000000.00000804   Kernel Mode, IPL 8, Interrupt
```

CLUE SG

Displays the scatter-gather map.

Format

CLUE SG [/CRAB=address]

Parameters

None.

Qualifier

/CRAB=address

Displays the ringbuffer for the specified Counted Resource Allocation Block (CRAB). The default action is to display the ringbuffer for all CRABs.

Description

CLUE SG decodes and displays the scatter/gather ringbuffer entries.

Examples

```
1. SDA> CLUE SG/CRAB=81224740
Scatter/Gather Ringbuffer for CRAB 81224740:
--------------------------------------------
XAct   CRCTX     Item_Num  Item_Cnt  DMA_Addr  Status    Callers_PC                                     Count     Buf_Addr
----   --------  --------  --------  --------  --------  ---------------------------------------------  --------  --------
ALLO   81272780  00000020  00000004  00000000  00000001  847DDA94 SYS$EWDRIVER+01A94                    00000018  81240AE0
ALLO   81272700  0000001C  00000004  00000000  00000001  847DDA94 SYS$EWDRIVER+01A94                    00000017  81240AC0
ALLO   81272680  00000018  00000004  00000000  00000001  847DDA94 SYS$EWDRIVER+01A94                    00000016  81240AA0
ALLO   81272600  00000014  00000004  00000000  00000001  847DDA94 SYS$EWDRIVER+01A94                    00000015  81240A80
ALLO   81272580  00000010  00000004  00000000  00000001  847DDA94 SYS$EWDRIVER+01A94                    00000014  81240A60
ALLO   81272500  0000000C  00000004  00000000  00000001  847DDA94 SYS$EWDRIVER+01A94                    00000013  81240A40
ALLO   81272480  00000008  00000004  00000000  00000001  847DDA94 SYS$EWDRIVER+01A94                    00000012  81240A20
ALLO   81272400  00000004  00000004  00000000  00000001  847DDA94 SYS$EWDRIVER+01A94                    00000011  81240A00
ALLO   81272380  00000000  00000004  00000000  00000001  847DDA94 SYS$EWDRIVER+01A94                    00000010  812409E0
DEAL   841DBEA0  00000000  0000000C  C0000000  00000001  803B5124 SYS$PKQDRIVER+0B124                   0000000F  812409C0
ALLO   841DBEA0  00000000  0000000C  00000000  00000001  803B4FB8 SYS$PKQDRIVER+0AFB8                   0000000E  812409A0
DEAL   841DBEA0  00000000  00000012  C0000000  00000001  803B5124 SYS$PKQDRIVER+0B124                   0000000D  81240980
ALLO   841DBEA0  00000000  00000012  00000000  00000001  803B4FB8 SYS$PKQDRIVER+0AFB8                   0000000C  81240960
DEAL   841DBEA0  00000000  0000000C  C0000000  00000001  803B5124 SYS$PKQDRIVER+0B124                   0000000B  81240940
ALLO   841DBEA0  00000000  0000000C  00000000  00000001  803B4FB8 SYS$PKQDRIVER+0AFB8                   0000000A  81240920
DEAL   841DBEA0  00000000  00000012  C0000000  00000001  803B5124 SYS$PKQDRIVER+0B124                   00000009  81240900
ALLO   841DBEA0  00000000  00000012  00000000  00000001  803B4FB8 SYS$PKQDRIVER+0AFB8                   00000008  812408E0
DEAL   841DBEA0  00000000  00000012  C0000000  00000001  803B5124 SYS$PKQDRIVER+0B124                   00000007  812408C0
ALLO   841DBEA0  00000000  00000012  00000000  00000001  803B4FB8 SYS$PKQDRIVER+0AFB8                   00000006  812408A0
DEAL   841DBEA0  00000000  00000012  C0000000  00000001  803B5124 SYS$PKQDRIVER+0B124                   00000005  81240880
ALLO   841DBEA0  00000000  00000012  00000000  00000001  803B4FB8 SYS$PKQDRIVER+0AFB8                   00000004  81240860
DEAL   841DBEA0  00000000  00000012  C0000000  00000001  803B5124 SYS$PKQDRIVER+0B124                   00000003  81240840
ALLO   841DBEA0  00000000  00000012  00000000  00000001  803B4FB8 SYS$PKQDRIVER+0AFB8                   00000002  81240820
DEAL   841DBEA0  00000000  0000000C  C0001E00  00000001  803B5124 SYS$PKQDRIVER+0B124                   00000001  81240800
ALLO   841DBEA0  00000000  0000000C  00000000  00000001  803B4FB8 SYS$PKQDRIVER+0AFB8                   00000000  812407E0)
```

VM-0769A-AI

In this example, the scatter-gather ringbuffer for the CRAB at address 81224740 is displayed.

```
2. SDA> CLUE SG/CRAB=8120D600
Scatter/Gather Ringbuffer for CRAB 8120D600:
--------------------------------------------
XAct   CRCTX     Item_Num  Item_Cnt  DMA_Addr  Status    Callers_PC                                     Count     Buf_Addr
----   --------  --------  --------  --------  --------  ---------------------------------------------  --------  --------
ALLO   8128A380  0001C000  00004000  00000000  00000001  8480E990 SYS$MCDRIVER+02990                    00000000  8121C760)
```

VM-0194A-AI

In this example, the scatter-gather ringbuffer for the CRAB address 8120D600 is displayed.

CLUE STACK

Identifies and displays the current stack. Use the SDA command SHOW STACK to display and decode the whole stack for the more common bugcheck types.

Format

CLUE STACK

Parameters

None.

Qualifiers

None.

Description

The CLUE STACK command identifies and displays the current stack together with the upper and lower stack limits. In case of a FATALEXCPT, INVEXCEPTN, SSRVEXCEPT, UNXSIGNAL, or PGFIPLHI bugcheck, CLUE STACK tries to decode the whole stack.

Example

```
SDA>  CLUE STACK
Stack Decoder:
--------------
Normal Process Kernel Stack:
Stack Pointer         00000000.7FFA1C98
Stack Limits (low)    00000000.7FFA0000
             (high)   00000000.7FFA2000

SSRVEXCEPT Stack:
-----------------
Stack Pointer  SP =>  00000000.7FFA1C98

Information saved by Bugcheck:
a(Signal Array)       00000000.7FFA1C98  00000000.00000000

EXE$EXCPTN[E] Temporary Storage:
EXE$EXCPTN[E] Stack Frame:
PV                    00000000.7FFA1CA0  FFFFFFFF.829CF010  EXE$EXCPTN
        Entry Point                      FFFFFFFF.82A21000  EXE$EXCPTN_C
return PC             00000000.7FFA1CA8  FFFFFFFF.82A2059C  SYS$CALL_HANDL_C+0002C
saved R2              00000000.7FFA1CB0  00000000.00000000
saved FP              00000000.7FFA1CB8  00000000.7FFA1CD0

SYS$CALL_HANDL Temporary Storage:
                      00000000.7FFA1CC0  FFFFFFFF.829CEDA8  SYS$CALL_HANDL
                      00000000.7FFA1CC8  00000000.00000000
SYS$CALL_HANDL Stack Frame:
PV                    00000000.7FFA1CD0  FFFFFFFF.829CEDA8  SYS$CALL_HANDL
        Entry Point                      FFFFFFFF.82A20570  SYS$CALL_HANDL_C
                      00000000.7FFA1CD8  00000000.00000000
return PC             00000000.7FFA1CE0  FFFFFFFF.82A1E930  CHF_REI+000DC
saved FP              00000000.7FFA1CE8  00000000.7FFA1F40
```

```
Fixed Exception Context Area:
Linkage Pointer         00000000.7FFA1CF0  FFFFFFFF.80C63780  EXCEPTION_MON_NPRW+06D80
a(Signal Array)         00000000.7FFA1CF8  00000000.7FFA1EB8
a(Mechanism Array)      00000000.7FFA1D00  00000000.7FFA1D40
a(Exception Frame)      00000000.7FFA1D08  00000000.7FFA1F00
Exception FP            00000000.7FFA1D10  00000000.7FFA1F40
Unwind SP               00000000.7FFA1D18  00000000.00000000
Reinvokable FP          00000000.7FFA1D20  00000000.00000000
Unwind Target           00000000.7FFA1D28  00000000.00020000  SYS$K_VERSION_04
#Sig Args/Byte Cnt      00000000.7FFA1D30  00000005.00000250  BUG$_NETRCVPKT
a(Msg)/Final Status     00000000.7FFA1D38  829CE050.000008F8  BUG$_SEQ_NUM_OVF

Mechanism Array:
Flags/Arguments         00000000.7FFA1D40  00000000.0000002C
a(Establisher FP)       00000000.7FFA1D48  00000000.7AFFBAD0
reserved/Depth          00000000.7FFA1D50  FFFFFFFF.FFFFFFFD
a(Handler Data)         00000000.7FFA1D58  00000000.00000000
a(Exception Frame)      00000000.7FFA1D60  00000000.7FFA1F00
a(Signal Array)         00000000.7FFA1D68  00000000.7FFA1EB8
saved R0                00000000.7FFA1D70  00000000.00020000  SYS$K_VERSION_04
saved R1                00000000.7FFA1D78  00000000.00000000
saved R16               00000000.7FFA1D80  00000000.00020004  UCB$M_NI_PRM_MLT+00004
saved R17               00000000.7FFA1D88  00000000.00010050  SYS$K_VERSION_16+00010
saved R18               00000000.7FFA1D90  FFFFFFFF.FFFFFFFF
saved R19               00000000.7FFA1D98  00000000.00000000
saved R20               00000000.7FFA1DA0  00000000.7FFA1F50
saved R21               00000000.7FFA1DA8  00000000.00000000
saved R22               00000000.7FFA1DB0  00000000.00010050  SYS$K_VERSION_16+00010
saved R23               00000000.7FFA1DB8  00000000.00000000
saved R24               00000000.7FFA1DC0  00000000.00010051  SYS$K_VERSION_16+00011
saved R25               00000000.7FFA1DC8  00000000.00000000
saved R26               00000000.7FFA1DD0  FFFFFFFF.8010ACA4  AMAC$EMUL_CALL_NATIVE_C+000A4
saved R27               00000000.7FFA1DD8  00000000.00010050  SYS$K_VERSION_16+00010
saved R28               00000000.7FFA1DE0  00000000.00000000
FP Regs not valid       [...............]
a(Signal64 Array)       00000000.7FFA1EA0  00000000.7FFA1ED0
SP Align = 10(hex)      [...............]

Signal Array:
Arguments               00000000.7FFA1EB8           00000005
Condition               00000000.7FFA1EBC           0000000C
Argument #2             00000000.7FFA1EC0           00010000  LDRIMG$M_NPAGED_LOAD
Argument #3             00000000.7FFA1EC4           00000000
Argument #4             00000000.7FFA1EC8           00030078  SYS$K_VERSION_01+00078
Argument #5             00000000.7FFA1ECC           00000003

64-bit Signal Array:
Arguments               00000000.7FFA1ED0  00002604.00000005
Condition               00000000.7FFA1ED8  00000000.0000000C
Argument #2             00000000.7FFA1EE0  00000000.00010000  LDRIMG$M_NPAGED_LOAD
Argument #3             00000000.7FFA1EE8  00000000.00000000
Argument #4             00000000.7FFA1EF0  00000000.00030078  SYS$K_VERSION_01+00078
Argument #5             00000000.7FFA1EF8  00000000.00000003

Interrupt/Exception Frame:
saved R2                00000000.7FFA1F00  00000000.00000003
saved R3                00000000.7FFA1F08  FFFFFFFF.80C63460  EXCEPTION_MON_NPRW+06A60
saved R4                00000000.7FFA1F10  FFFFFFFF.80D12740  PCB
saved R5                00000000.7FFA1F18  00000000.000000C8
saved R6                00000000.7FFA1F20  00000000.00030038  SYS$K_VERSION_01+00038
saved R7                00000000.7FFA1F28  00000000.7FFA1FC0
saved PC                00000000.7FFA1F30  00000000.00030078  SYS$K_VERSION_01+00078
saved PS                00000000.7FFA1F38  00000000.00000003  IPL INT CURR PREV
SP Align = 00(hex)      [...............]                     00  0  Kern User
```

```
Stack Frame:
PV                    00000000.7FFA1F40  00000000.00010050  SYS$K_VERSION_16+00010
       Entry Point                       00000000.00030060  SYS$K_VERSION_01+00060
                      00000000.7FFA1F48  00000000.00010000  LDRIMG$M_NPAGED_LOAD
return PC             00000000.7FFA1F50  FFFFFFFF.8010ACA4  AMAC$EMUL_CALL_NATIVE_C+000A4
saved FP              00000000.7FFA1F58  00000000.7FFA1F70

Stack (not decoded):
                      00000000.7FFA1F60  00000000.00000001
                      00000000.7FFA1F68  FFFFFFFF.800EE81C  RM_STD$DIRCACHE_BLKAST_C+005AC

Stack Frame:
PV                    00000000.7FFA1F70  FFFFFFFF.80C6EBA0  EXE$CMKRNL
       Entry Point                       FFFFFFFF.800EE6C0  EXE$CMKRNL_C
                      00000000.7FFA1F78  00000000.829CEDE8  EXE$SIGTORET
                      00000000.7FFA1F80  00010050.00000002
                      00000000.7FFA1F88  00000000.00020000  SYS$K_VERSION_04
                      00000000.7FFA1F90  00000000.00030000  SYS$K_VERSION_01
return PC             00000000.7FFA1F98  FFFFFFFF.800A4D64  __RELEASE_LDBL_EXEC_SERVICE+00284
saved R2              00000000.7FFA1FA0  00000000.00000003
saved R4              00000000.7FFA1FA8  FFFFFFFF.80D12740  PCB
saved R13             00000000.7FFA1FB0  00000000.00010000  LDRIMG$M_NPAGED_LOAD
saved FP              00000000.7FFA1FB8  00000000.7AFFBAD0

Interrupt/Exception Frame:
saved R2              00000000.7FFA1FC0  00000000.7FFCF880  MMG$IMGHDRBUF+00080
saved R3              00000000.7FFA1FC8  00000000.7B0E9851
saved R4              00000000.7FFA1FD0  00000000.7FFCF818  MMG$IMGHDRBUF+00018
saved R5              00000000.7FFA1FD8  00000000.7FFCF938  MMG$IMGHDRBUF+00138
saved R6              00000000.7FFA1FE0  00000000.7FFAC9F0
saved R7              00000000.7FFA1FE8  00000000.7FFAC9F0
saved PC              00000000.7FFA1FF0  FFFFFFFF.80000140  SYS$CLREF_C
saved PS              00000000.7FFA1FF8  00000000.0000001B  IPL INT CURR PREV
SP Align = 00(hex)    [...............]                      00  0  User User
```

CLUE STACK identifies and displays the current stack and its upper and lower limit. It then decodes the current stack if it is one of the more common bugcheck types. In this case, CLUE STACK tries to decode the entire INVEXCEPTN stack.

CLUE SYSTEM

Displays the contents of the shared logical name tables in the system.

Format

CLUE SYSTEM /LOGICAL

Parameters

None.

Qualifier

/LOGICAL
Displays all the shared logical names.

Description

The CLUE SYSTEM/LOGICAL command displays the contents of the shared logical name tables in the system.

Example

```
SDA> CLUE SYSTEM/LOGICAL

Shareable Logical Names:
------------------------
   "XMICONBMSEARCHPATH" = "CDE$HOME_DEFAULTS:[ICONS]%B%M.BM"
   "MTHRTL_TV" = "MTHRTL_D53_TV"
   "SMGSHR_TV" = "SMGSHR"
   "DECW$DEFAULT_KEYBOARD_MAP" = "NORTH_AMERICAN_LK401AA"
   "CONVSHR_TV" = "CONVSHR"
   "XDPS$INCLUDE" = "SYS$SYSROOT:[XDPS$INCLUDE]"
   "DECW$SYSTEM_DEFAULTS" = "SYS$SYSROOT:[DECW$DEFAULTS.USER]"
   "SYS$PS_FONT_METRICS" = "SYS$SYSROOT:[SYSFONT.PS_FONT_METRICS.USER]"
   "SYS$TIMEZONE_NAME" = "???"
   "STARTUP$STARTUP_VMS" = "SYS$STARTUP:VMS$VMS.DAT"
   "PASMSG" = "PAS$MSG"
   "UCX$HOST" = "SYS$COMMON:[SYSEXE]UCX$HOST.DAT;1"
   "SYS$SYLOGIN" = "SYS$MANAGER:SYLOGIN"
   "DNS$SYSTEM" = "DNS$SYSTEM_TABLE"
   "IPC$ACP_ERRMBX" = "d.Ú."
   "CDE$DETACHED_LOGICALS" = "DECW$DISPLAY,LANG"
   "DECW$SERVER_SCREENS" = "GXA0"
   "DNS$_COTOAD_MBX" = "ä<â."
   "DNS$LOGICAL" = "DNS$SYSTEM"
   "OSIT$MAILBOX" = "äAë."
   "XNL$SHR_TV" = "XNL$SHR_TV_SUPPORT.EXE"
   "MOM$SYSTEM" = "SYS$SYSROOT:[MOM$SYSTEM]"
   "MOP$LOAD" = "SYS$SYSROOT:<MOM$SYSTEM>"
   .
   .
   .
```

CLUE VCC

Displays virtual I/O cache-related information.

Note

If extended file cache (XFC) is enabled, the CLUE VCC command is disabled.

Format

CLUE VCC [/qualifier[,...]]

Parameters

None.

Qualifiers

/CACHE
Decodes and displays the cache lines that are used to correlate the file virtual block numbers (VBNs) with the memory used for caching. Note that the cache itself is not dumped in a selective dump. Use of this qualifier with a selective dump produces the following message:

```
%CLUE-I-VCCNOCAC, Cache space not dumped because DUMPSTYLE is selective
```

/LIMBO
Walks through the limbo queue (LRU order) and displays information for the cached file header control blocks (FCBs).

/STATISTIC
Displays statistical and performance information related to the virtual I/O cache.

/VOLUME
Decodes and displays the cache volume control blocks (CVCB).

Examples

1.
```
SDA>  CLUE VCC/STATISTIC
Virtual I/O Cache Statistics:
-----------------------------
Cache State       pak,on,img,data,enabled
Cache Flags       on,protocol_only
Cache Data Area   80855200

Total Size (pages)             400     Total Size (MBytes)             3.1 MB
Free Size (pages)                0     Free Size (MBytes)              0.0 MB
Read I/O Count               34243     Read I/O Bypassing Cache      3149
Read Hit Count               15910     Read Hit Rate                   46.4%
Write I/O Count               4040     Write I/O Bypassing Cache      856
IOpost PID Action Rtns       40829     IOpost Physical I/O Count       28
IOpost Virtual I/O Count         0     IOpost Logical I/O Count         7
Read I/O past File HWM         124     Cache Id Mismatches             44
Count of Cache Block Hits      170     Files Retained                 100

Cache Line LRU    82B11220 82B11620     Oldest Cache Line Time     00001B6E
Limbo LRU Queue   80A97E3C 80A98B3C     Oldest Limbo Queue Time    00001B6F
Cache VCB Queue   8094DE80 809AA000     System Uptime (seconds)    00001BB0
```

2.
```
SDA>  CLUE VCC/VOLUME
Virtual I/O Cache - Cache VCB Queue:
-----------------------------------
CacheVCB RealVCB   LockID      IRP Queue     CID  LKSB Ocnt State
-------- -------- -------- ----------------- ---- ---- ---- ---------------
8094DE80 80A7E440 020007B2 8094DEBC 8094DEBC 0000 0001 0002 on
809F3FC0 809F97C0 0100022D 809F3FFC 809F3FFC 0000 0001 0002 on
809D0240 809F7A40 01000227 809D027C 809D027C 0000 0001 0002 on
80978B80 809F6C00 01000221 80978BBC 80978BBC 0000 0001 0002 on
809AA000 809A9780 01000005 809AA83C 809AA03C 0007 0001 0002 on
```

3.
```
SDA>  CLUE VCC/LIMBO
Virtual I/O Cache - Limbo Queue:
--------------------------------
  CFCB     CVCB     FCB      CFCB   IOerrors   FID (hex)
-------- -------- -------- -Status- -------- --------------
80A97DC0 809AA000 80A45100 00000200 00000000 (076B,0001,00)
80A4E440 809AA000 809CD040 00000200 00000000 (0767,0001,00)
80A63640 809AA000 809FAE80 00000200 00000000 (0138,0001,00)
80AA2540 80978B80 80A48140 00000200 00000000 (0AA5,0014,00)
80A45600 809AA000 80A3AC00 00000200 00000000 (0C50,0001,00)
80A085C0 809AA000 809FA140 00000200 00000000 (0C51,0001,00)
80A69800 809AA000 809FBA00 00000200 00000000 (0C52,0001,00)
80951000 809AA000 80A3F140 00000200 00000000 (0C53,0001,00)
80A3E580 809AA000 80A11A40 00000200 00000000 (0C54,0001,00)
80A67F80 809AA000 80978F00 00000200 00000000 (0C55,0001,00)
809D30C0 809AA000 809F4CC0 00000200 00000000 (0C56,0001,00)
809D4B80 809AA000 8093E540 00000200 00000000 (0C57,0001,00)
[......]
80A81600 809AA000 8094B2C0 00000200 00000000 (0C5D,0001,00)
80AA3FC0 809AA000 80A2DEC0 00000200 00000000 (07EA,000A,00)
80A98AC0 809AA000 8093C640 00000200 00000000 (0C63,0001,00)
```

4. SDA> CLUE VCC/CACHE

```
Virtual I/O Cache - Cache Lines:
--------------------------------
   CL       VA      CVCB     CFCB     FCB      CFCB   IOerrors   FID (hex)
-------- -------- -------- -------- -------- -Status- -------- ------------
82B11200 82880000 809D0240 809D7000 80A01100 00000200 00000000 (006E,0003,00)
82B15740 82AAA000 809AA000 80A07A00 80A24240 00000000 00000000 (0765,0001,00)
82B14EC0 82A66000 809AA000 80A45600 80A3AC00 00000200 00000000 (0C50,0001,00)
82B12640 82922000 809D0240 809D7000 80A01100 00000200 00000000 (006E,0003,00)
82B123C0 8290E000 809AA000 80A45600 80A3AC00 00000200 00000000 (0C50,0001,00)
82B13380 8298C000 809D0240 809D7000 80A01100 00000200 00000000 (006E,0003,00)
82B15A40 82AC2000 809AA000 80A45600 80A3AC00 00000200 00000000 (0C50,0001,00)
82B15F40 82AEA000 809D0240 809D7000 80A01100 00000200 00000000 (006E,0003,00)
82B12AC0 82946000 809D0240 809D7000 80A01100 00000200 00000000 (006E,0003,00)
82B12900 82938000 809D0240 809D7000 80A01100 00000200 00000000 (006E,0003,00)
82B10280 82804000 809AA000 80A45600 80A3AC00 00000200 00000000 (0C50,0001,00)
82B122C0 82906000 809AA000 80A1AC00 80A48000 00000000 00000000 (0164,0001,00)
82B14700 82A28000 809AA000 809FFEC0 809F8DC0 00000004 00000000 (07B8,0001,00)
82B11400 82890000 809AA000 80A113C0 80A11840 00000000 00000000 (00AF,0001,00)
[......]
82B11380 8288C000 809AA000 809DA0C0 809C99C0 00002000 00000000 (00AB,0001,00)
82B130C0 82976000 809AA000 809DA0C0 809C99C0 00002000 00000000 (00AB,0001,00)
82B11600 828A0000 809AA000 809DA0C0 809C99C0 00002000 00000000 (00AB,0001,00)
```

CLUE XQP

Displays XQP-related information.

Format

CLUE XQP [/qualifier[,...]]

Parameters

None.

Qualifiers

/ACTIVE [/FULL]
Displays all active XQP processes.

/AQB
Displays any current I/O request packets (IRPs) waiting at the interlocked queue.

/BFRD=index
Displays the buffer descriptor (BFRD) referenced by the index specified. The index is identical to the hash value.

/BFRL=index
Displays the buffer lock block descriptor (BFRL) referenced by the index specified. The index is identical to the hash value.

/BUFFER=(n,m) [/FULL]
Displays the BFRDs for a given pool. Specify either 0, 1, 2 or 3, or a combination of these in the parameter list.

/CACHE_HEADER
Displays the block buffer cache header.

/FCB=address [/FULL]
Displays all file header control blocks (FCBs) with a nonzero DIRINDX for a given volume. If no address is specified, the current volume of the current process is used.

The address specified can also be either a valid volume control block (VCB), unit control block (UCB), or window control block (WCB) address.

/FILE=address
Decodes and displays file header (FCB), window (WCB), and cache information for a given file. The file can be identified by either its FCB or WCB address.

/GLOBAL
Displays the global XQP area for a given process.

/LBN_HASH=lbn
Calculates and displays the hash value for a given logical block number (LBN).

/LIMBO
Searches through the limbo queue and displays FCB information from available, but unused file headers.

/LOCK=lockbasis
Displays all file system serialization, arbitration, and cache locks found for the specified lockbasis.

/THREAD=n
Displays the XQP thread area for a given process. The specified thread number is checked for validity. If no thread number is specified, the current thread is displayed. If no current thread, but only one single thread is in use, then that thread is displayed. If more than one thread exists or an invalid thread number is specified, then a list of currently used threads is displayed.

/VALIDATE=(n,m)
Performs certain validation checks on the block buffer cache to detect corruption. Specify 1, 2, 3, 4, or a combination of these in the parameter list. If an inconsistency is found, a minimal error message is displayed. If you add the /FULL qualifier, additional information is displayed.

Description

The CLUE XQP command displays XQP information. XQP is part of the I/O subsystem.

Examples

1.
```
SDA>  CLUE XQP/CACHE_HEADER
Block Buffer Cache Header:
--------------------------
Cache_Header   8437DF90    BFRcnt         000005D2    FreeBFRL       843916A0
Bufbase        8439B400    BFRDbase       8437E080    BFRLbase       8438F7E0
Bufsize        000BA400    LBNhashtbl     84398390    BFRLhashtbl    84399BC8
Realsize       000D78A0    LBNhashcnt     0000060E    BFRLhashcnt    0000060E

Pool           #0          #1          #2          #3
Pool_LRU       8437E5C0    84385F40    84387E90    8438EEB0
               8437F400    84385D60    8438AC80    8438EE20
Pool_WAITQ     8437DFE0    8437DFE8    8437DFF0    8437DFF8
               8437DFE0    8437DFE8    8437DFF0    8437DFF8
Waitcnt        00000000    00000000    00000000    00000000
Poolavail      00000094    00000252    00000251    00000094
Poolcnt        00000095    00000254    00000254    00000095

AmbigQFL       00000000    Process_Hits   00000000    Cache_Serial   00000000
AmbigQBL       00000000    Valid_Hits     00000000    Cache_Stalls   00000000
Disk_Reads     00000000    Invalid_Hits   00000000    Buffer_Stalls  00000000
Disk_Writes    00000000    Misses         00000000
```

The SDA command CLUE XQP/CACHE_HEADER displays the block buffer cache header.

2.
```
SDA>  CLUE XQP/VALIDATE=(1,4)
Searching BFRD Array for possible Corruption...
Searching Lock Basis Hashtable for possible Corruption...
```

In this example, executing the CLUE XQP/VALIDATE=1,4 command indicated that no corruption was detected in either the BFRD Array or the Lock Basis Hashtable.

6 SDA Spinlock Tracing Utility

This chapter presents an overview of the SDA Spinlock Tracing Utility commands, and describes the SDA Spinlock Tracing commands.

6.1 Overview of the SDA Spinlock Tracing Utility

To synchronize access to data structures, the OpenVMS operating system uses a set of static and dynamic spinlocks, such as IOLOCK8 and SCHED. The operating system acquires a spinlock to synchronize data, and at the end of the critical code path the spinlock is then released. If a CPU attempts to acquire a spinlock while another CPU is holding it, the CPU attempting to acquire the spinlock has to spin, waiting until the spinlock is released. Any lost CPU cycles within such a spinwait loop are charged as MPsynch time.

By using the MONITOR utility, you can monitor the time in process modes, for example, with the command $ MONITOR MODES. A high rate of MP synchronization indicates contention for spinlocks. However, until the implementation of the Spinlock Tracing utility, there was no way to tell which spinlock was heavily used, and who was acquiring and releasing the contended spinlocks. The Spinlock Tracing utility allows a characterization of spinlock usage. It can also collect performance data for a given spinlock on a per-CPU basis.

This tracing ability is built into the system synchronization execlet, which contains the spinlock code, and can be enabled or disabled while the system is running. There is no need to reboot the system to load a separate debug image. The images that provide spinlock tracing functionality are as follows:

```
SYS$LOADABLE_IMAGES:SPL$DEBUG.EXE
SYS$SHARE:SPL$SDA.EXE
```

The SDA> prompt provides the command interface. From this command interface, you can load and unload the spinlock debug execlet using SPL LOAD and SPL UNLOAD, and start, stop and display spinlock trace data. This allows you to collect spinlock data for a given period of time without system interruption. Once information is collected, the trace buffer can be deallocated and the execlet can be unloaded to free up system resources. The spinlock trace buffer is allocated from S2 space and pages are taken from the freelist.

Should the system crash while spinlock tracing is enabled, the trace buffer is dumped into the system dump file, and it can later be analyzed using the spinlock trace utility. This is very useful in tracking down CPUSPINWAIT bugcheck problems.

Note that by enabling spinlock tracing, there is a performance impact. The amount of the impact depends on the amount of spinlock usage.

Note

The Spinlock Tracing utility is still under development. The command format, displays, and suggested approach to spinlock analysis are all subject to change.

6.2 How to Use the SDA Spinlock Tracing Utility

The following steps will enable you to collect spinlock statistics using the Spinlock Tracing Utility.

1. Load the Spinlock Tracing Utility execlet.

   ```
   SDA> SPL LOAD
   ```

2. Allocate a trace buffer and start tracing.

   ```
   SDA> SPL START TRACE
   ```

3. Wait a few seconds to allow some tracing to be done, then find out which spinlocks are incurring the most acquisitions and the most spinwaits.

   ```
   SDA> SPL SHOW TRACE/SUMMARY
   ```

   For example, you might see contention for the SCHED and IOLOCK8 spinlocks (a high acquisition count, with a significant proportion of the acquisitions being forced to wait).

4. Look to see if the spinlocks with a high proportion of spinwaits caused a significant delay in the acquisition of the spinlock. You must now collect more detailed statistics on a specific spinlock.

   ```
   SDA> SPL START COLLECT/SPINLOCK=SCHED
   ```

   This command accumulates additional data for the specified spinlock. As long as tracing is not stopped, collection will continue to accumulate spinlock-specific data from the trace buffer.

5. Display the additional data collected for the specified spinlock.

   ```
   SDA> SPL SHOW COLLECT
   ```

   This display includes the average hold time of the spinlock and the average spinwait time while acquiring the spinlock.

6. Repeat steps 4 and 5 for each spinlock that has contention. A START COLLECT cancels the previous collection.

7. Disable spinlock tracing when you have collected all the needed spinlock statistics and release all the memory used by the Spinlock Tracing utility with the following commands.

   ```
   SDA> SPL STOP COLLECT
   SDA> SPL STOP TRACE
   SDA> SPL UNLOAD
   ```

6.3 Example Command Procedure for Collection of Spinlock Statistics

The following example shows a command procedure that can be used for gathering spinlock statistics:

```
$ analyze/system
  spl load
  spl start trace/buffer=1000
  spawn wait 00:00:15
  spl stop trace
  read/executive/nolog
  set output spl_trace.lis
  spl show trace/summary
  spl start collect/spin=sched
  spawn wait 00:00:05
  spl show collect
  spl start collect/spin=iolock8
  spawn wait 00:00:05
  spl show collect
  spl start collect/spin=lckmgr
  spawn wait 00:00:05
  spl show collect
  spl start collect/spin=mmg
  spawn wait 00:00:05
  spl show collect
  spl start collect/spin=timer
  spawn wait 00:00:05
  spl show collect
  spl start collect/spin=mailbox
  spawn wait 00:00:05
  spl show collect
  spl start collect/spin=perfmon
  spawn wait 00:00:05
  spl show collect
  spl stop collect
  spl unload
  exit
$ exit
```

A more comprehensive procedure is provided as SYS$EXAMPLES:SPL.COM.

6.4 Listing of SDA Spinlock Tracing Commands

The following is a list of the spinlock tracing commands:

SPL LOAD
SPL SHOW COLLECT
SPL SHOW TRACE
SPL START COLLECT
SPL START TRACE
SPL STOP COLLECT
SPL STOP TRACE
SPL UNLOAD

SPL LOAD

Loads the SPL$DEBUG execlet. This must be done prior to starting spinlock tracing.

Format

SPL LOAD

Parameters

None.

Qualifiers

None.

Description

The SPL LOAD command loads the SPL$DEBUG execlet, which contains the tracing routines.

Example

```
SDA> SPL LOAD
SPL$DEBUG load status = 00000001
```

SPL SHOW COLLECT

Displays the collected spinlock data.

Format

SPL SHOW COLLECT [/RATES | /TOTALS]

Parameters

None.

Qualifiers

/RATES
Reports activity as a rate per second and hold/spin time as a percentage of time. This is the default.

/TOTALS
Reports activity as a count and hold/spin time as cycles.

Description

The SPL SHOW COLLECT command displays the collected spinlock data. It displays first a summary on a per-CPU basis, followed by the callers of the specific spinlock. This second list is sorted by the top consumers of the spinlock (in percent of time held). These displays show average spinlock hold and spinlock wait time in system cycles.

Example

```
SDA> SPL SHOW COLLECT

Spinlock Trace Information for SCHED:
-------------------------------------

                                                                                                   Spin to
CPU ID       % Time Held   Acquires/sec   Average Hold    % Time Spinning      Waits/sec   Average Spin   Hold Ratio
------   ---------------   ------------   ------------   ---------------   ------------   ------------  -----------
    08               4.6         1651.4           8296               0.3          298.2           2601         0.06
    09               4.9         1941.8           7578               0.2          276.3           1841         0.03
    10               4.0         1593.5           7454               0.1          225.4           1794         0.03
    11               5.2         2185.6           7185               0.2          272.8           1924         0.03
    12               5.4         2105.1           7702               0.2          271.3           2012         0.03
    13               5.7         6131.5           2785               2.5         2288.8           3330         0.45
         ---------------   ------------   ------------   ---------------   ------------   ------------  -----------
                    29.7        15608.8           6833               3.5         3632.8           2250         0.12

Spinlock Trace Information for SCHED: ( 6-DEC-2001 09:01:52.26,  3.3 nsec, 300 MHz)
-----------------------------------------------------------------------------------

                                                    % Time   Acquires                                  Spinwaits    Average  % Time
Caller's PC                                           Held       /sec    Maximum   Minimum    Average       /sec   Spinwait    Spin
--------------------------------------------------  ------  ---------  ----------  --------  ---------  ---------  ---------  ------
80342384  LCK$SND_CVTREQ_C+00344                      17.1     5758.4      26384      3531       8912       65.7       3181     0.1
8012D53C  SCH$IDLE_C+0024C                             5.3     2614.5      20897      1384       6134     1083.3       1524     0.5
80347BB0  LCK$DEALLOC_LKB_C+00220                      5.2     5880.6       7767       472       2641     2248.5       3332     2.5
80151F84  SCH$INTERRUPT+00064                          0.5      214.1      15564      1619       6895       35.3       6092     0.1
80343FB8  LCK$SND_LOCKREQ_C+00148                      0.4      137.8      24063      4716       9509        0.0          0     0.0
801375C0  SCH$QEND_C+00080                             0.3      228.9      12107      2474       4251       29.0       3315     0.0
```

VM-0674A-AI

SPL SHOW TRACE

Displays spinlock tracing information.

Format

SPL SHOW TRACE [/[NO]SPINLOCK=*spinlock* | /[NO]FORKLOCK=*forklock*
| /[NO]ACQUIRE | /RATES | /[NO]RELEASE | /[NO]WAIT
| /[NO]FRKDSPTH | /[NO]FRKEND
| /SUMMARY | /CPU=*n* | /TOP=*n* | /TOTALS]

Parameters

None.

Qualifiers

/SPINLOCK=*spinlock*
/NOSPINLOCK
The /SPINLOCK=*n* qualifier specifies the display of a specific spinlock, for example, /SPINLOCK=LCKMGR or /SPINLOCK=SCHED.

The /NOSPINLOCK qualifier specifies that no spinlock trace information be displayed. If omitted, all spinlock trace entries are decoded and displayed.

/FORKLOCK=*forklock*
/NOFORKLOCK
The /FORKLOCK=*forklock* qualifier specifies the display of a specific forklock, for example, /FORKLOCK=IOLOCK8 or /FORKLOCK=IPL8.

The /NOFORKLOCK qualifier specifies that no forklock trace information be displayed. If omitted, all fork trace entries are decoded and displayed.

/ACQUIRE
/NOACQUIRE
The /ACQUIRE qualifier displays any spinlock acquisitions.

The /NOACQUIRE qualifier ignores any spinlock acquisitions.

/RATES
Reports activity as a rate per second and hold/spin time as a percentage of time. This is the default.

/RELEASE
/NORELEASE
The /RELEASE qualifier displays any spinlock releases.

The /NORELEASE qualifier ignores any spinlock releases.

/TOTALS
Reports activity as a count and hold/spin time as cycles.

/WAIT
/NOWAIT
The /WAIT qualifier displays any spinwait operations.

The /NOWAIT qualifier ignores any spinwait operations.

/FRKDSPTH
/NOFRKDSPTH
The /FRKDSPTH qualifier displays all invocations of fork routines within the fork dispatcher. This is the default.

The /NOFRKDSPTH qualifier ignores all of the operations of the /FRKDSPTH qualifier.

/FRKEND
/NOFRKEND
The /FRKEND qualifier displays all returns from fork routines within the fork dispatcher. This is the default.

The /NOFRKEND qualifier ignores all operations of the /FRKEND qualifier.

/CPU=*n*
Specifies the display of information for a specific CPU only, for example, /CPU=5 or /CPU=PRIMARY. By default, all trace entries for all CPUs are displayed.

/SUMMARY
Steps through the entire trace buffer and displays a summary of all spinlock and forklock activity. It also displays the top ten callers.

/TOP=*n*
Displays a different number other than the top ten callers or fork PCs. By default, the top ten are displayed. This qualifier is only useful when you also specify the /SUMMARY qualifier.

Description

The SPL SHOW TRACE command displays spinlock tracing information. The latest acquired or released spinlock is displayed first, and then the trace buffer is stepped backwards in time.

By default, all trace entries will be displayed, but you can use qualifiers to select only certain entries.

Since this is not a time critical activity and a table lookup has to be done anyway to translate the SPL address to a spinlock name, commands like /SPINLOCK=(SCHED,IOLOCK8) do work. /SUMMARY will step the entire trace buffer and display a summary of all spinlock activity, along with the top-ten callers' PCs. You can use /TOP=n to display a different number of the top ranked callers.

Examples

1.
```
Spinlock Trace Information:
---------------------------
Timestamp             CPU Spin/Forklock/IPL Caller's/Fork PC                      EPID     Operation             Trace Buffer
1                     2   3                 4                                     5        6                     7
--------------------- --- ----------------- ------------------------------------- -------- --------------------- ----------------
23-JAN 15:32:03.223052  05 810B2200 MMG      80175594 MMG_STD$IOLOCK_BUF_C+00214    00000568 Release              FFFFFFFE.05F635E0
23-JAN 15:32:04.794732  0B 810B2900 FILSYS   800F4340 IOC_STD$MAPVBLK_C+002A0       0000056E Restore              FFFFFFFE.05F635C0
23-JAN 15:32:05.307011  0D 810B2200 MMG      8017B154 SYS$VM+17154                  00000570 Release              FFFFFFFE.05F635A0
23-JAN 15:32:05.307497  09 810B2100 SCHED    80144770 PROCESS_MANAGEMENT+2A770      00000000 Release              FFFFFFFE.05F63580
23-JAN 15:32:05.306490  0E 810B2200 MMG      8017550C MMG_STD$IOLOCK_BUF_C+0018C    00000571 Acquire  (spin)      FFFFFFFE.05F63560
23-JAN 15:32:05.307951  00 810B2200 MMG      80175D9C MMG_STD$IOUNLOCK_BUF_C+000    00000000 Acquire  (spin)      FFFFFFFE.05F63540
23-JAN 15:32:05.818853  0E 810B2200 MMG      80175594 MMG_STD$IOLOCK_BUF_C+00214    00000571 Release              FFFFFFFE.05F63520
23-JAN 15:32:05.819422  0C 810B2100 SCHED    8011F53C SCH$CALC_CPU_LOAD_C+0049C     00000000 Acquire  (spin)      FFFFFFFE.05F63500
23-JAN 15:32:05.819374  0D 810B2100 SCHED    8014C0E8 EXE$SYNCH_LOOP_C+00458        00000570 Acquire  (spin)      FFFFFFFE.05F634E0
23-JAN 15:32:05.818851  0E 810B2200 MMG      8017550C MMG_STD$IOLOCK_BUF_C+0018C    00000571 Acquire              FFFFFFFE.05F634C0
23-JAN 15:32:05.820320  00 810B2100 SCHED    801473A0 SCH$QAST_C+004F0              00000000 Acqnoipl             FFFFFFFE.05F634A0
23-JAN 15:32:05.819370  0D 810B2700 IOLOCK8  800FFB30 EXE_STD$INSIOQ_C+002B0        00000570 Release              FFFFFFFE.05F63480
23-JAN 15:32:05.819415  0C 810B2100 SCHED    8011F370 SCH$CALC_CPU_LOAD_C+002D0     00000000 Release              FFFFFFFE.05F63460
23-JAN 15:32:05.820316  00 8994FE00 ???      80146F44 SCH$QAST_C+00094              00000000 Acquire  (nospin)    FFFFFFFE.05F63440
23-JAN 15:32:05.820314  00 810B2200 MMG      80175DC0 MMG_STD$IOUNLOCK_BUF_C+000    00000000 Restore              FFFFFFFE.05F63420
23-JAN 15:32:05.820312  00 810B2200 MMG      80175D9C MMG_STD$IOUNLOCK_BUF_C+000    00000000 Acquire              FFFFFFFE.05F63400
23-JAN 15:32:05.819409  0C 810B2100 SCHED    8014C0E8 EXE$SYNCH_LOOP_C+00458        0000056F Acquire              FFFFFFFE.05F633E0
```

VM-0675A-AI

Callout	Meaning
1	Shows timestamps that are collected as system cycle counters (SCC) and then displayed with an accuracy down to microseconds. Each CPU is incrementing its own SCC as soon as it is started, so there is some difference between different CPUs' system cycle counters. The standard system time is incremented only every 10 Msec and as such is not exact enough. Adjusting the SCC to the specific CPU's system time and translating it into an accurate timestamp will thus sometimes display times out of order for different CPUs. However, for the same CPU ID, the timestamps are accurate.
2	Shows the physical CPU ID of the CPU logging the trace entry.
3	Shows the address of the spinlock fork. If it is a static one, its name is displayed; otherwise, it is marked as ???.
4	Shows the caller's PC address that acquired or released the spinlock, or the fork PC if the trace entry is a forklock. Symbolization is attempted, so a READ/EXECUTIVE might help to display a routine name, instead of simply a module and offset.
5	Shows the EPID, which is the external PID of the process generating the trace entry. If an interrupt or fork was responsible for the entry, then a zero EPID is displayed.
6	Shows the trace operation. For a spinlock, which was acquired without going through a spinwait, there is a matching acquire/release pair of trace entries for the same CPU ID for a given spinlock. If a spinlock is held, it cannot be acquired immediately, so there is also a spinwait trace entry for this pair. The different variations of the acquire and release operations are distinguished, as are the same spinlocks if they are acquired recursively multiple times.
7	Shows the address of the trace buffer entry, in case there is a need to access the raw and undecoded trace data.

```
SDA> SPL SHOW TRACE/SUMMARY 8

Spinlock Trace Information: (at  6-DEC-2001 09:01:47.02, trace time 00:00:01.415159)
------------------------------------------------------------------------------------

               Events    Acquires    Releases     Acq Own  Acq NoSpin   Spinwaits           %
Spinlock         /sec        /sec        /sec        /sec        /sec        /sec    Spinwait
----------  ----------  ----------  ----------  ----------  ----------  ----------  ----------
EMB                1.4         0.7         0.7         0.0         0.0         0.0         0.0
MEGA               1.4         0.7         0.7         0.0         0.0         0.0         0.0
HWCLK           2049.2      1024.6      1024.6         0.0         0.0         0.0         0.0
INVALIDATE       221.9       110.9       110.9         0.0         0.0         0.0         0.0
MAILBOX            4.2         2.1         2.1         0.0         0.0         0.0         0.0
SCHED          34851.2     15609.6     15608.8         0.0         0.0      3632.8        23.3
MMG             1776.5       781.5       888.2        12.7        94.0         0.0         0.0
TIMER            308.1       154.0       154.0         0.0         0.0         0.0         0.0
TX_SYNCH          57.9        29.0        29.0         0.0         0.0         0.0         0.0
IOLOCK8        33944.6     15285.9     15292.3         6.4         0.0      3360.0        22.0
LCKMGR         53421.6     17816.4     17843.2         0.0        28.3     17733.7        99.4
FILSYS           278.4       139.2       139.2         0.0         0.0         0.0         0.0
QUEUEAST           5.7         2.8         2.8         0.0         0.0         0.0         0.0
???            41312.0     20538.3     20655.6         0.0       117.3         0.7         0.0
----------  ----------  ----------  ----------  ----------  ----------  ----------  ----------
              168234.1     71495.8     71752.4        19.1       239.5     24727.3        34.5

Spinlock Trace Information: 9
---------------------------

               Events    Acquires  or   Spins     %    Own
Spinlock         /sec    Releases/sec    /sec  Spin   /sec Caller's PC                          Module                                  Offset
---------- ---------- -------------- ------- ----- ------ ------------------------------------- ----------------------------------
.
.
.
SCHED          8129.1    5880.6 Acq/s  2248.5  38.2    0.0 80347BB0  LCK$DEALLOC_LKB_C+00220      SYS$CLUSTER                           00027BB0
SCHED          6186.6    6186.6 Rel/s     0.0   0.0    0.0 80152668  SCH$INTERRUPT+00748          PROCESS_MANAGEMENT                    0002A668
SCHED          5880.6    5880.6 Rel/s     0.0   0.0    0.0 80347C24  LCK$DEALLOC_LKB_C+00294      SYS$CLUSTER                           00027C24
SCHED          5824.1    5758.4 Acq/s    65.7   1.1    0.0 80342384  LCK$SND_CVTREQ_C+00344       SYS$CLUSTER                           00022384
SCHED          3697.8    2614.5 Acq/s  1083.3  41.4    0.0 8012D53C  SCH$IDLE_C+0024C             PROCESS_MANAGEMENT                    0000553C
SCHED          2614.5    2614.5 Rel/s     0.0   0.0    0.0 8012D370  SCH$IDLE_C+00080             PROCESS_MANAGEMENT                    00005370
SCHED           444.5     368.9 Acq/s    75.6  20.5    0.0 80157E10  SCH$POSTEF_C+00050           PROCESS_MANAGEMENT                    0002FE10
SCHED           368.9     368.9 Rel/s     0.0   0.0    0.0 80157A70  SCH$POSTEF_SCHED_C+00140     PROCESS_MANAGEMENT                    0002FA70
SCHED           258.6     229.7 Acq/s    29.0  12.6    0.0 801375C0  SCH$QEND_C+00080             PROCESS_MANAGEMENT                    0000F5C0
SCHED           249.4     214.1 Acq/s    35.3  16.5    0.0 80151F84  SCH$INTERRUPT+00064          PROCESS_MANAGEMENT                    00029F84

MMG             154.8     154.8 Acq/s     0.0   0.0    0.0 80186AA4  MMG$PAGEFAULT_C+000A4        SYS$VM                                00014AA4
MMG             106.7     106.7 Acq/s     0.0   0.0    0.0 8017E658  MMG_STD$SET_GH_AND_FASTMAP_6 SYS$VM                                0000C658
MMG             106.7     106.7 Rel/s     0.0   0.0    0.0 8017E68C  MMG_STD$SET_GH_AND_FASTMAP_6 SYS$VM                                0000C68C
MMG              88.3      88.3 Rel/s     0.0   0.0    0.0 80187024  MMG$PAGEFAULT_C+00624        SYS$VM                                00015024
MMG              77.7      77.7 Rel/s     0.0   0.0    0.0 8019E904  MMG_STD$SETPRTPAG_64_C+002C4 SYS$VM                                0002C904
.
.
.
```

continued
VM-0676A-AI

Callout	Meaning
8	Shows the summary information by stepping through the whole trace buffer, and displaying a single line of information for each spinlock. If the percent of spin wait is very high, then a spinlock is a candidate for high contention.
9	For each spinlock in the summary display, the top ten callers' PCs are displayed along with the number of spinlock acquisitions and releases, as well as spinwait counts and the number of multiple acquisitions of the same spinlock.

```
Forklock Trace Information: (at  6-DEC-2001 09:01:47.02, trace time 00:00:01.415159) 10
-----------------------------------------------------------------------------------

            Total         CPU ID
Forklock    Events/sec         8      9     10     11     12     13
----------  ----------    ------------------------------------------
IPL 08          2523.4       0.0    0.0    0.0    0.0    0.0 2523.4
TIMER             49.5      49.5    0.0    0.0    0.0    0.0    0.0
IOLOCK8          686.1     684.0    0.7    0.7    0.0    0.7    0.0
LCKMGR          3069.6     168.2    0.0    0.0    0.0    0.0 2901.4
QUEUEAST           2.8       0.0    0.7    0.0    1.4    0.7    0.0
            ----------    ------------------------------------------
Totals          6331.4     901.7    1.4    0.7    1.4    1.4 5424.8

Forklock Trace Information:
---------------------------

Forklock    Event/sec      % Time Held    Average    Minimum    Maximum  Fork PC
----------  ---------  ---------------  ---------  ---------  ---------  ----------------------------------------

IPL 08         2523.4             16.7      19911       5761      66873  803F1490  SYS$PCADRIVER+05490
----------  ---------  ---------------
Totals         2523.4             16.7

TIMER            49.5              0.6      35812        504     813332  80050050  EXE$SWTIMER_FORK_C
----------  ---------  ---------------
Totals           49.5              0.6

IOLOCK8         496.1              1.1       6732        491      24046  805C4840  SYS$EWDRIVER+04840
IOLOCK8         190.1              0.5       7619       1224      28993  805EEEC8  EXEC.FORK_C+00080
----------  ---------  ---------------
Totals          686.1              1.6

LCKMGR         3069.6             18.7      18268       3933      64563  8032E5E0  CNX$RCV_MSG_LCKMGR_FRK_C
----------  ---------  ---------------
Totals         3069.6             18.7

QUEUEAST          2.8              0.0      24885      20589      32203  802E4370  XFCCOMMONFORKDISPATCH_C
----------  ---------  ---------------
Totals            2.8              0.0

==========  =========  ===============
Totals         6331.4             37.6
```

VM-0775A-AI

Callout	Meaning
10	The forklock summary displays the number of fork operations on a specific CPU for each forklock. For each forklock, the top ten fork PC addresses are displayed, along with the minimum, maximum and average duration of the fork operation in system cycles. The percent of time spent in a given fork routine is displayed along with the percent of time for the forklock.

SPL START COLLECT

Starts to collect spinlock information a longer period of time than will fit into the trace buffer.

Format

SPL START COLLECT [/SPINLOCK=*spinlock* | /ADDRESS=*n*]

Parameters

None.

Qualifiers

/SPINLOCK=spinlock
Specifies the tracing of a specific spinlock, for example, /SPINLOCK=LCKMGR or /SPINLOCK=SCHED.

/ADDRESS=n
Specifies the tracing of a specific spinlock by address.

Description

The SPL START COLLECT command starts a collection of spinlock information for a longer period of time than will fit into the trace buffer. You need to enable spinlock tracing before a spinlock collection can be started. On a system with heavy activity, the trace buffer typically can only hold a relatively small time window of spinlock information. In order to collect spinlock information over a longer time period, a collection can be started. The collection tries to catch up with the running trace index and save the spinlock information into a balanced tree within the virtual address space of the process performing the spinlock collection. Either use the name of a static spinlock, or supply the address of a dynamic spinlock, for which information should be gathered.

The trace entries are kept in the trace buffer, which is allocated from S2 space, hence there is no disruption, if tracing is started from within SDA and then the user exits from SDA. However, for the longer period data collection, the information is kept in process-specific memory, thus a user needs to stay within SDA; otherwise the data collection is automatically terminated by SDA's image rundown. You can collect data for two or more spinlocks simultaneously, by using a separate process for each collection.

Examples

1.
```
SDA> SPL START COLLECT
Use /SPINLOCK=name or /ADDRESS=n to specify which spinlock info needs to be collected...
```

This example shows that you need to supply either a spinlock name of a static spinlock, or the address of a dynamic spinlock, if you want to collect information over a long period of time.

2.
```
SDA> SPL START COLLECT/SPINLOCK=LCKMGR
```

This example shows the command line to start to collect information on the usage of the LCKMGR spinlock.

SPL START TRACE

Enables spinlock tracing.

Format

SPL START TRACE [/[NO]SPINLOCK=*spinlock* | /[NO]FORKLOCK=forklock | /BUFFER=*pages* | /[NO]ACQUIRE | | /[NO]RELEASE | /[NO]WAIT | /[NO]FRKDSPTH | /[NO]FRKEND | /CPU=n]

Parameters

None.

Qualifiers

/SPINLOCK=*spinlock*
/NOSPINLOCK
The /SPINLOCK=*spinlock* qualifier specifies the tracing of a specific spinlock, for example, /SPINLOCK=LCKMGR or /SPINLOCK=SCHED.

The /NOSPINLOCK qualifier disables spinlock tracing and does not collect any spinlock data. If omitted, all spinlocks are traced.

/FORKLOCK=*forklock*
/NOFORKLOCK
The /FORKLOCK=*forklock* qualifier specifies the tracing of a specific forklock, for example, /FORKLOCK=IOLOCK8 or /FORKLOCK=IPL8.

The /NOFORKLOCK qualifier disables forklock tracing and does not collect any forklock data. If omitted, all forks are traced.

/BUFFER=*pages*
Specifies the size of the trace buffer (in Alpha page units). It defaults to 128 pages, which is equivalent to 1MB, if omitted.

/ACQUIRE
/NOACQUIRE
The /ACQUIRE qualifier traces any spinlock acquisitions. This is the default.

The /NOACQUIRE qualifier ignores any spinlock acquisitions.

/RELEASE
/NORELEASE
The /RELEASE qualifier traces any spinlock releases. This is the default.

The /NORELEASE qualifier ignores any spinlock releases.

/WAIT
/NOWAIT
The /WAIT qualifier traces any spinwait operations. This is the default.

The /NOWAIT qualifier ignores any spinwait operations.

/FRKDSPTH
/NOFRKDSPTH
The /FRKDSPTH qualifier traces all invocations of fork routines within the fork dispatcher. This is the default.

The /NOFRKDSPTH qualifier ignores all of the /FRKDSPTH operations.

/FRKEND
/NOFRKEND
The /FRKEND qualifier traces all returns from fork routines within the fork dispatcher. This is the default.

The /NOFRKEND qualifier ignores all of the operations of the /FRKEND qualifier.

/CPU=*n*
Specifies the tracing of a specific CPU only, for example, /CPU=5 or /CPU=PRIMARY. By default, all CPUs are traced.

Description

The SPL START TRACE command enables spinlock and fork tracing. By default all spinlocks and forks are traced and a 128 page (1MByte) trace buffer is allocated and used as a ring buffer.

Examples

1.
```
SDA> SPL START TRACE/BUFFER=1000
Tracing started... (Spinlock = 00000000, Forklock = 00000000)
```
This example shows how to enable a tracing for all spinlock and forklock operations into a 8 MByte trace buffer.

2.
```
SDA> SPL START TRACE/CPU=PRIMARY/SPINLOCK=SCHED /NOFORKLOCK
Tracing started... (Spinlock = 810AF600, Forklock = 00000000)
```
This example shows how to trace only SCHED spinlock operations on the primary CPU.

3.
```
SDA> SPL START TRACE /NOSPINLOCK /FORKLOCK=IPL8
Tracing started... (Spinlock = 00000000, Forklock = 863A4C00)
```
This example shows how to trace only fork operations to IPL8.

SPL STOP COLLECT

Stops the spinlock collection, but does not stop spinlock tracing.

Format

SPL STOP COLLECT

Parameters

None.

Qualifiers

None.

Description

The SPL STOP COLLECT command stops the data collection, but does not affect tracing. This allows the user to start another collection for a different spinlock during the same trace run.

Example

```
SDA> SPL STOP COLLECT
```

SPL STOP TRACE

Disables spinlock tracing, but it does not deallocate the trace buffer.

Format

SPL STOP TRACE

Parameters

None.

Qualifiers

None.

Description

The SPL STOP TRACE command stops tracing, but leaves the trace buffer allocated for further analysis.

Example

```
SDA> SPL STOP TRACE
Tracing stopped...
```

SPL UNLOAD

Unloads the SPL$DEBUG execlet and performs cleanup. Tracing is automatically disabled and the trace buffer deallocated.

Format

SPL UNLOAD

Parameters

None.

Qualifiers

None.

Description

The SPL UNLOAD command disables the tracing or collection functionality with a delay to a state of quiescence. This ensures that all pending trace operations in progress have finished before the trace buffer is deallocated. Finally the SPL UNLOAD command unloads the SPL$DEBUG execlet.

Example

```
SDA> SPL UNLOAD
SPL$DEBUG unload status = 00000001
```

7

SDA Extended File Cache (XFC) Extension Commands

This chapter describes the SDA extension commands for the Extended File Cache (XFC).

7.1 Overview of SDA Extensions That Support the Extended File Cache (XFC)

The SDA extension commands for Extended File Cache (XFC) enable you to perform the following tasks:

- Display, in a convenient and readable format, various XFC data structures
- Display, in a convenient and readable format, statistics that aid in tuning the extended file cache

7.2 Listing of SDA Extended File Cache (XFC) Extension Commands

The section describes the following SDA XFC extension commands:

EXIT
LOAD DSF
SHOW CONTEXT
SHOW EXTENT
SHOW FILE
SHOW MEMORY
SHOW SUMMARY
SHOW TABLES
SHOW TRACE
SHOW VOLUME

EXIT

Exits the XFC SDA extensions.

Format

EXIT

Parameters

None.

Qualifiers

None.

Description

The EXIT command issued from the SDA> prompt exits you from SDA to the DCL ($) prompt. If you invoke XFC at the SDA> prompt, you receive an XFC> prompt, from which you can then invoke a specific command, for example, SHOW SUMMARY. If you invoke EXIT at the XFC> prompt, you are returned to the SDA> prompt.

Example

```
SDA> XFC
XFC> SHOW SUMMARY

XFC Summary
-----------
Extended File Cache V1.0 (May  6 2002 11:33:46)
Anchor Block Address:            FFFFFFFF80D30410
Build Id:
Cache State:                     0000A010
Cache in no-cache state:         False
   .
   .
   .
XFC>EXIT
SDA>
```

This command shows the procedure for exiting from the XFC extension.

LOAD DSF

Loads the symbols in the specified debug symbol file (DSF) for use with the SDA FORMAT command.

Format

LOAD DSF filename

Parameter

filename
The name of the symbol file.

Qualifiers

None.

Description

The LOAD DSF command loads the symbol tables for the XFC internal data structures. The XFC symbol tables are contained in a file SYS$XFCACHE.DSF, which is located in the system directory, SYS$LOADABLE_IMAGES.

Example

```
SDA> XFC SHOW FILE/BRIEF

XFC Cache File Block brief listing
----------------------------------
CFB Address      CVB Address      Volume Name       File ID           Access
FFFFFFFD83120D40 FFFFFFFD831FA080 DISK$FRROOG_RUBY            (541,5,0)    0
   .
   .
   .
SDA> FORMAT FFFFFFFD83120D40
%SDA-E-NOSYMBOLS, no "VCC_CFB" symbols found to format this block
DA> xfc load dsf sys$loadable_images:sys$xfcache
Reading symbols from SYS$SYSROOT:[SYS$LDR]SYS$XFCACHE.DSF;21

Loaded 825 symbols>

SDA>  FORMAT FFFFFFFD83120D40
FFFFFFFD.83120D40   CFB$R_PSNOLDHEADER              00000001
FFFFFFFD.83120D44                                   00000001
FFFFFFFD.83120D48   CFB$W_UWMUSTBEONE                   0001
FFFFFFFD.83120D4A   CFB$B_BTYPE                       6F
FFFFFFFD.83120D4B   CFB$B_BSUBTYPE                  40
FFFFFFFD.83120D4C   CFB$R_PFCBFILE                  81935900
FFFFFFFD.83120D50   CFB$Q_UQSIZE                    0000021C
FFFFFFFD.83120D54                                   00000000
FFFFFFFD.83120D58   CFB$R_PCVBCACHEVOLUME           831FA080
FFFFFFFD.83120D5C                                   FFFFFFFD
FFFFFFFD.83120D60   CFB$R_QHDQUEUEHEAD              83120B40
FFFFFFFD.83120D64                                   FFFFFFFD
FFFFFFFD.83120D68                                   83121800
FFFFFFFD.83120D6C                                   FFFFFFFD
   .
   .
   .
```

This example shows the output of loading symbols from the XFC debug symbols file, and using those symbols to format a CFB structure.

SHOW CONTEXT

Displays the contents of an XFC context block (CTX).

Format

SHOW CONTEXT [address][/STALLING|/FULL|/BRIEF]

Parameter

address
The address of the CTX. If no address is supplied, then all the context structures are displayed.

Qualifiers

/BRIEF
Displays a brief summary for each context; for example, the I/O type, start virtual block number (VBN), and length of I/O.

/FULL
Displays the complete context structure. This is the default.

/STALLING
Displays only contexts that are stalling; for example, those that have a stall reason code other than **estrNotStalling**.

Description

The SHOW CONTEXT command displays the contents of an active context block. The state of each active operation within XFC is maintained in a data structure called a context block.

Examples

```
1. SDA> XFC SHOW CONTEXT/BRIEF

List of All XFC Active Contexts (CTX)
-------------------------------------
Address             I/O Type            I/O phase         I/O Stall reason          Volume ID     File ID      Start VBN      Length        IRP
FFFFFFFF818C6250    eiotReadThrough     eiopFillContext   estrWindowTurn     FFFFFFFD8311BD00        3156         382593          32   818F7780
FFFFFFFF81854D10    eiotReadThrough     eiopFillContext   estrWindowTurn     FFFFFFFD8311BD00        3156         283873          32   81B26940
FFFFFFFF818787D0    eiotReadThrough     eiopFillContext   estrWindowTurn     FFFFFFFD8311BD00        3156         351777          32   81265FC0
FFFFFFFF81849E50    eiotReadAround      eiopSegmentDone   estrDiskIO         FFFFFFFD8311BD00        3156         289089          32   818F7540
FFFFFFFF818DC0D0    eiotReadAround      eiopSegmentDone   estrDiskIO         FFFFFFFD8311BD00        3156         271809          32   817C1800
FFFFFFFF81854190    eiotClusterTrans    eiopClusterIdle   estrNotStalled     0000000000000000           0              0           0   00000000

Contexts found: 6
```

VM-1055A-AI

This example shows the address of the context block, I/O type (the type of operation), I/O phase (what phase the operation is in), I/O stall (reason for its stalling), volume ID (address of the control volume block), start VBN (starting VBN of the I/O), length of the I/O, and I/O request packet (the address of the IRP).

```
2. SDA> XFC SHOW CONTEXT FFFFFFFF8190D690

List of All XFC Active Contexts (CTX)
-------------------------------------
Context (CTX) Address: FFFFFFFF8190D690
I/O Phase:             eiopFillContext
I/O Type:              eiotReadThrough
Operation started:   17-APR-2002 11:23:29.00
Stall Reason:          estrWindowTurn
Stall Extent:          0000000000000000
Stall Op (IRP):        FFFFFFFF81267A40
Saved AST Parameter:   0000000000000000
Restart Routine:       0000000000000000
Context state flags    00000000
  Cache Hit:               False
  HWM Checked:             False
  Fork Restarted           False
  AST Required (flush)     False
  Buffer locked            False
  Stalled converting       False
  Fork Block in use        False
  Override resource checks False
  Restart cluster trans    False
  Restart cluster flush    False
  MV volumes skipped       False
  Depose pending           False
  Ignore CFB Quiesce       False
  Delete CFB               False
  Read-ahead hit           False
ECB Count:                      0
Index:                 00000000 (         0)
Start VBN:             000107C1 (     67521)
Length in Blocks:      00000020 (        32)
Next VBN:              000107C1 (     67521)
I/O Extent Count:               0
Disk I/O Length:       00000020 (        32)
Bytes Copied:                   0
Bytes Zeroed:                   0
Bytes Requested:            16384
Volume (CVB):          0000000000000000
Volume Id:             FFFFFFFD8311BD00
File Id:               0000000000000C54
Cache File Block:      FFFFFFFD82CEA2A0
Process (PCB):         FFFFFFFF818FA500
```

This example shows output of a full display of a context block for a read I/O.

SHOW EXTENT

Displays the contents of an extent control block (ECB).

Format

SHOW EXTENT address

Parameter

address
The address of the ECB.

Qualifiers

None.

Description

The SHOW EXTENT command diplays the contents of an extent control block (ECB). The data in the cache is divided into groups of VBNs called extents. Each extent is maintained in a data structure called an extent control block.

Example

```
SDA> XFC SHOW EXTENT FFFFFFFD82A58A20

Cache Extent Address:  FFFFFFFD82A58A20
Type:                  Primary
Flink:                 FFFFFFFF7F880350
Blink:                 FFFFFFFF7F880350
Start VBN:             00000001 (        1)
Start LBN:             00BA711C (  12218652)
Length in Blocks:      00000006 (        6)
Data State:            Clean
Pin:                   None
Buffer Address:        FFFFFFFDB0996000
Secondary ECB Queue:   FFFFFFFD82A58A60
    Flink:               FFFFFFFD83199A20
    Blink:               FFFFFFFD83199A20
Primary ECB:           0000000000000000
LRU Queue:             FFFFFFFD82A58AAC
    Flink:               FFFFFFFD82A5A26C
    Blink:               FFFFFFFD82A5344C
Waiters Queue:         FFFFFFFD82A58A50
    Flink:               FFFFFFFD82A58A50
    Blink:               FFFFFFFD82A58A50
Lock Id:               00000000
Parent CFB:            FFFFFFFD82A61180
ECB delete pending     False
ECB on LRU queue       True
ECB depose pending     False
ECB read ahead         False
LRU priority:             1
```

This example shows the contents of an extent control block.

SHOW FILE

Displays the contents of the cache file block (CFB).

Format

SHOW FILE [address] [/EXTENTS | /ID=*file-id*
| /CVB=*address* | /OPEN | /CLOSED | /STATISTICS | /FULL
| /BRIEF]

Parameter

address
The address of the CFB. The /OPEN and /CLOSED qualifiers, if present, are ignored. If no address is supplied, then all the CFBs are displayed.

Qualifiers

/BRIEF
Displays summary information for each cache file block (CFB), such as the CFB address, cache volume block (CVB) address, access count, active I/O count, and file ID.

/CLOSED
Displays only CFBs whose access count is zero.

/CVB=*address*
Displays only information about any files matching the given cache volume block address.

/EXTENTS
Displays the cache extents held in cache for any displayed files. This shows the primary and secondary cache extents along with their data state and virtual block numbers (VBNs). It also shows a summary of memory usage (pagelets used and pagelets valid) for any displayed files. The /EXTENTS qualifier is incompatible with the /BRIEF qualifier.

/FULL
Displays all fields for each cache file block. This is the default.

/ID=*file-id*
Displays only information about any files matching the given file-identification (FID). The file identification (FID) is the hexadecimal file number component in a format file ID (file number, sequence number, relative volume number).

/OPEN
Displays only CFBs whose access count is greater than zero.

/STATISTICS
Displays more statistics about the specified file. The /STATISTICS qualifier is incompatible with the /BRIEF qualifier.

Description

The SHOW FILE command displays the contents of the XFC cache file block. The state of any file in the cache is maintained in a data structure called a cache file block (CFB). There is a CFB for every open file on a system and a CFB for each closed file that is still being cached.

Examples

```
1. SDA> XFC SHOW FILE/BRIEF

XFC Cache File Block brief listing
----------------------------------
CFB Address      CVB Address      Volume Name            File ID  Access   Write   Total   Read     Hit  Extent  Allocated
                                                                   Count  Access    I/Os   Hits    Rate   Count      Pages
FFFFFFFD831A24C0 FFFFFFFD831FE080 DISK$FRROOG_RUBY     (899,4,0)       1       0      14      6  42.86%      13         13
FFFFFFFD8319EF60 FFFFFFFD831FE080 DISK$FRROOG_RUBY    (2098,4,0)       1       0       1      0   0.00%       1          1
FFFFFFFD831E97E0 FFFFFFFD831FE080 DISK$FRROOG_RUBY    (2336,4,0)       1       0      10      3  30.00%       4          4
FFFFFFFD831F3C20 FFFFFFFD831FE080 DISK$FRROOG_RUBY     (423,4,0)       1       0       2      0   0.00%       3          3
FFFFFFFD831104C0 FFFFFFFD831FE080 DISK$FRROOG_RUBY     (904,4,0)       1       0       6      0   0.00%       3          3
FFFFFFFD831F04C0 FFFFFFFD831FE080 DISK$FRROOG_RUBY     (426,4,0)       1       0       2      0   0.00%       4          4
FFFFFFFD8318FA00 FFFFFFFD831FE080 DISK$FRROOG_RUBY    (2338,4,0)       1       0     141    101  71.63%     131        131
FFFFFFFD831F0080 FFFFFFFD831FE080 DISK$FRROOG_RUBY     (427,4,0)       1       0       2      0   0.00%       4          4
.
.
.
```

VM-1056A-AI

This example shows the brief output from this command.

```
2. SDA> XFC SHOW FILE/STATISTICS FFFFFFFD831A24C0

Full Cache File Block (CFB) Details
-----------------------------------
CFB Address:           FFFFFFFD831A24C0
CFB Address:           FFFFFFFD831A24C0
Flink:                 FFFFFFFD831A22C0
Blink:                 FFFFFFFD831A2700
Access Count:                   1
Write Access Count:             0
Volume (CVB):          FFFFFFFD831FE080
Quiescing:             False
File (FCB):            FFFFFFFF81943D80
Volume Id:             FFFFFFFD831FE080
File Id:               0000000000000383
External FID:          (899,4,0)
Predicted Next VBN:    000000FB (       251)
Active Caching Mode:   Write Through
Active I/O count:               0
Flush Fail Status:     00000000 (         0)
No Readahead Reasons:           0
Active Readaheads:              0
File Bad:              False
Caching disabled:      False
File deleted on close: False
File Quiescing:        False
File Deposing:         False
File Deleting:         False
File BlkASTInProg:     False
File IgnoreBlkAST      False
File Readahead EOF     False
PECBs Allocated:               13 (        13 pages)
PECBs Deallocated:              0
PECBs Deallocated:              0
SECBs Allocated:                3
SECBs Deallocated:             19
Lock Id:               0C00037F
   Granted Lock mode:  PRMode
   Conversion phase:   Illegal
Conversion phase count:         1
```

```
Hash Bucket Queue:     FFFFFFFD831A2520
    Flink:               FFFFFFFF7FF819B0
    Blink:               FFFFFFFF7FF819B0
PECB Queue:            FFFFFFFD831A2530
    Flink:               FFFFFFFD8311888C
    Blink:               FFFFFFFD831A072C
Stalled IOs Queue:     FFFFFFFD831A24F0
    Flink:               FFFFFFFD831A24F0
    Blink:               FFFFFFFD831A24F0
FAL transition Queue:  FFFFFFFD831A2500
    Flink:               FFFFFFFD831A2500
    Blink:               FFFFFFFD831A2500
Contexts Waiting:      FFFFFFFD831A2510
    Flink:               FFFFFFFD831A2510
    Blink:               FFFFFFFD831A2510
BlkASTs Waiting:       FFFFFFFD831A2540
    Flink:               FFFFFFFD831A2540
    Blink:               FFFFFFFD831A2540
Deaccess Wait List:    FFFFFFFD831A2600
    Flink:               0000000000000000
Quiesce context:       0000000000000000
Up convert context:    0000000000000000
File IO Statistics - all in decimal
-----------------------------------
Statistics Valid From:   19-APR-2002 07:10:32.77

Total QIOs to this file:               14
Read IOs to this file:                 14
Write IOs to this file:                 0
Write IOs to this file:                 0
Read Hits:                              6
Hit Rate:                           42.86 %
Average Overall I/O response time to this file
 in milliseconds:                   0.9525
Average Cache Hit I/O response time to this file
 in milliseconds:                   0.0702
Average Disk I/O response time to this file
 in milliseconds:                   1.6141
Accuracy of I/O resp time:                 65 %
Read Ahead Count:                       0
Read Through Count:                    14
Write Through Count:                    0
Read Around Count:                      0
Write Around Count:                     0
CFB FAL stalls:                         1
CFB Operation stalls:                   0
FAL Blocking ASTs:                      0
Quiesce Depose:                         0
Quiesce depose Stalls:                  0

(I/O size statistics not collected for this file)

Files found: 1
```

This example shows a collection of performance statistics for a file.

SHOW MEMORY

Displays information about memory used by the cache.

Format

SHOW MEMORY [/BRIEF | /FULL]

Parameters

None.

Qualifiers

/BRIEF
Displays summary statistics on XFC memory use.

/FULL
Displays full statistics on XFC memory use.

Examples

1.
```
SDA> XFC SHOW MEMORY

XFC Memory Statistics
---------------------
Pool allocation calls          : 430
Pool allocation failures       : 0
Pool deallocation calls        : 0

Page allocation calls          : 2745
Page deallocation calls        : 6

Cache VA Regions and Limits
---------------------------
Cache VA region from FFFFFFFD80000000 to FFFFFFFF80000000 ( 1048576 pages)

  permanent area   : FFFFFFFD80000000 to FFFFFFFDBE800000 (  128000 pages)
            pool   : FFFFFFFD80000000 to FFFFFFFD83200000 (    6400 pages)
            data   : FFFFFFFD83200000 to FFFFFFFDBE800000 (  121600 pages)

  dynamic area     : FFFFFFFDBE800000 to FFFFFFFF7F780000 (  919488 pages)
          pool     : FFFFFFFDBE800000 to FFFFFFFDD4F2C000 (   45974 pages)
          data     : FFFFFFFDD4F2C000 to FFFFFFFF7F780000 (  873514 pages)

  extent hash table: FFFFFFFF7F780000 to FFFFFFFF7FF80000 (    1024 pages)
  file hash table  : FFFFFFFF7FF80000 to FFFFFFFF80000000 (      64 pages)
  file hash table  : FFFFFFFF7FF80000 to FFFFFFFF80000000 (      64 pages)

qhdPermanentPoolFreePages       : FFFFFFFF80D305B8
qhdPermanentDataFreePages       : FFFFFFFF80D305C8
Non-Paged Pool allocated        : 45248 (44.1 KB)
Non-Paged Pool number of - FKBs :      403
Non-Paged Pool number of - DBMs :        3
Non-Paged Pool number of - CTXs :       10
Current Maximum Cache Size      : 8589934592 (8.0 GB)
Boottime Maximum Cache Size     : -1

Permanent Data Pages: Allocated :   121600
                      In use    :     2739
          Pool Pages: Allocated :     6400
                      In use    :      128
```

```
Dynamic Pages: Max Allowed      :   919488
               Allocated        :        0
               In use           :        0
               Min Allowed      :    20971
   Data Pages: Allowed          :   873514
               In use           :        0
   Pool Pages: Allowed          :    45974
               In use           :        0
                  PFN List      :        0
                  Non PFN List  :        0

Total Cache Memory (bytes)      : 1048621248 (1000.0 MB)

Private PFN List Stats
----------------------
Dynamic Area PFN List           : FFFFFFFF818EB340
Free physical pages on list     : 0
Pages attributed to this list   : 0
Pages being requested for return: 0
List priority                   : 0
Callback routine                : 80DF8A40
Free PFN queue head             : FFFFFFFF818EB350
  First free page               : 0000000000000000
  Last free page                : 0000000000000000

MMG Callback Counters
---------------------
MMG callback active             : 0
MMG callback count              : 0
MMG callback requeues           : 0
MMG callback requeue again      : 0
Expand attempts callback active : 0
Pages reclaimed                 : 0
Trim reclaim attempts           : 0
LRU depose calls TrimWorkingSet : 0
Zone Purges: Permanent          : 0
             Dynamic PFNLST     : 0
             Dynamic No PFNLST  : 0

Pool Zone Stats (S2 Space)        Permanent    Dynamic
SECB: Size 112,  PerPage 71
    Pages / MaxPages           12 / 6400     |||   0 /  45974
    FreePkts / TotalPkts       64 /  852     |||   0 /      0
    Hits                     5499            |||   0
    Not first page             0             |||   0
    Misses (expns/fails)       12 (   12 /0) |||   0 (      0 /        0)

PECB: Size 176,  PerPage 45
    Pages / MaxPages           85 / 6400     |||   0 /    45974
    FreePkts / TotalPkts        6 / 3825     |||   0 /        0
    Hits                     3740            |||   0
    Not first page             0             |||   0
    Misses (expns/fails)       85 (   85 /0) |||   0 (        0 /        0)

CFB: Size 544,  PerPage 14
    Pages / MaxPages           29 / 6400     |||   0 /    45974
    FreePkts / TotalPkts        3 /  406     |||   0 /        0
    Hits                      488            |||   0
    Not first page             0             |||   0
    Misses (expns/fails)       29 (   29 /0) |||   0 (        0 /        0)

CVB: Size 608,  PerPage 13
    Pages / MaxPages            2 / 6400     |||   0 /    45974
    FreePkts / TotalPkts       12 /   26     |||   0 /        0
    Hits                       12            |||   0
    Not first page             0             |||   0
    Misses (expns/fails)        2 (    2 /0) |||   0 (        0 /        0)
```

```
IOSIZE: Size 3120,  PerPage 2
    Pages / MaxPages            0 / 6400     |||  0 /    45974
    FreePkts / TotalPkts        0 /    0     |||  0 /        0
    Hits                        0            |||  0
    Not first page              0            |||  0
    Misses (expns/fails)        0 (    0 /0) |||  0 (        0 /        0)
```

This example shows the full output from this command.

2. `SDA> XFC SHOW MEMORY/BRIEF`

```
XFC Memory Summary
------------------
Current Maximum Cache Size      : 8589934592 (8.0 GB)
Boottime Maximum Cache Size     : -1

Permanent Data Pages: Allocated :   121600
                      In use    :     2739
          Pool Pages: Allocated :     6400
                      In use    :      128

Dynamic Pages: Max Allowed      :   919488
               Allocated        :        0
               In use           :        0
               Min Allowed      :    20971
   Data Pages: Allowed          :   873514
               In use           :        0
   Pool Pages: Allowed          :    45974
               In use           :        0
                  PFN List      :        0
                  Non PFN List  :        0

Total Cache Memory (bytes)      : 1048621248 (1000.0 MB)
```

This example shows the brief output from this command.

SHOW SUMMARY

Displays general information about the Extended File Cache.

Format

SHOW SUMMARY [/STATISTICS]

Parameters

None.

Qualifier

/STATISTICS
Displays read and write activity arranged by I/O size.

Example

```
SDA> XFC SHOW SUMMARY

XFC Summary
-----------
Extended File Cache V1.0 Let unk I/Os through (Apr 18 2002 15:01:16)
Anchor Block Address:             FFFFFFFF80D30210
Build Id:
Cache State:                      0000A010
Cache in no-cache state:          False
MaxAllowedCacheMode:              eNodeFullXFC
Minimum cache size in Pages:      0001F400 (    128000)

General
-------
Extent Hash Table Address:        FFFFFFFF7F780000
Extent Hash Table Buckets:            524287
File Hash Table Address:          FFFFFFFF7FF80000
File Hash Table Buckets:               32767
Count of private CTXs:                    10
Count of private FKBs:                   403
Count of private DIOBMs:                   3

LRU
---
LRU Priority 0 Queue Address:     FFFFFFFF80D30288
               Queue Length:      00000446 (      1094)
LRU Priority 1 Queue Address:     FFFFFFFF80D30298
               Queue Length:      00000AA5 (      2725)
qhdContexts Address               FFFFFFFF80D302B0
qhdIRPs Address                   FFFFFFFF80D302C0

Spinlock
--------
Cache Spinlock:                   8125E780
  Last Acquiring Module:          ROOT$:[XFC.TMPSRC]XFC_SYS.C;4
       Acquiring Line:            2887
       Acquiring IPL:             0
```

```
Cache Tracing
-------------
Number of trace entries:               10000
Size of trace buffer:                 800000
Current trace level:                       4
Lost trace entrys:                         0
Current trace sequence number:        318768

System Wide I/O Statistics since last reset
-------------------------------------------
Time of Last System-Wide Reset:   19-APR-2002 07:10:23.43

Total cache calls:                    4505
Total cache calls:                    4505
 - Sum of Paging I/Os:                2493
 - and other QIOs:                    2012
 - and NoCVB or PermNoCache QIOs:        0

Total Virtual Reads:                  4197
Total Virtual Writes:                  112
Total PageIOs not cached:              196
Total Logical I/Os:                      0
Total Physical I/Os:                     0
Total bypass write I/Os:                 0

Synchronous I/O completions:           598
Physical I/O completions:                0
Total PID completion I/Os:               0

Total num IOs on reserved files:      1606
Total num IOs on global sections:      247
Count of stalls performed:              13

System Wide Read Percentage:         97.40 %
System Wide Cache Hit ratio:         57.90 %

System-Wide Read Statistics since last reset
--------------------------------------------
Virtual Reads:                        4197
  Sum of Read Around Count:            179
  and Read Through Count:             4018
Reads Completed:                      4197
Read Hits:                            2495
Read Cache Hit Percentage:           59.45 %
Total Synch Completion Count:          598
Read Around due to Het. Cluster:         0
Read Around due to Modifiers:            0
Read Around due to Size:                16
Total reads past EOF:                    1
Total I/Os with read-ahead:            239
Read Hits due to read-ahead:           307
Paging I/Os:                          2493

System-Wide Write Statistics since last reset
---------------------------------------------
Virtual Writes:                        112
  Sum of Write Around Count:             0
  and Write Through Count:             112
Write Around due to Het. Cluster:        0
Writes Completed:                      112
Write Around due to Modifiers:           0
Write Around due to Size:                0
Total writes past EOF:                   0
```

```
File/Volume Statistics
----------------------
Open Files:                                  239
Closed Files in the Cache:                   164
Number of files truncated:                     3
Volumes in Full XFC Mode:                      0
Volumes in VIOC Compatible Mode:              13
Volumes in No Caching Mode:                    1
Volumes in Perm. No Caching Mode:              0
Volume Queue:                     FFFFFFFF80D30238

File/Volume Statistics
----------------------
FAL locks currently held:                    370
FAL locks chosen to skip:                      0
FAL locks acquired since boot:               374
FAL locks released since boot:                 4
FAL locks converted:                          55

I/Os that have stalled for FAL                 0
CACHE$ACCESS stalls for CFB                    0
ulStallOpQStalls                               1
Read-thro->Read-around conv.                   0
Writes converted to write-around               0
ulLockResourceExhaustionRetries:               0
ulFALLocksEverInContention:                    3
ulFALUpConversionRequests:                     3
ulFALLocksConvertedToPR:                       0
ulFALLocksConvertedToNL:                       0
FAL BlkASTs received:                          1
FAL BlkASTs ignored:                           0
ECBs Split Right:                           2229
ECBs Split Left:                            1710
ECBs Split Three Ways:                       786
ECBs Requiring no splits:                   5802

Volume Lock Statistics
----------------------
VIL Blocking ASTs received                     0
VIL Blocking ASTs stalled                      0
VIL Blocking ASTs started                      0
VIL Blocking ASTs completed                    0
VIL Up-conversion requests made                0
VIL Up-conversion grants                       0
VCML Blocking ASTs received                    0
VCML Blocking ASTs stalled                     0
VCML Blocking ASTs started                     0
VCML Blocking ASTs completed                   0
VCML Up-conversion requests made               0
VCML Up-conversion grants                      0
Stalls on VCML up-conversion                   0
Restarts on VCML up-conversion                 0

Quiesce and Depose Statistics
-----------------------------
Quiesce and Depose files Stalled:              0
File Quiesce and Deposes Started:            114
File Quiesce and Deposes Cmpltd:             114
File Quiesce and Deposes Cmpltd:             114
Q&D CTX used count:                            0
Q&D CTX in use:                   False
```

```
Most recent Depose time                     0.0005 msec.
Most recent Depose ECB count                0
Maximum Depose time                         0.1125 msec.
Maximum ECBs deposed                        3
Total Depose time                           0.0002 seconds
Total ECBs deposed                          6

Pending Lock Up-conversion Statistics
-------------------------------------
Up-conversions stalled:                     0
Up-conversions started:                     0
```

This example shows the output of detailed statistics and status for the cache.

SHOW TABLES

Displays both the extent hash table (EHT) and the file hash table (FHT).

Format

SHOW TABLES [/ALL][/EXTENT][/FILE][/SUMMARY]

Parameters

None.

Qualifiers

/ALL
Displays the contents of the extent hash table (EHT) and file hash table (FHT). This is the default.

/EXTENT
Displays only the contents of the EHT.

/FILE
Displays only the contents of the FHT.

/SUMMARY
Displays summary information about EHT and FHT.

Description

The SHOW TABLES command outputs information about the two hash tables used by XFC to locate key data structures.

Example

```
SDA> XFC SHOW TABLES/SUMMARY

Full Map of CFB HashTable
-------------------------
FHT: Contents of 32768 buckets

 0(32366)
 1(401)
 2(1)
Total number of CFBs:    403
Longest chain length:    2
Shortest chain length:   0
Shortest chain length:   0
Average chain length:        0.01

Full Map of PECB HashTable
--------------------------
EHT: verifying 524288 buckets
```

```
 0(520501)
 1(3755)
 2(32)
Total number of PECBs:   3819
Longest chain length:    2
Shortest chain length:   0
Average chain length:        0.01
```

This example shows summary output about each of the hash tables.

SHOW TRACE

Displays all or selected portions of the XFC trace buffer, starting with the most recent entry and moving backward in time.

Format

SHOW TRACE [/ALL]/CONTAINING=*value* | /CPU=*cpu-num*
| /LINENUMBER=*linenumber*
| /MATCH [=[AND | OR]] | /Px=*value*

Parameters

None.

Qualifiers

/ALL
Displays the entire trace buffer. This is the default.

/CONTAINING=*value*
Displays only records where any of the traced parameters is equal to *value*.

/CPU=*cpu-num*
Displays only records from threads executing on CPU *cpu-num*.

/LINENUMBER=*linenumber*
Displays only records from tracepoints at line *linenumber* in the relevant source files.

/MATCH [=AND | OR]
Alters the sense of the match condition when more than one of the filter qualifiers /CPU, /LINENUMBER, /FILENAME, /Px, or /CONTAINING are specified.

/Px=*value*
Displays only records where one of the traced parameters P1, P2, P3, or P4 is equal to *value*.

Description

The SHOW TRACE command outputs the contents of each entry in the XFC trace buffer. Currently, detailed XFC tracing is enabled only for debug versions of XFC.

Example

```
SDA> XFC SHOW TRACE

XFC Trace Buffer
----------------
Sequence    Time   Label                              Line  C I P1               P2               P3               P4
     319011 19-APR 09:11:16.70 SYS $IOPOST p1, p2, p3  8811  0 4 000000000001000C 0000000000000200 00000010B9BFF800 000002000087A72D
     319010 19-APR 09:11:16.70 SYS $IOPOST            8803  0 4 FFFFFFFF81987940 0000000000000002 000000000000600B FFFFFFFF8150F200
     319009 19-APR 09:11:16.69 Sys LOGIO              5305  3 2 0000000000000000 0000000000088000 0000000000000009 0000000000000010
     319008 19-APR 09:11:16.69 Sys Logical_IO1        4989  3 2 0000000000088000 0000000000000000 FFFFFFFF8150F200 FFFFFFFF81905100
     319007 19-APR 09:11:16.69 Sys Logical_IO         4981  3 2 FFFFFFFF81987940 FFFFFFFFB9BFF800 0000000000000200 000000000087A72D
     319006 19-APR 09:11:16.69 Mem FreeContext        1829  3 8 FFFFFFFF81905910 FFFFFFFF81905F80 0000000000000000 0000000000000000
     319005 19-APR 09:11:16.69 Sys eiopCloseComplete  8276  3 8 FFFFFFFF81905910 FFFFFFFD831853A0 0000000000000000 0000000000000000
     319004 19-APR 09:11:16.69 Common Restart CFBW    332   3 8 FFFFFFFD831853A0 0000000000000000 0000000000000003 0000000000000000
     319003 19-APR 09:11:16.69 Sys eiopCloFlushed     7700  3 8 FFFFFFFF81905910 FFFFFFFD831853A0 0000000000000000 0000000000000000
     319002 19-APR 09:11:16.69 Sys eiopCloseInit      7659  3 8 FFFFFFFF81905910 FFFFFFFD831853A0 0000000000000000 0000000000000000
.
.
.
```

VM-1057A-AI

This example shows the output of XFC trace information.

SHOW VOLUME

Displays the contents of a cache volume block (CVB).

Format

SHOW VOLUME [address]/BRIEF | /FULL | /NAME=*DISK$volume_label* |
/STATISTICS

Parameter

address
The address of a CVB. If no address is supplied, then all volumes are displayed.

Qualifiers

/BRIEF
Displays summary information for each volume.

/FULL
Displays a complete list of information about each volume. This is the default.

/NAME=DISK$volume_label
Displays information for the volume with the specified name.

/STATISTICS
Displays the read and write I/O activity for this volume. The /STATISTICS qualifier is incompatible with the /BRIEF qualifier.

Description

The SHOW VOLUME command shows state information and statistics about all volumes mounted on the system.

Examples

```
1. SDA> XFC SHOW VOLUME/BRIEF

Summary of XFC Cached Volumes (CVBs)
------------------------------------
Volume Name       CVB               Open    Closed         Total      Read   Read     Write      ... Response (Milliseconds)...
                                   Files     Files          I/Os      Hits  Count     Count          Hits       disk    Average
DISK$SNKRNET      FFFFFFFD8311C080     0         0             0         0      0         0
DISK$FRROOGSYS    FFFFFFFD831FFD00     0         0             0         0      0         0
DISK$V73_DENBO2   FFFFFFFD831FFAA0     0         0             0         0      0         0
DISK$DENBO2_V73   FFFFFFFD831FF840     0         1             1         0      1         0        0.0000    14.2451    14.2451
DISK$VEALSYS      FFFFFFFD831FF5E0     0         0             0         0      0         0
DISK$SCRATCH2     FFFFFFFD831FF380     0         0             0         0      0         0
DISK$SCRATCH1     FFFFFFFD831FF120     0         0             0         0      0         0
DISK$BRAMHA_SCR   FFFFFFFD831FEEC0     0         0             0         0      0         0
DISK$COMMON       FFFFFFFD831FEC60     0         0             0         0      0         0
DISK$X907_BRAMHA  FFFFFFFD831FEA00     0         0             0         0      0         0
DISK$OLDSYS       FFFFFFFD831FE7A0     0         1             1         0      1         0        0.0000     7.8946     7.8946
DISK$RAM_FRROOG   FFFFFFFD831FE540     0         0             0         0      0         0
DISK$RMSTA2_USER  FFFFFFFD831FE2E0     3         5           115        89    112         3        0.0370    20.7218     4.7135
DISK$FRROOG_RUBY  FFFFFFFD831FE080   236       157          4195      2408   4085       110        0.0789     4.8671     2.1186

Volumes found: 14
```

VM-1058A-AI

This example shows the output derived from invoking the /BRIEF qualifer.

```
2. SDA> XFC SHOW VOLUME FFFFFFFD831FE080

Cache Volume Block (CVB)
------------------------
Statistics Valid From:   19-APR-2002 07:10:23.54

Name:                  DISK$FRROOG_RUBY
CVB Address:           FFFFFFFD831FE080
Flink:                 FFFFFFFF80D30238
Blink:                 FFFFFFFD831FE300
Volume (VCB):          FFFFFFFF81905100
Unit (UCB):            FFFFFFFF8150F200
Files Queue:           FFFFFFFD831FE0C0
    Flink:               FFFFFFFD83111800
    Blink:               FFFFFFFD831FC0A0
Cached Open Files:          236
Cached Closed Files:        157
Files Ever Opened:          502
Files Ever Deposed:         109
Pages Allocated:           2726
Total QIOs:                4195
Read Hit Count:            2408
Virtual Read Count:        4085
Virtual Write Count:        110
Read Percentage:             97 %
Hit Rate:                    57 %
Average Overall I/O response time to this Volume
 in milliseconds:           2.1186
Average Cache Hit I/O response time to this Volume
 in milliseconds:           0.0789
Average Disk I/O response time to this Volume
 in milliseconds:           4.8671
Accuracy of I/O resp time:    83 %
Readahead Count:            233
Volume Caching Mode:   evcmVIOCCompatible
Mounted /NOCACHE:      False    VCML Allows Caching:   True
Quiescing:             False    Quiesce in Progress:   False
No Cache from Logio:   False    VIL Blk AST Stall:     False
Flush Pending:         False    VCML Blk AST Stall:    False
VCML Blk CTX Stall:    False    VIL Blk CTX Stall:     False
Dismount Stall:        False    Logio Stall:           False
Flush in Progress:     False    Cluster Trans Stall:   False
```

```
Dismount Pending:      False     VIL Up Needed:         False
Tqe In Use:            False     VCML Up Needed:        False
VIL blocking AST CTX:  0000000000000000
VCML blocking AST CTX: 0000000000000000
Dismount Stall CTX:    0000000000000000
LogIO Stall CTX:       0000000000000000
Up conversion CTX:     0000000000000000
VIL lock id:           0100007A
VIL LogIO lock id:     00000000
VCML lock id:          010000FF
VCML LogIO lock id:    00000000
Logical IO safety:     elogioNotSafe
LogIOMutex:            00000000818EB610
Last LogIO time:       00000000
Active I/O count:              0
Stalled Ops Queue:     FFFFFFFD831FE0B0
    Flink:               FFFFFFFD831FE0B0
    Blink:               FFFFFFFD831FE0B0

Volumes found: 1
```

This example shows the output for a specific cache volume block (CVB).

8 SDA Extension Routines

This chapter describes how to write, debug, and invoke an SDA Extension. This chapter also describes the routines available to an SDA Extension.

8.1 Introduction

When analysis of a dump file or a running system requires intimate knowledge of data structures that are not known to the System Dump Analyzer, the functionality of SDA can be extended by the addition of new commands into which the necessary knowledge has been built. Note that in this description, whenever a reference is made to accessing a dump file (ANALYZE/CRASH_DUMP), this also includes accessing memory in the running system (ANALYZE/SYSTEM).

For example, a user-written device driver allocates nonpaged pool and records additional data about the device there (logging different types of I/O, perhaps), and a pointer to the new structure is saved in the device-specific extension of the UCB. After a system crash, the only way to look at the data from SDA is to do the following:

- Invoke the SDA command DEFINE to define a new symbol (for example, UCB$L_FOOBAR) whose value is the offset in the UCB of the pointer to the new structure.
- Invoke the SDA commands "SHOW DEVICE <device>" and "FORMAT UCB" to obtain the address of the nonpaged pool structure.
- Invoke the SDA command "EXAMINE <address>;<length>" to display the contents of the data in the new nonpaged pool structure as a series of hexadecimal longwords.
- Decode manually the contents of the data structure from this hexadecimal dump.

An SDA extension that knows the layout of the nonpaged pool structure, and where to find the pointer to it in the UCB, could output the data in a formatted display that alerts the user to unexpected data patterns.

8.2 General Description

The following discussion uses an example of an SDA extension that invokes the MBX command to output a formatted display of the status of the mailbox devices in the system. The source file, MBX$SDA.C, is provided in SYS$EXAMPLES.

An SDA extension consists of a shareable image, in this case MBX$SDA.EXE, either located in the directory SYS$LIBRARY or found by translating the logical name MBX$SDA. It contains two universal symbols: SDA$EXTEND, the entry point; and SDA$EXTEND_VERSION, the address of a longword that contains the version of the interface used (in the format of major/minor ident), which allows SDA to confirm it has activated a compatible extension. The image contains at least two modules: MBX$SDA, the user-written module that defines the two symbols and provides the code and data necessary to produce the desired formatted output; and SDA_EXTEND_VECTOR, which provides jackets for all of the callable SDA routines, and is found in SYS$LIBRARY:VMS$VOLATILE_PRIVATE_INTERFACES.OLB. The user-written portion can be split into multiple modules.

Whenever SDA receives an unrecognized command, like "SDA> MBX", it attempts to activate the shareable image MBX$SDA at the SDA$EXTEND entry point. If you choose a command name that matches the abbreviation of an existing command, SDA can be forced to activate the extension using the "DO" command. For example, if you had an SDA extension called VAL$SDA, you could not activate it with a command like "SDA> VAL" as SDA would interpret that as an abbreviation of its VALIDATE command. But VAL$SDA can be activated by issuing "SDA> DO VAL".

With or without the "DO" prefix, the rest of the command line is passed to the extension; it is up to the extension to parse it. The example extension MBX$SDA includes support for commands of the form "SDA> MBX SUMMARY" and "SDA> MBX <address>" to demonstrate this. If the extension is invoked with no arguments, it should do no more than display a simple announcement message, or prompt for input. This assists in the debugging of the extension, as described in Section 8.4.

8.3 Detailed Description

This section describes how to compile, link, and invoke an SDA extension. It also describes the contents of an SDA extension.

8.3.1 Compiling and Linking an SDA Extension

The user-written module is only supported when written in Compaq C (minimum Version 5.2), following the pattern of the example extension, MBX$SDA.C. It should be compiled and linked using commands of the following form:

```
$cc mbx$sda + alpha$library:sys$lib_c /library
$link /share -
                mbx$sda.obj, -
                alpha$library:vms$volatile_private_interfaces /library, -
                sys$input /option
        symbol_vector = (sda$extend=procedure)
        symbol_vector = (sda$extend_version=data)
```

Note

1. You can include the qualifier /INSTRUCTION=NOFLOAT on the compile command line if floating-point instructions are not needed.

2. The `+ ALPHA$LIBRARY:SYS$LIB_C /LIBRARY` is not needed on the compile command line if the logical name DECC$TEXT_LIBRARY is defined and translates to ALPHA$LIBRARY:SYS$LIB_C.TLB.

3. If the user-written extension needs to signal SDA condition codes, or output their text with $PUTMSG, you should add the qualifier /INCLUDE=SDAMSG to the parameter `ALPHA$LIBRARY:VMS$VOLATILE_PRIVATE_INTERFACES /LIBRARY`.

8.3.2 Invoking an SDA Extension

You can invoke the SDA extension as follows:

```
$define mbx$sda sys$disk:[]mbx$sda
$analyze /system
SDA>mbx summary
SDA>mbx <address>
```

8.3.3 Contents of an SDA Extension

At a minimum, the user-written module must contain:

- #include statements for DESCRIP.H and SDA_ROUTINES.H
- The global variable SDA$EXTEND_VERSION, initialized as follows:

  ```
  int sda$extend_version = SDA_FLAGS$K_VERSION;
  ```

- The routine SDA$EXTEND (prototype follows)

Optionally, the user-written module may also contain the statement:

```
#define __NEW_STARLET
```

You should use this option because it provides type checking of function arguments and gives consistency in casing and naming conventions.

The entry point in the user-written module, SDA$EXTEND, is called as a routine with three arguments and no return value. The declaration is as follows:

```
void sda$extend (
        int *transfer_table,
        struct dsc$descriptor_s *cmd_line,
        SDA_FLAGS sda_flags)
```

The arguments in this code example have the following meanings:

Line of Code	Meaning
transfer_table	Address of the vector table in the base image. The user-written routine SDA$EXTEND must copy this to SDA$EXTEND_VECTOR_TABLE_ADDR before any SDA routines can be called.
cmd_line	Address of the descriptor of the command line as entered by the user, less the name of the extension. So, if you enter "SDA> MBX" or "SDA> DO MBX", the command line is a zero length string. If you enter the command "SDA> MBX 80102030", the command line is " 80102030" (the separating space is not stripped).
sda_flags	Definition for the following four bits in this structure:

Bit	Meaning
sda_flags.sda_flags$v_override	Indicates SDA has been activated with the ANALYZE/CRASH_DUMP/OVERRIDE command
sda_flags.sda_flags$v_current	Indicates SDA has been activated with the ANALYZE/SYSTEM command
sda_flags.sda_flags$v_target	Indicates that SDA was invoked from the kept debugger during an SCD or SDD session or when analyzing a process dump
sda_flags.sda_flags$v_process	Indicates SDA was activated with the ANALYZE/CRASH_DUMP command to analyze a process dump
No bits set	Indicates SDA was activated with the ANALYZE/CRASH_DUMP command to analyze a system dump

The first executable statement of the routine must be to copy TRANSFER_TABLE to SDA$VECTOR_TABLE (which is declared in SDA_ROUTINES.H):

```
sda$vector_table = transfer_table;
```

If this is not done, you cannot call any of the routines described below. Any attempts to call the routines receive a status return of SDA$_VECNOTINIT. (For routines defined not to return a status, this value can be found only by examining R0.)

The next statement should be one to establish a condition handler, as it is often difficult to track down errors in extensions such as access violations because the extension is activated dynamically with LIB$FIND_IMAGE_SYMBOL. A default condition handler, SDA$COND_HANDLER, is provided that outputs the following information in the event of an error:

- The error condition
- The VMS version
- A list of activated images, with start and end virtual addresses

- The signal array and register dump
- The current call frame chain

You can establish this condition handler as follows:

```
lib$establish (sda$cond_handler);
```

Note

The error condition, signal array, and register dump are output directly to SYS$OUTPUT and/or SYS$ERROR, and are not affected by the use of the SDA commands SET OUTPUT and SET LOG.

Thus, a minimal extension would be:

```
#define __NEW_STARLET 1
#include <descrip.h>
#include <sda_routines.h>

int sda$extend_version = SDA_FLAGS$K_VERSION;

void sda$extend (int *transfer_table,
                 struct dsc$descriptor_s *cmd_line,
                 SDA_FLAGS sda_flags)
  {
  sda$vector_table = transfer_table;
  lib$establish (sda$cond_handler);

  sda$print ("hello, world");
  return;
  }
```

8.4 Debugging an Extension

In addition to the "after-the-fact" information provided by the condition handler, you can debug SDA extensions using the OpenVMS Debugger. A second copy of the SDA image, SDA_DEBUG.EXE, is provided in SYS$SYSTEM. By defining the logical name SDA to reference this image, you can debug SDA extensions as follows:

- Compile your extension /DEBUG/NOOPT and link it /DEBUG.
- Define logical names for SDA and the extension, and invoke SDA.
- Type GO at the initial DBG> prompt.
- Invoke the extension with no argument at the initial SDA> prompt.
- Return control to Debug at the next prompt (either from SDA or the extension).
- Use Debug commands to set breakpoints, and so on, in the extension and then type GO.
- Invoke the extension, providing the necessary arguments.

An example of the preceding steps is as follows:

```
$ cc /debug /noopt mbx$sda + alpha$library:sys$lib_c /library
$ link /debug /share -
        mbx$sda.obj, -
        alpha$library:vms$volatile_private_interfaces /library, -
        sys$input /option
symbol_vector = (sda$extend=procedure)
symbol_vector = (sda$extend_version=data)
$ !
$ define mbx$sda sys$disk:[]mbx$sda
$ define sda sda_debug
$ analyze /system
...
DBG> go
...
SDA> mbx
MBX commands: 'MBX SUMMARY' and 'MBX <address>'
SDA>
^C <CR>
DBG> set image mbx$sda
DBG> set language c
DBG> set break /exception
DBG> go
SDA> mbx summary
...
SDA> mbx <address>
...
%DEBUG-I-DYNMODSET, setting module MBX$SDA
%SYSTEM-E-INVARG, invalid argument
...
DBG>
```

8.5 Callable Routines Overview

The user-written routine may call SDA routines to accomplish any of the following tasks:

- Read the contents of memory locations in the dump.
- Translate symbol names to values and vice-versa, define new symbols, and read symbol table files.
- Map an address to the activated image or executive image that contains that address.
- Output text to the terminal, with page breaks, page headings, and so on (and which is output to a file if the SDA commands SET OUTPUT or SET LOG have been used).
- Allocate and deallocate dynamic memory.
- Validate queues/lists.
- Format data structures.
- Issue any SDA command.

The full list of available routines is as follows:

SDA$ADD_SYMBOL
SDA$ALLOCATE
SDA$DBG_IMAGE_INFO
SDA$DEALLOCATE
SDA$DISPLAY_HELP
SDA$ENSURE
SDA$FORMAT
SDA$FORMAT_HEADING
SDA$GET_ADDRESS
SDA$GET_BLOCK_NAME
SDA$GET_BUGCHECK_MSG
SDA$GET_CURRENT_CPU
SDA$GET_CURRENT_PCB
SDA$GET_DEVICE_NAME
SDA$GET_HEADER
SDA$GET_HW_NAME
SDA$GET_IMAGE_OFFSET
SDA$GET_INPUT
SDA$GET_LINE_COUNT
SDA$GETMEM
SDA$INSTRUCTION_DECODE
SDA$NEW_PAGE
SDA$PARSE_COMMAND
SDA$PRINT
SDA$READ_SYMFILE
SDA$REQMEM
SDA$SET_ADDRESS
SDA$SET_CPU
SDA$SET_HEADING_ROUTINE
SDA$SET_LINE_COUNT
SDA$SET_PROCESS
SDA$SKIP_LINES
SDA$SYMBOL_VALUE
SDA$SYMBOLIZE
SDA$TRYMEM
SDA$TYPE
SDA$VALIDATE_QUEUE

The details of all these routines follow. But there are some points to be aware of in using them:

- There are three different routines available to read the contents of memory locations in the dump: SDA$TRYMEM, SDA$GETMEM, and SDA$REQMEM. They are used as follows:

  SDA$TRYMEM is called from both SDA$GETMEM and SDA$REQMEM as the lower-level routine that actually does the work. SDA$TRYMEM returns success/failure status in R0, but does not signal any errors. Use it directly when you expect that the location being read may be inaccessible. The caller of SDA$TRYMEM will handle this situation by checking the status returned by SDA$TRYMEM.

  SDA$GETMEM signals a warning when any error status is returned from SDA$TRYMEM. Signaling a warning will print out a warning message, but does not abort the SDA command in progress. You should use this routine when you expect the location to be read to be accessible. This routine does not prevent the command currently being executed from continuing. The caller of SDA$GETMEM must allow for this by checking the status returned by SDA$GETMEM.

  SDA$REQMEM signals an error when any error status is returned from SDA$TRYMEM. Signaling an error will print out an error message, abort the SDA command in progress and return to the "SDA>" prompt. You should use this routine when you expect the location to be read to be accessible. This routine will prevent the command currently being executed from continuing. The caller of SDA$REQMEM will not resume if an error occurs.

- You should use only the routines provided to output text. Do not use printf( ) or any other standard routine. If you do, the SDA commands SET OUTPUT and SET LOG will not produce the expected results. Do not include control characters in output (except tab); in particular, avoid <CR>, <LF>,<FF>, and the FAO directives that create them. Use the FAO directive !AF when contents of memory returned by SDA$TRYMEM, and so on, are being displayed directly, because embedded control characters will cause undesirable results. For example, displaying process names or resource names that contain particular control characters or escape sequences can lock up the terminal.
- You should use only the routines provided to allocate and deallocate dynamic memory. Do not use malloc( ) and free( ). Where possible, allocate dynamic memory once, the first time the extension is activated, and deallocate it only if it needs to be replaced by a larger allocation. Because SDA commands can be interrupted by invoking another command at the "Press return for more" prompt, it is very easy to cause memory leaks.
- Some routines expect 32-bit pointers, and others expect 64-bit pointers. At first this not may appear to be logical, but in fact it is. All code and data used by SDA and any extensions must be in P0 or P1 space, as SDA does not need to (and does not) use P2 space for local data storage. However, addresses in the system dump (or running system, in the case of ANALYZE/SYSTEM) are 64-bit addresses, and SDA must provide access to all locations in the dump.

So, for example, the first two arguments to the routine SDA$TRYMEM are:

```
VOID_PQ start   /* 64-bit pointer */

void *dest      /* 32-bit pointer */
```

They specify the address of interest in the dump and the address in local storage to which the dump contents are to be copied.

8.6 Callable Routines Specifics

The following section describes the SDA extension callable routines.

SDA$ADD_SYMBOL

Adds a symbol to SDA's local symbol table.

Format

void sda$add_symbol (char *symbol_name, uint64 symbol_value);

Arguments

symbol_name

OpenVMS usage	char_string
type	character string
access	read only
mechanism	by reference

Address of symbol name string (zero-terminated).

symbol_value

OpenVMS usage	quadword_unsigned
type	quadword (unsigned)
access	read only
mechanism	by value

The symbol value.

Description

SDA maintains a list of symbols and the corresponding values. SDA$ADD_SYMBOL is used to insert additional symbols into this list, so that they can be used in expressions and during symbolization.

Condition Values Returned

None

Example

```
sda$add_symbol ("MBX", 0xFFFFFFFF80102030);
```

This call defines the symbol MBX to the hexadecimal value FFFFFFFF80102030.

SDA$ALLOCATE

Allocates dynamic memory.

Format

void sda$allocate (uint32 size, void **ptr_block);

Arguments

size

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	read only
mechanism	by value

Size of block to allocate (in bytes).

ptr_block

OpenVMS usage	address
type	longword (unsigned)
access	write only
mechanism	by reference

Address of longword to receive address of block.

Description

The requested memory is allocated and the address returned. Note that this is the only supported mechanism for allocation of dynamic memory.

Related Routine

SDA$DEALLOCATE

Condition Values Returned

None

If no memory is available, the error is signaled and the SDA session aborted.

Example

```
PCB *local_pcb;
...
sda$allocate (PCB$C_LENGTH, (void *)&local_pcb);
```

This call allocates a block of heap storage for a copy of a PCB, and stores its address in the pointer LOCAL_PCB.

SDA$DBG_IMAGE_INFO

Displays a list of activated images together with their virtual address ranges for debugging purposes.

Format

void sda$dbg_image_info ();

Arguments

None.

Description

A list of the images currently activated, with their start and end addresses, is displayed. This is provided as a debugging aid for SDA extensions.

Condition Values Returned

None

Example

```
sda$dbg_image_info ();
```

SDA outputs the list of images in the following format:

```
Current VMS Version:   "X6DX-FT1"

     Process Activated Images:

        Start VA  End VA    Image Name
        00010000  000301FF  SDA
        00032000  00177FFF  SDA$SHARE
        7B508000  7B58BFFF  DECC$SHR
        7B2D8000  7B399FFF  DPML$SHR
        7B288000  7B2C9FFF  CMA$TIS_SHR
        7B698000  7B6D9FFF  LBRSHR
        0021A000  0025A3FF  SCRSHR
        00178000  002187FF  SMGSHR
        7B1E8000  7B239FFF  LIBRTL
        7B248000  7B279FFF  LIBOTS
        80C140D0  80C23120  SYS$BASE_IMAGE
        80C036B8  80C05288  SYS$PUBLIC_VECTORS
        002C6000  002D31FF  PRGDEVMSG
        002D4000  002DA9FF  SHRIMGMSG
        002DC000  002DFFFF  DECC$MSG
        00380000  003E03FF  MBX$SDA
```

SDA$DEALLOCATE

Deallocates and frees dynamic memory.

Format

void sda$deallocate (void *ptr_block, uint32 size);

Arguments

ptr_block

OpenVMS usage	address
type	longword (unsigned)
access	read only
mechanism	by value

Starting address of block to be freed.

size

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	read only
mechanism	by value

Size of block to deallocate (in bytes).

Description

The specified memory is deallocated. Note that this is the only supported mechanism for deallocation of dynamic memory.

Related Routine

SDA$ALLOCATE

Condition Values Returned

None

If an error occurs, it is signaled and the SDA session aborted.

Example

```
PCB *local_pcb;
...
sda$deallocate ((void *)local_pcb, PCB$C_LENGTH;
```

This call deallocates the block of length PCB$C_LENGTH whose address is stored in the pointer LOCAL_PCB.

SDA$DISPLAY_HELP

Displays online help.

Format

void sda$display_help (char *library_desc, char *topic_desc);

Arguments

library

OpenVMS usage	char_string
type	character string
access	read only
mechanism	by reference

Address of library filespec. Specify as zero-terminated ASCII string.

topic

OpenVMS usage	char_string
type	character string
access	read only
mechanism	by reference

Address of topic name. Specify as zero-terminated ASCII string.

Description

Help from the specified library is displayed on the given topic.

Condition Values Returned

None

Example

```
sda$display_help ("SYS$HELP:SDA", "HELP");
```

This call produces the following output at the terminal:

```
HELP

     The System Dump Analyzer (SDA) allows you to inspect the contents
     of memory as saved in the dump taken at crash time or as exists
     in a running system. You can use SDA interactively or in batch
     mode. You can send the output from SDA to a listing file. You can
     use SDA to perform the following operations:
```

```
                      Assign a value to a symbol
                      Examine memory of any process
                      Format instructions and blocks of data
                      Display device data structures
                      Display memory management data structures
                      Display a summary of all processes on the system
                      Display the SDA symbol table
                      Copy the system dump file
                      Send output to a file or device
                      Read global symbols from any object module
                      Send output to a file or device
                      Read global symbols from any object module
                      Search memory for a given value

     For help on performing these functions, use the HELP command and
     specify a topic.

     Format

       HELP  [topic-name]


   Additional information available:

   Parameter

 HELP Subtopic?
```

SDA$ENSURE

Ensures sufficient space on the current output page.

Format

void sda$ensure (uint32 lines);

Argument

lines

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	read only
mechanism	by value

Number of lines to fit on a page.

Description

This routine checks and makes sure that the number of lines specified fit on the current page; otherwise, it issues a page break.

Condition Values Returned

None

Example

```
sda$ensure (5);
```

This call ensures that there are five lines left on the current page, and it outputs a page break if there are not.

SDA$FORMAT

Displays the formatted contents of a data structure.

Format

void sda$format (VOID_PQ struct_addr, __optional_params);

Arguments

struct_addr

OpenVMS usage	address
type	quadword (unsigned)
access	read only
mechanism	by value

The address in the system dump of the data structure to be formatted.

options

OpenVMS usage	mask_longword
type	longword (unsigned)
access	read only
mechanism	by value

The following provides more information on options:

Option	Meaning
None	Uses structure type from the xxx$B_TYPE and/or xxx$B_SUBTYPE field of the structure. This is the default.
SDA_OPT$M_FORMAT_TYPE	Uses the structure type given in struct_prefix.
SDA_OPT$M_FORMAT_PHYSICAL	Indicates that struct_addr is a physical address instead of a virtual address.

struct_prefix

OpenVMS usage	char_string
type	character string
access	read only
mechanism	by reference

Address of structure name string (zero-terminated).

Description

This routine displays the formatted content of a data structure that begins at the address specified. If no symbol prefix is passed, then SDA tries to find the symbols associated with the block type specified in the block-type byte of the data structure.

Condition Values Returned

None

Example

```
PCB *local_pcb;
PHD *local_phd;
...
sda$format (local_pcb);
sda$format (local_phd, SDA_OPT$M_FORMAT_TYPE, "PHD");
```

The first call formats the structure whose system address is held in the variable LOCAL_PCB, determining the type from the type and/or subtype byte of the structure. The second call formats the structure whose system address is held in the variable LOCAL_PHD, using PHD symbols.

SDA$FORMAT_HEADING

Formats a new page heading.

Format

void sda$format_heading (char *ctrstr, __optional_params);

Arguments

ctrstr

OpenVMS usage	char_string
type	character-coded text string
access	read only
mechanism	by reference

Address of control string (zero-terminated ASCII string).

prmlst

OpenVMS usage	varying_arg
type	quadword (signed or unsigned)
access	read only
mechanism	by value

FAO parameters that are optional. All arguments after the control string are copied into a quadword parameter list as used by $FAOL_64.

Description

This routine prepares and saves the page heading to be used whenever SDA$NEW_PAGE is called. Nothing is output either until SDA$NEW_PAGE is next called, or a page break is necessary because the current page is full.

Condition Values Returned

None

If the $FAOL_64 call issued by SDA$FORMAT_HEADING fails, the control string is used as the page heading.

Example

```
char hw_name[64];
...
sda$get_hw_name (hw_name, sizeof(hw_name));
sda$format_heading (
       "SDA Extension Commands, system type !AZ",
        &hw_name);
sda$new_page ();
```

This example produces the following heading:

```
SDA Extension Commands, system type DEC 3000 Model 400
------------------------------------------------------
```

SDA$GET_ADDRESS

Gets the address value of the current memory location.

Format

void sda$get_address (VOID_PQ *address);

Argument

address

OpenVMS usage	quadword_unsigned
type	quadword (unsigned)
access	write only
mechanism	by reference

Location to store the current 64-bit memory address.

Description

Returns the current address being referenced by SDA (location ".").

Condition Values Returned

None

Example

```
VOID_PQ current_address;
...
sda$get_address (&current_address);
```

This call stores SDA's current memory location in the long pointer CURRENT_ADDRESS.

SDA$GET_BLOCK_NAME

Returns the name of a structure, given its type and/or subtype.

Format

void sda$extend_get_block_name (uint32 block_type, uint32 block_subtype,
char *buffer_ptr, uint32 buffer_len);

Arguments

block_type

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	read only
mechanism	by value

Block type in range 0 - 255 (usually extracted from xxx$b_type field).

block_subtype

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	read only
mechanism	by value

Block subtype in range 0 - 255 (ignored if the given block type has no subtypes).

buffer_ptr

OpenVMS usage	char_string
type	character string
access	write only
mechanism	by reference

Address of buffer to save block name, which is returned as a zero-terminated string.

buffer_len

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	read only
mechanism	by value

Length of buffer to receive block name.

Description

Given the block type and/or subtype of a structure, this routine returns the name of the structure. If the structure type is one that has no subtypes, the given subtype is ignored. If the structure type is one that has subtypes, and the subtype is given as zero, the name of the block type itself is returned. If an invalid type or subtype (out of range) is given, an empty string is returned.

Note

The buffer should be large enough to accomodate the largest possible block name (25 bytes plus the termination byte). The block name is truncated if it is too long for the supplied buffer.

Condition Values Returned

None

Example

```
char buffer[32];
...
sda$get_block_name (0x6F, 0x20,
        buffer,
        sizeof (buffer));
if (strlen (buffer) == 0)
    sda$print ("Block type: no named type/subtype");
else
    sda$print ("Block type: !AZ", buffer);
```

This example produces the following output:

```
Block type: VCC_CFCB
```

SDA$GET_BUGCHECK_MSG

Gets the text associated with a bugcheck code.

Format

void sda$get_bugcheck_msg (uint32 bugcheck_code, char *buffer_ptr, uint32 buffer_size);

Arguments

bugcheck_code

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	read only
mechanism	by value

The bugcheck code to look up.

buffer_ptr

OpenVMS usage	char_string
type	character string
access	write only
mechanism	by reference

Address of buffer to save bugcheck message.

buffer_len

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	read only
mechanism	by value

Length of buffer to receive message.

Description

Gets the string representing the bugcheck code passed as the argument. The bugcheck message string is passed in the buffer (represented as a pointer and length) as a zero-terminated ASCII string.

Note

The buffer should be large enough to accomodate the largest possible bugcheck message (128 bytes including the termination byte). The text is terminated if it is too long for the supplied buffer.

Condition Values Returned

None

Example

```
char buffer[128];
...
sda$get_bugcheck_msg (0x108, buffer, sizeof(buffer));
sda$print ("Bugcheck code 108 (hex) =");
sda$print ("!_\"!AZ\"", buffer);
```

This example produces the following output:

```
   Bugcheck code 108 (hex) =
               "DOUBLDALOC, Double deallocation of swap file space"
```

SDA$GET_CURRENT_CPU

Gets the CPU database address of the currently selected CPU.

Format

void sda$get_current_cpu (CPU **cpudb);

Arguments

cpudb

OpenVMS usage	address
type	longword (unsigned)
access	write only
mechanism	by reference

Location to which the address of the CPU database is to be returned.

Description

This routine causes SDA to return the address of the database for the currently selected CPU.

Condition Values Returned

None

Example

```
#include  <cpudef>
CPU  *current_cpu;
sda$get_current_cpu  (  &current_cpu  );
```

In this example, the system address of the database for the current CPU is returned in variable *current_cpu*.

SDA$GET_CURRENT_PCB

Gets the PCB address of the "SDA current process" currently selected.

Format

void sda$get_current_pcb (PCB **pcbadr);

Argument

pcbadr

OpenVMS usage	quadword_unsigned
type	quadword (unsigned)
access	write only
mechanism	by reference

Location in which to store the current PCB address.

Description

The PCB address of the process currently selected by SDA is returned in the specified location.

Condition Values Returned

None

Example

```
PCB *current_pcb;
...
sda$get_current_pcb ( &current_pcb );
```

This call stores the system address of the PCB of the process currently being referenced by SDA in the pointer CURRENT_PCB.

SDA$GET_DEVICE_NAME

Gets the device name, given the UCB address of the device.

Format

int sda$get_device_name (VOID_PQ ucb_addr, char *name_buf, int name_len);

Arguments

ucb_addr

OpenVMS usage	address
type	quadword (unsigned)
access	read only
mechanism	by value

System address of the Unit Control Block of the device.

name_buf

OpenVMS usage	char_string
type	character string
access	write only
mechanism	by reference

Address of buffer to receive device name.

name_len

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	read only
mechanism	by value

Length of buffer to receive device name.

Description

This routine creates and returns the name for the device described by the given UCB. The device name is returned as a zero-terminated ASCII string.

Note

The buffer should be large enough to accomodate the largest possible device name (32 bytes including the termination byte). The text is terminated if it is too long for the supplied buffer.

Condition Values Returned

SDA$_SUCCESS	Successful completion
SDA$_NOTAUCB	The address given is not the address of a UCB
SDA$_NOREAD	The data is inaccessible for some reason
Others	The data is inaccessible for some reason

Example

```
VOID_PQ address;
     char buffer[32];
     ...
     sda$parse_command ("SHOW DEVICE DKB0:");
     sda$symbol_value ("UCB", (uint64 *)&address);
     sda$get_device_name ((VOID_PQ)address, buffer, 32);
     sda$print ("UCB address: !XL = ""!AZ:""", address, buffer);
```

This example produces the following output:

```
     UCB address: 814A9A40 = $31$DKB0:
```

SDA$GET_HEADER

Returns pointers to local copies of the dump file header and the error log buffer together with the sizes of those data structures.

Format

void sda$get_header (DMP **dmp_header, uint32 *dmp_header_size, void **errlog_buf, uint32 *errlog_buf_size);

Arguments

dmp_header

OpenVMS usage	address
type	longword (unsigned)
access	write only
mechanism	by reference

Location in which to store the address of the copy of the dump file header held by SDA.

dmp_header_size

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	write only
mechanism	by reference

Location in which to store the size of the dump file header.

errlog_buf

OpenVMS usage	address
type	longword (unsigned)
access	write only
mechanism	by reference

Location in which to store the address of the copy of the error log buffer held by SDA.

errlog_buf_size

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	write only
mechanism	by reference

Location in which to store the size of the error log buffer.

Description

This routine returns the addresses and sizes of the dump header and error logs read by SDA when the dump file is opened. If this routine is called when the running system is being analyzed with ANALYZE/SYSTEM, then the following occurs:

- Returns the address and size of SDA's dump header buffer, but the header contains zeroes
- Returns zeroes for the address and size of SDA's error log buffer

Condition Values Returned

None

Example

```
DMP *dmp_header;
uint32 dmp_header_size;
char *errlog_buffer;
uint32 errlog_buffer_size;
...
sda$get_header (&dmp_header,
        &dmp_header_size,
        (void **)&errlog_buffer,
        &errlog_buffer_size);
```

This call stores the address and size of SDA's copy of the dump file header in DMP_HEADER and DMP_HEADER_SIZE, and stores the address and size of SDA's copy of the error log buffers in ERRLOG_BUFFER and ERRLOG_BUFFER_SIZE, respectively.

SDA$GET_HW_NAME

Returns the full name of the hardware platform where the dump was written.

Format

void sda$get_hw_name (char *buffer_ptr, uint32 buffer_len);

Arguments

buffer_ptr

OpenVMS usage	char_string
type	character string
access	write only
mechanism	by reference

Address of buffer to save HW name.

buffer_len

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	read only
mechanism	by value

Length of buffer to receive HW name.

Description

Returns a zero-terminated ASCII string representing the platform hardware name and puts it in the buffer passed as the argument.

Note

The buffer should be large enough to accomodate the largest possible hardware platform name (120 bytes including the termination byte). The name is truncated if it is too long for the supplied buffer.

Condition Values Returned

None

Example

```
char hw_name[64];
...
sda$get_hw_name (hw_name, sizeof(hw_name));
sda$print ("Platform name: \"!AZ\"", hw_name);
```

This example produces output of the form:

```
Platform name: "DEC 3000 Model 400"
```

SDA$GET_IMAGE_OFFSET

Maps a given virtual address onto an image or execlet.

Format

COMP_IMG_OFF sda$get_image_offset (VOID_PQ va, VOID_PQ img_info, VOID_PQ subimg_info, VOID_PQ offset);

Arguments

va

OpenVMS usage	address
type	quadword (unsigned)
access	read only
mechanism	by value

Virtual address of interest.

img_info

OpenVMS usage	address
type	quadword (unsigned)
access	write only
mechanism	by reference

Pointer to return addr of LDRIMG or IMCB block.

subimg_info

OpenVMS usage	address
type	quadword (unsigned)
access	write only
mechanism	by reference

Pointer to return addr of ISD_OVERLAY or KFERES.

offset

OpenVMS usage	quadword_unsigned
type	quadword (unsigned)
access	write only
mechanism	by reference

Pointer to address to return offset from image.

Description

Given a virtual address, this routine finds in which image it falls and returns the image information and offset. The loaded image list is traversed first to find this information. If it is not found, then the activated image list of the currently selected process is traversed. If still unsuccessful, then the resident installed images are checked.

Condition Values Returned

SDA_CIO$V_VALID	Set if image offset is found
SDA_CIO$V_PROCESS	Set if image is an activated image
SDA_CIO$V_SLICED	Set if the image is sliced
SDA_CIO$V_COMPRESSED	Set if activated image contains compressed data sections
SDA_CIO$V_ISD_INDEX	Index into ISD_LABELS table (only for LDRIMG execlets)

The status returned indicates the type of image if a match was found.

SDA_CIO$V_xxx flags set:	img_info type:	subimg_info type:
valid	LDRIMG	n/a
valid && sliced	LDRIMG	ISD_OVERLAY
valid && process	IMCB	n/a
valid && process && sliced	IMCB	KFERES_SECTION

Example

```
VOID_PQ va = (VOID_PQ)0xFFFFFFFF80102030;
COMP_IMG_OFF sda_cio;
int64 img_info;
int64 subimg_info;
int64 offset;
...
sda_cio = sda$get_image_offset (va,
        &img_info,
        &subimg_info,
        &offset);
```

For an example of code that interprets the returned COMP_IMG_OFF structure, see the supplied example program, SYS$EXAMPLES:MBX$SDA.C.

SDA$GET_INPUT

Reads input commands.

Format

int sda$get_input (char *prompt, char *buffer, uint32 buflen);

Arguments

prompt

OpenVMS usage	char_string
type	character string
access	read only
mechanism	by reference

Address of prompt string (zero-terminated ASCII string).

buffer

OpenVMS usage	char_string
type	character string
access	write only
mechanism	by reference

Address of buffer to store command.

buflen

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	read only
mechanism	by value

Maximum length of buffer.

Description

The command entered is returned as a zero-terminated string. The string is not uppercased. If you do not enter input but simply press <return> or <ctrl/Z>, the routine returns a null string.

Condition Values Returned

SS$_NORMAL	Successful completion.
RMS$_EOF	User pressed <ctrl/Z>

Example

```
int status;
char buffer[128];
...
status = sda$get_input ( "MBX> ", buffer, sizeof (buffer) );
```

This call prompts you for input with "MBX> " and stores the response in the buffer.

SDA$GET_LINE_COUNT

Obtains the number of lines currently printed on the current page.

Format

void sda$get_line_count (uint32 *line_count);

Argument

line_count

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	write only
mechanism	by reference

The number of lines printed on current page.

Description

Returns the number of lines that have been printed so far on the current page.

Condition Values Returned

None

Example

```
uint32 line_count;
...
sda$get_line_count (&line_count);
```

This call copies the current line count on the current page of output to the location LINE_COUNT.

SDA$GETMEM

Reads dump or system memory and signals a warning if inaccessible.

Format

int sda$getmem (VOID_PQ start, void *dest, int length, __optional_params);

Arguments

start

OpenVMS usage	address
type	quadword (unsigned)
access	read only
mechanism	by value

Starting virtual address in dump or system.

dest

OpenVMS usage	address
type	varies
access	write only
mechanism	by reference

Return buffer address.

length

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	read only
mechanism	by value

Length of transfer.

physical

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	read only
mechanism	by value

0: <start> is a virtual address. This is the default.
1: <start> is a physical address.

Description

This routine transfers an area from the memory in the dump file or the running system to the caller's return buffer. It performs the necessary address translation to locate the data in the dump file. SDA$GETMEM signals a warning and returns an error status if the data is inaccessible.

Related Routines

SDA$REQMEM and SDA$TRYMEM

Condition Values Returned

SDA$_SUCCESS	Successful completion
SDA$_NOREAD	The data is inaccessible for some reason.
SDA$_NOTINPHYS	The data is inaccessible for some reason.
Others	The data is inaccessible for some reason.

If a failure status code is returned, it has already been signaled as a warning.

Example

```
int status;
PCB *current_pcb;
PHD *current_phd;
 ...
status = sda$getmem ((VOID_PQ)&current_pcb->pcb$l_phd, &current_phd, 4);
```

This call returns the contents of the PCB$L_PHD field of the PCB, whose system address is in the pointer CURRENT_PCB, to the pointer CURRENT_PHD.

SDA$INSTRUCTION_DECODE

Translates one Alpha machine instruction into the assembler string equivalent.

Format

int sda$instruction_decode (void *istream_ptr, char *buffer, uint32 buflen);

Arguments

istream_ptr

OpenVMS usage	address
type	longword (unsigned)
access	read/write
mechanism	by reference

Address of the pointer that points to a copy of the i-stream in a local buffer.

buffer

OpenVMS usage	char_string
type	character string
access	write only
mechanism	by reference

Address of a string buffer into which to store the output assembler string.

buflen

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	read only
mechanism	by value

Maximum size of the string buffer.

Description

Translates an Alpha machine instruction into the assembler string equivalent. Alpha instructions are always 4 bytes long. The instruction stream must first be read into local memory and then the address of a pointer to the local copy of the instruction stream is passed to the routine. For every successful translated instruction, the pointer is automatically updated to point to the next instruction.

The output assembler string is zero-terminated and in case of a failure a null string is returned.

Condition Values Returned

SS$_NORMAL	Successful completion.
SS$_BADPARAM	Any of the following failures: Output buffer too small Invalid register Invalid opcode class/format Could not translate instruction

Example

```
int status;
VOID_PQ va = (VOID_PQ)0xFFFFFFFF80102030;
uint32 instruction;
uint32 *istream = &instruction;
char buffer[64];
...
sda$reqmem (va, &instruction, 4);
status = sda$instruction_decode (&istream, buffer, sizeof (buffer));
```

This example reads the instruction at dump location VA and decodes it, putting the result into BUFFER. Pointer ISTREAM is incremented (to the next longword).

SDA$NEW_PAGE

Begins a new page of output.

Format

void sda$new_page ();

Arguments

None.

Description

This routine causes a new page to be written and outputs the page heading (established with SDA$FORMAT_HEADING) and the current subheading (established with SDA$SET_HEADING_ROUTINE).

Condition Values Returned

None

Example

```
sda$new_page ();
```

This call outputs a page break and displays the current page heading and subheading (if any).

SDA$PARSE_COMMAND

Parses and executes an SDA command line.

Format

void sda$parse_command (char *cmd_line, __optional_params);

Arguments

cmd_line

OpenVMS usage	char_string
type	character string
access	read only
mechanism	by reference

Address of a valid SDA command line (zero-terminated).

options

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	read only
mechanism	by value

The **options** argument has the following values:

Value	Meaning
SDA_OPT$K_PARSE_DONT_SAVE	Indicates "do not save this command." This is the default.
SDA_OPT$K_PARSE_SAVE	Indicates "save this command." That is, it can be recalled with KP0 or REPEAT.

Description

Not every SDA command has a callable extension interface. For example, to redirect SDA's output, you would pass the command string "SET OUTPUT MBX.LIS" to this parse command routine. Abbreviations are allowed.

Condition Values Returned

None

Example

```
sda$parse_command ("SHOW ADDRESS 80102030");
```

This call produces the following output:

```
FFFFFFFF.80102030 is an S0/S1 address

          Mapped by Level-3 PTE at: FFFFFFFD.FFE00408
          Mapped by Level-2 PTE at: FFFFFFFD.FF7FF800
          Mapped by Level-1 PTE at: FFFFFFFD.FF7FDFF8
          Mapped by Selfmap PTE at: FFFFFFFD.FF7FDFF0

          Also mapped in SPT window at: FFFFFFFF.FFDF0408
```

The "SHOW ADDRESS" command is not recorded as the most recent command for use with the KP0 key or the REPEAT command.

SDA$PRINT

Formats and prints a single line.

Format

int sda$print (char *ctrstr, __optional_params);

Arguments

ctrstr

OpenVMS usage	char_string
type	character-coded text string
access	read only
mechanism	by reference

Address of a zero-terminated control string.

prmlst

OpenVMS usage	varying_arg
type	quadword (signed or unsigned)
access	read only
mechanism	by value

Optional FAO parameters. All arguments after the control string are copied into a quadword parameter list, as used by $FAOL_64.

Description

Formats and prints a single line. This is normally output to the terminal, unless you used the SDA commands SET OUTPUT or SET LOG to redirect or copy the output to a file.

Condition Values Returned

SDA$_SUCCESS	Indicates a successful completion.
SDA$_CNFLTARGS	Indicates more than twenty FAO parameters given.
Other	Returns from the $PUT issued by SDA$PRINT (the error is also signaled). If the $FAOL_64 call issued by SDA$PRINT fails, the control string is output.

Example

```
char buffer[32];
...
sda$get_block_name (0x6F, 0x20,
        buffer,
        sizeof (buffer));
sda$print ("Block type: !AZ", buffer);
```

This example outputs the following line:

```
Block type: VCC_CFCB
```

SDA$READ_SYMFILE

Reads symbols from a given file.

Format

int sda$read_symfile (char *filespec, uint32 options, __optional_params);

Arguments

filespec

OpenVMS usage	char_string
type	character string
access	read only
mechanism	by reference

Address of file or directory specification from which to read the symbols (zero-terminated ASCII string).

options

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	read only
mechanism	by value

Indicates type of symbol file and flags, as shown in the following:

Flags	Effect
SDA_OPT$M_READ_FORCE	read/force <file>
SDA_OPT$M_READ_IMAGE	read/image <file>
SDA_OPT$M_READ_SYMVA	read/symva <file>
SDA_OPT$M_READ_RELO	read/relo <file>
SDA_OPT$M_READ_EXEC	read/exec [<dir>]
SDA_OPT$M_READ_NOLOG	/nolog, suppress count of symbols read
SDA_OPT$M_READ_FILESPEC	<file> or <dir> given
SDA_OPT$M_READ_NOSIGNAL	return status, without signaling errors

relocate_base

OpenVMS usage	address
type	longword (unsigned)
access	read only
mechanism	by value

Base address for symbols (nonsliced symbols).

symvect_va

OpenVMS usage	address
type	longword (unsigned)
access	read only
mechanism	by value

The symbol vector address (symbols are offsets into the symbol vector).

symvect_size

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	read only
mechanism	by value

Size of symbol vector.

loaded_img_info

OpenVMS usage	address
type	longword (unsigned)
access	read only
mechanism	by reference

The address of $LDRIMG data structure with execlet information.

Description

This command reads symbols from a given file to add symbol definitions to the working symbol table by reading GST entries. The file is usually a symbol file (.STB) or an image (.EXE). If SDA_OPT$M_READ_EXEC is specified in the options, then the filespec is treated as a directory specification, where symbol files and/or image files for all execlets may be found (as with READ/EXECUTIVE). If no directory specification is given, the logical name SDA$READ_DIR is used.

Note that when SDA reads symbol files and finds routine names, the symbol name that matches the routine name is set to the address of the procedure descriptor. A second symbol name, the routine name with "_C" appended, is set to the start of the routine's prologue.

Condition Values Returned

SDA$_SUCCESS	Successful completion.
SDA$_CNFLTARGS	No filename given and SDA_OPT$M_READ_EXEC not set.

Others errors are signaled and/or returned, exactly as though the equivalent SDA READ command had been used. Use HELP/MESSAGE for explanations.

Example

```
sda$read_symfile ("SDA$READ_DIR:SYSDEF", SDA_OPT$M_READ_NOLOG);
```

The symbols in SYSDEF.STB are added to SDA's internal symbol table, and the number of symbols found is not output to the terminal.

SDA$REQMEM

Reads dump or system memory and signals an error if inaccessible.

Format

int sda$reqmem (VOID_PQ start, void *dest, int length, __optional_params);

Arguments

start

OpenVMS usage	address
type	quadword (unsigned)
access	read only
mechanism	by value

Starting virtual address in dump or system.

dest

OpenVMS usage	address
type	varies
access	write only
mechanism	by reference

Return buffer address.

length

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	read only
mechanism	by value

Length of transfer.

physical

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	read only
mechanism	by value

0: <start> is a virtual address. This is the default.
1: <start> is a physical address.

Description

This routine transfers an area from the memory in the dump file or the running system to the caller's return buffer. It performs the necessary address translation to locate the data in the dump file. SDA$REQMEM signals an error and aborts the current command if the data is inaccessible.

Related Routines

SDA$GETMEM and SDA$TRYMEM

Condition Values Returned

SDA$_SUCCESS	Successful completion.

Any failure is signaled as an error and the current command aborts.

Example

```
VOID_PQ address;
uint32 instruction;
...
sda$symbol_value ("EXE_STD$ALLOCATE_C", (uint64 *)&address);
sda$reqmem (address, &instruction, 4);
```

This example reads the first instruction of the routine EXE_STD$ALLOCATE into the location INSTRUCTION.

SDA$SET_ADDRESS

Stores a new address value as the current memory address (".").

Format

void sda$set_address (VOID_PQ address);

Argument

address

OpenVMS usage	quadword_unsigned
type	quadword (unsigned)
access	read only
mechanism	by value

Address value to store in current memory location.

Description

The specified address becomes SDA's current memory address (the predefined SDA symbol ".").

Condition Values Returned

None

Example

```
sda$set_address ((VOID_PQ)0xFFFFFFFF80102030);
```

This call sets SDA's current address to FFFFFFFF.80102030.

SDA$SET_CPU

Sets a new SDA CPU context.

Format

int sda$set_cpu (int cpu_id);

Arguments

cpu_id

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	read only
mechanism	by value

The desired CPU ID.

Description

This routine causes SDA to set the specified CPU as the currently selected CPU.

Condition Values Returned

SDA$_SUCCESS	Successful completion.

Any failure is signaled as an error and the current command aborts.

Example

```
int cpu_id = 2;
status = sda$set_cpu  (  cpu_id  );
```

In this example, SDA's current CPU context is set to the CPU whose number is held in the variable CPU_ID.

SDA$SET_HEADING_ROUTINE

Sets the current heading routine to be called after each page break.

Format

void sda$set_heading_routine (void (*heading_rtn) ( ));

Argument

heading_rtn

OpenVMS usage	procedure
type	rocedure value
access	read only
mechanism	by value

Address of routine to be called after each new page.

Description

When SDA begins a new page of output (either because SDA$NEW_PAGE was called, or because the current page is full), it outputs two types of headings. The first is the page title, and is set by calling the routine SDA$FORMAT_HEADING. This is the title that is included in the index page of a listing file when you issue a SET OUTPUT command. The second heading is typically for column headings, and as this can vary from display to display, you must write a routine for each separate heading. When you call SDA$SET_HEADING_ROUTINE to specify a user-written routine, the routine is called each time SDA begins a new page.

To stop the routine from being invoked each time SDA begins a new page, call either SDA$FORMAT_HEADING to set a new page title, or SDA$SET_HEADING_ROUTINE and specify the routine address as NULL.

If the column headings need to be output during a display (that is, in the middle of a page), and then be re-output each time SDA begins a new page, call the user-written routine directly the first time, then call SDA$SET_HEADING_ROUTINE to have it be called automatically thereafter.

Condition Values Returned

None

Example

```
void mbx$title (void)
  {
  sda$print ("Mailbox     UCB      ...");
  sda$print ("  Unit    Address    ...");
  sda$print ("------------------------");
  return;
  }
...
sda$set_heading_routine (mbx$title);
...
sda$set_heading_routine (NULL);
```

This example sets the heading routine to the routine MBX$TITLE, and later clears it. The routine is called if any page breaks are generated by the intervening code.

SDA$SET_LINE_COUNT

Sets the number of lines printed so far on the current page.

Format

void sda$set_line_count (uint32 line_count);

Argument

line_count

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	read only
mechanism	by value

The number of lines printed on current page.

Description

The number of lines that have been printed so far on the current page is set to the given value.

Condition Values Returned

None

Example

```
sda$set_line_count (5);
```

This call sets SDA's current line count on the current page of output to 5.

SDA$SET_PROCESS

Sets a new SDA process context.

Format

int sda$set_process (const char *proc_name, int proc_index, int proc_addr);

Arguments

proc_name

OpenVMS usage	character_string
type	character string
access	read only
mechanism	by reference

Address of the process name string (zero-terminated).

proc_index

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	read only
mechanism	by value

The index of the desired process.

proc_addr

OpenVMS usage	address
type	longword (unsigned)
access	read only
mechanism	by value

The address of the PCB for the desired process.

Description

This routine causes SDA to set the specified process as the currently selected process.

Note

The proc_name, proc_index, and proc_addr are mutually exclusive.

Condition Values Returned

SDA$_SUCCESS	Successful completion.

Any failure is signaled as an error and the current command aborts.

Example

```
status = sda$set_process  (  "JOB_CONTROL",  0,  0);
```

In this example, SDA's current process context is set to the JOB_CONTROL process.

SDA$SKIP_LINES

This routine outputs a specified number of blank lines.

Format

void sda$skip_lines (uint32 lines);

Argument

lines

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	read only
mechanism	by value

Number of lines to skip.

Description

The specified number of blank lines are output.

Condition Values Returned

None

Example

```
sda$skip_lines (2);
```

This call causes two blank lines to be output.

SDA$SYMBOL_VALUE

Obtains the 64-bit value of a specified symbol.

Format

int sda$symbol_value (char *symb_name, uint64 *symb_value);

Arguments

symb_name

OpenVMS usage	char_string
type	character string
access	read only
mechanism	by reference

Zero-terminated string containing symbol name.

symb_value

OpenVMS usage	quadword_unsigned
type	quadword (unsigned)
access	write only
mechanism	by reference

Address to receive symbol value.

Description

A search through SDA's symbol table is made for the specified symbol. If found, its 64-bit value is returned.

Condition Values Returned

SDA$_SUCCESS	Symbol found.
SDA$_BADSYM	Symbol not found.

Example

```
int status;
VOID_PQ address;
...
status = sda$symbol_value ("EXE_STD$ALLOCATE_C", (uint64 *)&address);
```

This call returns the start address of the prologue of routine EXE_STD$ALLOCATE to location ADDRESS.

SDA$SYMBOLIZE

Converts a value to a symbol name and offset.

Format

int sda$symbolize (uint64 value, char *symbol_buf, uint32 symbol_len);

Arguments

value

OpenVMS usage	quadword_unsigned
type	quadword (unsigned)
access	read only
mechanism	by value

Value to be translated.

symbol_buf

OpenVMS usage	char_string
type	character string
access	write only
mechanism	by reference

Address of buffer to which to return string.

symbol_len

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	read only
mechanism	by value

Maximum length of string buffer.

Description

This routine accepts a value and returns a string that contains a symbol and offset corresponding to that value. First the value is checked in the symbol table. If no symbol can be found (either exact match or up to 0XFFF less than the specified value), the value is then checked to see if it falls within one of the loaded or activated images.

Condition Values Returned

SS$_NORMAL	Successful completion.
SS$_BUFFEROVF	Buffer too small, string truncated.
SS$_NOTRAN	No symbolization for this value (null string returned).

Example

```
VOID_PQ va = VOID_PQ(0xFFFFFFFF80102030);
char buffer [64]
status = sda$symbolize (va, buffer, sizeof(buffer));
sda$print ("FFFFFFFF.80102030 = \"!AZ\"", buffer);
```

This example outputs the following:

```
FFFFFFFF.80102030 = "EXE$WRITE_PROCESS_C+00CD0"
```

SDA$TRYMEM

Reads dump or system memory and returns the error status (without signaling) if inaccessible.

Format

int sda$trymem (VOID_PQ start, void *dest, int length, __optional_params);

Arguments

start

OpenVMS usage	address
type	quadword (unsigned)
access	read only
mechanism	by value

Starting virtual address in dump or system.

dest

OpenVMS usage	address
type	varies
access	write only
mechanism	by reference

Return buffer address.

length

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	read only
mechanism	by value

Length of transfer.

physical

OpenVMS usage	longword_unsigned
type	longword (unsigned)
access	read only
mechanism	by value

0: <start> is a virtual address. This is the default.
1: <start> is a physical address.

Description

This routine transfers an area from the memory in the dump file or the running system to the caller's return buffer. It performs the necessary address translation to locate the data in the dump file. SDA$TRYMEM does not signal any warning or errors. It returns the error status if the data is inaccessible.

Related Routines

SDA$GETMEM and SDA$REQMEM

Condition Values Returned

SDA$_SUCCESS	Successful completion.
SDA$_NOREAD	The data is inaccessible for some reason.
SDA$_NOTINPHYS	The data is inaccessible for some reason.
Others	The data is inaccessible for some reason.

Example

```
int status;
DDB *ddb;
...
status = sda$trymem (ddb->ddb$ps_link, ddb, DDB$K_LENGTH);
if ($VMS_STATUS_SUCCESS (status))
    sda$print ("Next DDB is successfully read from dump");
else
    sda$print ("Next DDB is inaccessible");
```

This example attempts to read the next DDB in the DDB list from the dump.

SDA$TYPE

Formats and types a single line to SYS$OUTPUT.

Format

int sda$type (char *ctrstr, __optional_params);

Arguments

ctrstr

OpenVMS usage	char_string
type	character-coded text string
access	read only
mechanism	by reference

Address of a zero-terminated control string.

prmlst

OpenVMS usage	varying_arg
type	quadword (signed or unsigned)
access	read only
mechanism	by value

Optional FAO parameters. All arguments after the control string are copied into a quadword parameter list, as used by $FAOL_64.

Description

Formats and prints a single line to the terminal. This is unaffected by the use of the SDA commands SET OUTPUT or SET LOG.

Condition Values Returned

SDA$_SUCCESS	Indicates a successful completion.
SDA$_CNFLTARGS	Indicates more than twenty FAO parameters given.
Other	Returns from the $PUT issued by SDA$TYPE (the error is also signaled). If the $FAOL_64 call issued by SDA$TYPE fails, the control string is output.

Example

```
int status;
...
status = sda$type ("Invoking SHOW SUMMARY to output file...");
```

This example displays the message "Invoking SHOW SUMMARY to output file..." to the terminal.

SDA$VALIDATE_QUEUE

Validates queue structures.

Format

void sda$validate_queue (VOID_PQ queue_header, __optional_params);

Arguments

queue_header

OpenVMS usage	address
type	quadword (unsigned)
access	read only
mechanism	by value

Address from which to start search.

options

OpenVMS usage	mask_longword
type	longword (unsigned)
access	read only
mechanism	by value

The following table shows the flags that indicate the type of queue:

Flag	Meaning
None	Defaults to doubly-linked longword queue
SDA_OPT$M_QUEUE_BACKLINK	Validates the integrity of a doubly-linked queue using the back links instead of the forward links
SDA_OPT$M_QUEUE_LISTQUEUE	Displays queue elements for debugging
SDA_OPT$M_QUEUE_QUADLINK	Indicates a quadword queue
SDA_OPT$M_QUEUE_SELF	Indicates a self-relative queue
SDA_OPT$M_QUEUE_SINGLINK	Indicates a singly-linked queue

Description

You can use this routine to validate the integrity of doubly-linked, singly-linked or self-relative queues either with longword or quadword links. If you specify the option SDA_OPT$M_QUEUE_LISTQUEUE, the queue elements are displayed for debugging. Otherwise a one-line summary indicates how many elements were found and whether the queue is intact.

Condition Values Returned

None

If an error occurs, it is signaled by SDA$VALIDATE_QUEUE.

Example

```
int64 temp;
int64 *queue;
...
sda$symbol_value ("EXE$GL_NONPAGED", &temp);
temp += 4;
sda$reqmem ((VOID_PQ)temp, &queue, 4);
sda$validate_queue (queue, SDA_OPT$M_QUEUE_SINGLINK);
```

This sequence validates the nonpaged pool free list, and outputs a message of the form:

```
Queue is zero-terminated, total of 204 elements in the queue
```

Part II

OpenVMS Alpha System Code Debugger and System Dump Debugger

Part II describes the System Code Debugger (SCD) and the System Dump Debugger (SDD). It presents how to use SCD and SDD by doing the following:

- Building a system image to be debugged
- Setting up the target system for connections
- Setting up the host system
- Starting SCD
- Troubleshooting connections and network failures
- Looking at a sample SCD session
- Analyzing memory as recorded in a system dump
- Looking at a sample SDD session

9

The OpenVMS Alpha System Code Debugger

This chapter describes the OpenVMS Alpha System Code Debugger (SCD) and how it can be used to debug nonpageable system code and device drivers running at any interrupt priority level (IPL).

You can use SCD to perform the following tasks:

- Control the system software's execution—-stop at points of interest, resume execution, intercept fatal exceptions, and so on
- Trace the execution path of the system software
- Monitor exception conditions
- Examine and modify the values of variables
- Test the effect of modifications, in some cases, without having to edit the source code, recompile, and relink

The use of SCD requires two systems:

- The host system, probably also the system where the image to be debugged has been built
- The target system, usually a standalone test system, where the image being debugged is executed

SCD is a symbolic debugger. You can specify variable names, routine names, and so on, precisely as they appear in your source code. SCD can also display the source code where the software is executing, and allow you to step by source line.

SCD recognizes the syntax, data typing, operators, expressions, scoping rules, and other constructs of a given language. If your code or driver is written in more than one language, you can change the debugging context from one language to another during a debugging session.

To use SCD, you must do the following:

- Build a system image or device driver to be debugged.
- Set up the target kernel on a standalone system.

  The **target kernel** is the part of SCD that resides on the system that is being debugged. It is integrated with XDELTA and is part of the SYSTEM_DEBUG execlet.
- Set up the host system environment, which is integrated with the OpenVMS Debugger.

The following sections cover these tasks in more detail, describe the available user-interface options, summarize applicable OpenVMS Debugger commands, and provide a sample SCD session.

9.1 User-Interface Options

SCD has the following user-interface options:

- A DECwindows Motif interface for workstations

  When using this interface, you interact with SCD by using a mouse and pointer to choose items from menus, click on buttons, select names in windows, and so on.

  Note that you can also use OpenVMS Debugger commands with the DECwindows Motif interface.

- A character cell interface for terminals and workstations

  When using this interface, you interact with SCD by entering commands at a prompt. The sections in this chapter describe how to use the system code debugger with the character cell interface.

For more information about using the OpenVMS DECwindows Motif interface and OpenVMS Debugger commands with SCD, see the *OpenVMS Debugger Manual*.

9.2 Building a System Image to Be Debugged

1. Compile the sources you want to debug, and be sure to use the /DEBUG and /NOOPT qualifiers.

   Note

   Debugging optimized code is much more difficult and is not recommended unless you know the Alpha architecture well. The instructions are reordered so much that single-stepping by source line will look like you are randomly jumping all over the code. Also note that you cannot access all variables. SCD reports that they are optimized away.

2. Link your image using the /DSF (debug symbol file) qualifier. Do not use the /DEBUG qualifier, which is for debugging user programs. The /DSF qualifier takes an optional filename argument similar to the /EXE qualifier. For more information, see the *OpenVMS Linker Utility Manual*. If you specify a name in the /EXE qualifier, you will need to specify the same name for the /DSF qualifier. For example, you would use the following command:

   ```
   $ LINK/EXE=EXE$:MY_EXECLET/DSF=EXE$:MY_EXECLET OPTIONS_FILE/OPT
   ```

   The .DSF and .EXE file names must be the same. Only the extensions will be different, that is .DSF and .EXE.

   The contents of the .EXE file should be exactly the same as if you had linked without the /DSF qualifier. The .DSF file will contain the image header and all the debug symbol tables for .EXE file. It is not an executable file, and cannot be run or loaded.

3. Put the .EXE file on your target system.

4. Put the .DSF file on your host system, because when you use SCD to debug code in your image, it will try to look for a .DSF file first and then look for an .EXE file. The .DSF file is better because it has symbols in it. Section 9.4 describes how to tell SCD where to find your .DSF and .EXE files.

9.3 Setting Up the Target System for Connections

The target kernel is controlled by flags and devices specified when the system is booted, by XDELTA commands, by a configuration file, and by several system parameters. The following sections contain more information about these items.

Boot Command

The form of the boot command varies depending on the type of OpenVMS Alpha system you are using. However, all boot commands have the concept of boot flags and boot devices as well as a way to save the default boot flags and devices. This section uses syntax from a DEC 3000 Model 400 Alpha Workstation in examples.

To use SCD, you must specify an Ethernet device with the boot command on the target system. The target system uses this device to communicate with the host debugger. It is currently a restriction that this device must not be used for anything else (either for booting or network software such as DECnet, TCP/IP products, and LAT products). Thus, you must also specify a different device from which to boot. For example, the following command will boot a DEC 3000 Model 400 from the DKB100 disk, and SCD will use the ESA0 Ethernet device.

```
>>> boot dkb100,esa0
```

To find out the Ethernet devices available on your system, enter the following command:

```
>>> show device
```

In addition to devices, you can also specify flags on the boot command line. Boot flags are specified as a hex number; each bit of the number represents a true or false value for a flag. The following flag values are relevant to the system code debugger.

- **8000**

  This is the SCD boot flag. It enables operation of the target kernel. If this SCD boot flag is not set, not only will it be impossible to use SCD to debug the system, but the additional XDELTA commands related to the target kernel will generate an XDELTA error message. If this boot flag is set, SYSTEM_DEBUG is loaded, and SCD is enabled.

- **0004**

  This is the initial breakpoint boot flag. It controls whether the system calls INI$BRK at the beginning and end of EXEC_INIT. Notice that if SCD is the default debugger, the first breakpoint is not as early as it is for XDELTA. It is delayed until immediately after the PFN database is set up.

- **0002**

  This is the XDELTA boot flag, which controls whether XDELTA is loaded. It behaves slightly differently when the SCD boot flag is also set.

  If the SCD boot flag is clear, this flag simply determines if XDELTA is loaded. If the SCD boot flag is set, this flag determines whether XDELTA or the system code debugger is the default debugger. If the XDELTA flag is set, XDELTA will be the default debugger. In this state, the initial system breakpoints and any calls to INI$BRK trigger XDELTA, and you must enter an XDELTA command to start using SCD. If the XDELTA boot flag is clear, the initial breakpoints and calls to INI$BRK go to SCD. You cannot use XDELTA if the XDELTA boot flag is clear.

Boot Command Example The following command boots a DEC 3000 Model 400 from disk DKA0, enables SCD, defaults to using XDELTA, and takes the initial system boot breakpoints.

```
>>> boot dka0,esa0 -fl 0,8006
```

You can set these devices and flags to be the default values so that you will not have to specify them each time you boot the system. On a DEC 3000 Model 400, use the following commands:

```
>>> set bootdef_dev dka0,esa0
>>> set boot_osflags 0,8006
```

SCD Configuration File

The SCD target system reads a configuration file in SYS$SYSTEM named DBGTK$CONFIG.SYS. The first line of this file contains a default password, which must be specified by the host debug system to connect to the target. The default password may be the null string; in this case the host must supply the null string as the password (/PASSWORD="") on the connect command as described in Section 9.5, or no password at all. Other lines in this file are reserved by Compaq. Note that you must create this file because Compaq does not supply it. If this file does not exist, you can only run SCD by specifying a default password with the XDELTA ;R command described in the following section.

XDELTA Commands

When the system is booted with both the XDELTA boot flag and the SCD boot flag, the following two additional XDELTA commands are enabled:

- n,\xxxx;R ContRol SCD connection

  You can use this command to do the following:

  – Change the password which the SCD host must present

  – Disconnect the current session from SCD

  – Give control to SCD by simulating a call to INI$BRK

  – Any combination of these

  Optional string argument xxxx specifies the password that the system code debugger must present for its connection to be accepted. If this argument is left out, the required password is unchanged. The initial password is taken from the first line of the SYS$SYSTEM:DBGTK$CONFIG.SYS file. The new password does not remain in effect across a boot of the target system.

The optional integer argument *n* controls the behavior of the ;R command as follows:

Value of N	Action
+1	Gives control to SCD by simulating a call to INI$BRK
+2	Returns to XDELTA after changing the password. 2;R without a password is a no-op
0	Performs the default action
-1	Changes the password, breaks any existing connection to SCD, and then simulates a call to INI$BRK (which will wait for a new connection to be established and then give control to SCD)
-2	Returns to XDELTA after changing the password and breaking an existing connection

Currently, the default action is the same action as +1.

If SCD is already connected, the ;R command transfers control to SCD, and optionally changes the password that must be presented the next time a system code debugger tries to make a connection. This new password does not last across a boot of the target system.

- n;K Change inibrK behavior

  If optional argument *n* is 1, future calls to INI$BRK will result in a breakpoint being taken by SCD. If the argument is 0, or no argument is specified, future calls to INI$BRK will result in a breakpoint being taken by XDELTA.

SYSTEM Parameters

- **DBGTK_SCRATCH**

  Bits 0 through 7 specify how many pages of memory are allocated for SCD. This memory is allocated only if system code debugging is enabled with the SCD boot flag (described earlier in this section). Usually, the default value of 1 is adequate; however, if SCD displays an error message, increase this value.

  Bits 8 through 31 are reserved by Compaq.

- **SCSNODE**

  Identifies the target kernel node name for SCD. See Section 9.3.1 for more information.

9.3.1 Making Connections Between the Target Kernel and the System Code Debugger

It is always SCD on the host system that initiates a connection to the target kernel. When SCD initiates this connection, the target kernel accepts or rejects the connection based on whether the remote debugger presents it with a node name and password that matches the password in the target system (either the default password from the SYS$SYSTEM:DBGTK$CONFIG.SYS file, or a different password specified via XDELTA). SCD obtains the node name from the SCSNODE system parameter.

The target kernel can accept a connection from SCD any time the system is running below IPL 22, or if XDELTA is in control (at IPL 31). However, the target kernel actually waits at IPL 31 for a connection from the SCD host in two cases: when it has no existing connection to an SCD host and (1) it receives a breakpoint caused by a call to INI$BRK (including either of the initial breakpoints), or (2) when you enter a 1;R or -1;R command to XDELTA.

9.3.2 Interactions Between XDELTA and the Target Kernel/System Code Debugger

XDELTA and the target kernel are integrated into the same system. Normally, you choose to use one or the other. However, XDELTA and the target kernel can be used together. This section explains how they interoperate.

The XDELTA boot flag controls which debugger (XDELTA or the SCD target kernel) gets control first. If it is not set, the target kernel gets control first, and it is not possible to use XDELTA without rebooting. If it is set, XDELTA gets control first, but you can use XDELTA commands to switch to the target kernel and to switch INI$BRK behavior such that the target kernel gets control when INI$BRK is called.

Breakpoints always *stick* to the debugger that set them; for example, if you set a breakpoint at location “A” with XDELTA, and then you enter the commands 1;K (switch INI$BRK to the system code debugger) and ;R (start using the system code debugger) then, from SCD, you can set a breakpoint at location “B”. If the system executes the breakpoint at A, XDELTA reports a breakpoint, and SCD will see nothing (though you could switch to SCD by issuing the XDELTA ;R command). If the system executes the breakpoint at B, SCD will get control and report a breakpoint (you cannot switch to XDELTA from SCD).

Notice that if you examine location A with SCD, or location B with XDELTA, you will see a BPT instruction, not the instruction that was originally there. This is because neither debugger has any information about the breakpoints set by the other debugger.

One useful way to use both debuggers together is when you have a system that exhibits a failure only after hours or days of heavy use. In this case, you can boot the system with SCD enabled (8000), but with XDELTA the default (0002) and with initial breakpoints enabled (0004). When you reach the initial breakpoint, set an XDELTA breakpoint at a location that will only be reached when the error occurs. Then proceed. When the error breakpoint is reached, possibly days later, then you can set up a remote system to debug it and enter the ;R command to XDELTA to switch control to SCD.

Here is another technique to use when you do not know where to put an error breakpoint as previously mentioned. Boot the system with only the SCD boot flag set. When you see that the error has occurred, halt the system and initiate an IPL 14 interrupt, as you would to start XDELTA. The target kernel will get control and wait for a connection for SCD.

9.4 Setting Up the Host System

To set up the host system, you need access to all system images and drivers that are loaded (or can be loaded) on the target system. You should have access to a source listings kit or a copy of the following directories:

SYS$LOADABLE_IMAGES:
SYS$LIBRARY:
SYS$MESSAGE:

You need all the .EXE files in those directories. The .DSF files are available with the OpenVMS Alpha source listings kit.

Optionally, you need access to the source files for the images to be debugged. SCD will look for the source files in the directory where they were compiled. If your build system and host system are different, you must use the SET SOURCE command to point SCD to the location of the source code files. For an example of the SET SOURCE command, see Section 9.12.

Before making a connection to the target system, you must set up the logical name DBGHK$IMAGE_PATH, which must be set up as a search list to the area where the system images or .DSF files are kept. For example, if the copies are in the following directories:

```
DEVICE:[SYS$LDR]
DEVICE:[SYSLIB]
DEVICE:[SYSMSG]
```

you would define DBGHK$IMAGE_PATH as follows:

```
$ define dbghk$image_path DEVICE:[SYS$LDR],DEVICE:[SYSLIB],DEVICE:[SYSMSG]
```

This works well for debugging using all the images normally loaded on a given system. However, you might be using the debugger to test new code in an execlet or a new driver. Because that image is most likely in your default directory, you must define the logical name as follows:

```
$ define dbghk$image_path [],DEVICE:[SYS$LDR],DEVICE:[SYSLIB],DEVICE:[SYSMSG]
```

If SCD cannot find one of the images through this search path, a warning message is displayed. SCD will continue initialization as long as it finds at least one image. If SCD cannot find the SYS$BASE_IMAGE file, which is the OpenVMS Alpha operating system's main image file, an error message is displayed and the debugger exits.

If and when this happens, check the directory for the image files and compare it to what is loaded on the target system.

9.5 Starting the System Code Debugger

To start SCD on the host side, enter the following command:

```
$ DEBUG/KEEP
```

SCD displays the DBG> prompt. With the DBGHK$IMAGE_PATH logical name defined, you can invoke the CONNECT command and the optional qualifiers /PASSWORD and /IMAGE_PATH.

To use the CONNECT command and the optional qualifiers (/PASSWORD and /IMAGE_PATH) to connect to the node with name <node-name>, enter the following command:

```
DBG> CONNECT %NODE_NAME node-name /PASSWORD="password"
```

If a password has been set up on the target system, you must use the /PASSWORD qualifier. If a password is not specified, a zero length string is passed to the target system as the password.

The /IMAGE_PATH qualifier is also optional. If you do not use this qualifier, SCD uses the DBGHK$IMAGE_PATH logical name as the default. The /IMAGE_PATH qualifier is a quick way to change the logical name. However, when you use it, you cannot specify a search list. You can use only a logical name or a device and directory, although the logical name can be a search list.

Usually, SCD obtains the source file name from the object file. This is put there by the compiler when the source is compiled with the /DEBUG qualifier. The SET SOURCE command can take a list of paths as a parameter. It treats them as a search list.

9.6 Summary of System Code Debugger Commands

In general, any OpenVMS debugger command can be used in SCD. For a complete list, refer to the *OpenVMS Debugger Manual*. The following are a few examples:

- Commands to manipulate the source display, such as TYPE and SCROLL.
- Commands used in OpenVMS debugger command programs, such as DO and IF.
- Commands that affect output formats, such as SET RADIX.
- Commands that manipulate symbols and scope, such as EVALUATE, SET LANGUAGE, and CANCEL SCOPE. Note that the debugger SHOW IMAGE command is equivalent to the XDELTA ;L command, and the debugger DEFINE command is equivalent to the XDELTA ;X command.
- Commands that cause code to be executed, such as STEP and GO. Note that the debugger STEP command is equivalent to the XDELTA S and O commands, and the debugger GO command is equivalent to the XDELTA ;P and ;G commands.
- Commands that manipulate breakpoints, such as SET BREAK and CANCEL BREAK. These commands are equivalent to the XDELTA ;B command. However, unlike XDELTA, there is no limit on the number of breakpoints in SCD.
- Commands that affect memory, such as DEPOSIT and EXAMINE. These commands are equivalent to the XDELTA /,!,[,",’ commands.

You can also use the OpenVMS debugger command SDA to examine the target system with System Dump Analyzer semantics. This command, which is not available when debugging user programs, is described in the next section.

9.7 Using System Dump Analyzer Commands

Once a connection has been established to the target system, you can use the commands listed in the previous section to examine the target system. You can also use some System Dump Analyzer (SDA) commands, such as SHOW SUMMARY and SHOW DEVICE. This feature allows the system programmer to take advantage of the strengths of both the OpenVMS Debugger and SDA to examine the state of the target system and to debug system programs such as device drivers.

To obtain access to SDA commands, you simply type "SDA" at the OpenVMS Debugger prompt ("DBG>") at any time after a connection has been established to the target system. SDA initializes itself and then outputs the "SDA>" prompt. Enter SDA commands as required. (See Chapter 4 for more information.) To return to the OpenVMS Debugger, you enter "EXIT" at the "SDA>" prompt. Optionally, you may invoke SDA to perform a single command and then return immediately to the OpenVMS Debugger, as in the following example:

```
DBG>SDA SHOW SUMMARY
```

You may reenter SDA at any time, with or without the optional SDA command. Once SDA has been initialized, the SDA> prompt is output more quickly on subsequent occasions.

Note that there are some limitations on the use of SDA from within SCD.

- You cannot switch between processes, whether requested explicitly (SET PROCESS <name>) or implicitly (SHOW PROCESS <name>). The exception to this is that access to the system process is possible.
- You cannot switch between CPUs.
- SDA has no knowledge of the OpenVMS debugger's Motif or Windows interfaces. Therefore, all SDA input and output occurs at the terminal or window where the OpenVMS debugger was originally invoked. Also, while using SDA, the OpenVMS debugger window is not refreshed; you must exit SDA to allow the OpenVMS debugger window to be refreshed.
- When you invoke SDA from SCD with an immediate command, and that command produces a full screen of output, SDA displays the message "Press RETURN for more." followed by the "SDA>" prompt before continuing. If you enter another SDA command at this prompt, SDA does not automatically return to SCD upon completion. To do this, you must enter an EXIT command.

9.8 System Code Debugger Network Information

The SCD host and the target kernel use a private Ethernet protocol to communicate. For the two systems to see each other, they have to be on the same Ethernet segment.

The network portion of the target system finds the first Ethernet device and communicates through it. The network portion of the host system also finds the first Ethernet device and communicates through it. However, if for some reason, SCD picks the wrong device, you can override this by defining the logical DBGHK$ADAPTOR to the template device name for the appropriate adaptor.

9.9 Troubleshooting Checklist

If you have trouble starting a connection, perform the following tasks to correct the problem:

- Check SCSNODE on the target system.

  It must match the name you are using in the host CONNECT command.
- Make sure that both the Ethernet and boot device are on the boot command.
- Make sure that the host system is using the correct Ethernet device, and that the host and target systems are connected to the same Ethernet segment.
- Check the version of the operating system and make sure that both the host and target systems are running the same version of the OpenVMS Alpha operating system.

9.10 Troubleshooting Network Failures

There are three possible network errors:

- NETRETRY

  Indicates the system code debugger connection is lost
- SENDRETRY

  Indicates a message send failure
- NETFAIL

  Results from the two previous errors

The netfail error message has a status code that can be one of the following values:

Value	Status
2, 4, 6	Internal network error, submit a problem report to Compaq.
8,10,14,16,18,20,26,28,34,38	Network protocol error, submit a problem report to Compaq.
22,24	Too many errors on the network device most likely due to congestion. Reduce the network traffic or switch to another network backbone.
30	Target system scratch memory not available. Check DBGTK_SCRATCH. If increasing this value does not help, submit a problem report to Compaq.
32	Ran out of target system scratch memory. Increase value of DBGTK_ SCRATCH.
All others	There should not be any other network error codes printed. If one occurs that does not match the previous ones, submit a problem report to Compaq.

9.11 Access to Symbols in OpenVMS Executive Images

Accessing OpenVMS executive images' symbols is not always straightforward with SCD. Only a subset of the symbols may be accessible at one time and in some cases, the symbol value the debugger currently has may be stale. To understand these problems and their solutions, you must understand how the debugger maintains its symbol tables and what symbols exist in the OpenVMS executive images. The following sections briefly summarize these topics.

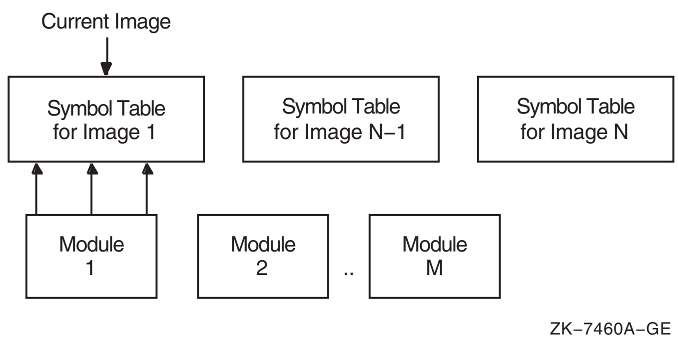
9.11.1 Overview of How the OpenVMS Debugger Maintains Symbols

The debugger can access symbols from any image in the OpenVMS loaded system image list by reading in either the .DSF or .EXE file for that particular image. The .EXE file contains information only about symbols that are part of the symbol vector for that image. The current image symbols for any set module are defined. (You can tell if you have the .DSF or .EXE file by doing a SHOW MODULE. If there are no modules, you have the .EXE file.) This includes any symbols in the SYS$BASE_IMAGE.EXE symbol vector for which the code or data resides in the current image. However, you cannot access a symbol that is part of the SYS$BASE_IMAGE.EXE symbol vector that resides in another image.

In general, at any one point in time, the debugger can access only the symbols from one image. It does this to reduce the time it takes to search for a symbol in a table. To load the symbols for a particular image, use the SET IMAGE command. When you set an image, the debugger loads all the symbols from the new image and makes that image the current image. The symbols from the previous image are in memory, but the debugger will not look through them to translate symbols. To remove symbols from memory for an image, use the CANCEL IMAGE command (which does not work on the main image, SYS$BASE_IMAGE).

There is a set of modules for each image the debugger accesses. The symbol tables in the image that are part of these modules are not loaded with the SET IMAGE command. Instead they can be loaded with the SET MODULE <module-name> or SET MODULE/ALL commands. As they are loaded, a new symbol table is created in memory under the symbol table for the image. Figure 9–1 shows what this looks like.

Figure 9–1 Maintaining Symbols



When the debugger needs to look up a symbol name, it first looks at the current image to find the information. If it does not find it there, it then looks into the appropriate module. It determines which module is appropriate by looking at the module range symbols which are part of the image symbol table.

To see the symbols that are currently loaded, use the debugger's SHOW SYMBOL command. This command has a few options to obtain more than just the symbol name and value. (See the *OpenVMS Debugger Manual* for more details.)

9.11.2 Overview of OpenVMS Executive Image Symbols

Depending on whether the debugger has access to the .DSF or .EXE file, different kinds of symbols could be loaded. Most users will have the .EXE file for the OpenVMS executive images and a .DSF file for their private images—that is, the images they are debugging.

The OpenVMS executive consists of two base images, SYS$BASE_IMAGE.EXE and SYS$PUBLIC_VECTORS.EXE, and a number of separately loadable executive images.

The two base images contain symbol vectors. For SYS$BASE_IMAGE.EXE, the symbol vector is used to define symbols accessible by all the separately loadable images. This allows these images to communicate with each other through cross-image routine calls and memory references. For SYS$PUBLIC_VECTORS.EXE, the symbol vector is used to define the OpenVMS system services. Because these symbol vectors are in the .EXE and the .DSF files, the debugger can load these symbols no matter which one you have.

All images in the OpenVMS executive also contain global and local symbols. However, none of these symbols ever gets into the .EXE file for the image. These symbols are put in the specific module's section of the .DSF file if that module was compiled using /DEBUG and the image was linked using /DSF.

9.11.3 Possible Problems You May Encounter

- **Access to All Executive Image Symbols**

  When the current image is not SYS$BASE_IMAGE, but one of the separately loaded images, the debugger does not have access to any of the symbols in the SYS$BASE_IMAGE symbol vector. This means you cannot access (set breakpoints, and so on) any of the cross-image routines or data cells. The only symbols you have access to are the ones defined by the current image.

  If the debugger has access only to the .EXE file, then only symbols that have vectors in the base image are accessible. For .DSF files, the current image symbols for any set module are defined. (You can tell if you have the .DSF or .EXE by using the SHOW MODULE command—if there are no modules you have the .EXE). This includes any symbols in the SYS$BASE_IMAGE.EXE symbol vector for which the code or data resides in the current image. However, the user cannot access a symbol that is part of the SYS$BASE_IMAGE.EXE symbol vector that resides in another image. For example, if you are in one image and you want to set a breakpoint in a cross-image routine from another image, you do not have access to the symbol. Of course, if you know in which image it is defined, you can do a SET IMAGE, SET MODULE/ALL, and then a SET BREAK.

  There is a debugger workaround for this problem. The debugger and SCD let you use the SET MODULE command on an image by prefixing the image name with SHARE$ (SHARESYSBASE_IMAGE, for example). This treats that image as a module which is part of the current image. In the previous figure, think of it as another module in the module list for an image. Note, however, that only the symbols for the symbol vector are loaded. None of the symbols for the modules of the SHARE$xxx image are loaded. Therefore, this command is only useful for base images.

  So, in other words, by doing SET MODULE SHARESYSBASE_IMAGE, the debugger gives you access to all cross-image symbols for the OpenVMS executive.

- **Stale Data from the Symbol Vector**

  When an OpenVMS executive based image is loaded, the values in the symbol vectors are only correct for information that resides in that based image. For all symbols that are defined in the separately loaded images, the based image contains a pointer to a placeholder location. For routine symbols this is a routine that just returns "an image not loaded" failure code. A symbol vector entry is fixed to contain the real symbol address when the image in which the data resides is loaded.

  Therefore, if you do a SET IMAGE command to a base image before all the symbol entries are corrected, the SET IMAGE obtains the placeholder value for those symbols. Then, once the image containing the real data is loaded, the debugger will still have the placeholder value. This means that you are looking at stale data. One solution to this is to make sure to do a SET IMAGE command on the base image in order to get the most up-to-date symbol vector loaded into memory.

  The CANCEL IMAGE/SET IMAGE combination does not currently work for SYS$BASE_IMAGE because it is the main image and DEBUG does not allow you to CANCEL the main image. Therefore, if you connect to the target system early in the boot process, you will have stale data as part of the SYS$BASE_IMAGE symbol table. However, the SET MODULE SHARE$xxx command always reloads the information from the symbol vector. So, to solve this problem you could SET IMAGE to an image other than SYS$BASE_IMAGE and then use the CANCEL MODULE SHARESYSBASE_IMAGE and SET MODULE SHARESYSBASE_IMAGE commands to do the same thing. The only other solution is to always connect to the target system once all images are loaded that define the real data for values in the symbol vectors. You could also enter the following commands, and you would obtain the latest values from the symbol vector:

```
SET IMAGE EXEC_INIT
SET MODULE/ALL
SET MODULE SHARE$SYS$BASE_IMAGE
```

- **Problems with SYS$BASE_IMAGE.DSF**

  For those who have access to the SYS$BASE_IMAGE.DSF file, there may be another complication with accessing symbols from the symbol vector. The problem is that the module SYSTEM_ROUTINES contains the placeholder values for each symbol in the symbol vector. So, if SYSTEM_ROUTINES is the currently set module (which is the case if you are sitting at the INI$BRK breakpoint) then the debugger will have the placeholder value of the symbol as well as the value in the symbol vector. You can see what values are loaded with the SHOW SYMBOL/ADDRESS command. The symbol vector version should be marked with (global); the local one is not.

  To set a breakpoint at the correct code address for a routine when in this state, use the SHOW SYMBOL/ADDRESS command on the routine symbol name. If the global and local values for the code address are the same, then the image with the routine has not yet been loaded. If not, set a breakpoint at the code address for the global symbol.

9.12 Sample System Code Debugging Session

This section provides a sample session that shows the use of some OpenVMS debugger commands as they apply to SCD. The examples in this session show how to work with C code that has been linked into the SYSTEM_DEBUG execlet. It is called as an initialization routine for SYSTEM_DEBUG.

To reproduce this sample session, the host system needs access to the SYSTEM_DEBUG.DSF matching the SYSTEM_DEBUG.EXE file on your target system, and to the source file C_TEST_ROUTINES.C, which is available in SYS$EXAMPLES. The target system is booted with the boot flags 0, 8004, so it stops at an initial breakpoint, and the devices DKB200,ESA0.

Example 9–1 Booting the Target System

```
>>> b -fl 0,8004 dkb200,esa0
INIT-S-CPU...
INIT-S-RESET_TC...
INIT-S-ASIC...
INIT-S-MEM...
INIT-S-NVR...
INIT-S-SCC...
INIT-S-NI...
INIT-S-SCSI...
INIT-S-ISDN...
INIT-S-TC0...
AUDIT_BOOT_STARTS ...
AUDIT_CHECKSUM_GOOD
AUDIT_LOAD_BEGINS
AUDIT_LOAD_DONE

%SYSBOOT-I-GCTFIL, Using a configuration file to boot as a Galaxy instance.

    OpenVMS (TM) Alpha Operating System, Version V7.2

DBGTK: Initialization succeeded.  Remote system debugging is now possible.

DBGTK: Waiting at breakpoint for connection from remote host.
```

The example continues by invoking the system code debugger's character cell interface on the host system.

Example 9–2 Invoking the System Code Debugger

```
$ define dbg$decw$display " "
$ debug/keep

         OpenVMS Alpha Debug64 Version V7.2-019

DBG>
```

Use the CONNECT command to connect to the target system. In this example, the target system's default password is the null string, and the logical name DBGHK$IMAGE_PATH is used for the image path; so the command qualifiers /PASSWORD and /IMAGE_PATH are not being used. You may need to use them.

When you have connected to the target system, the DBG> prompt is displayed. Enter the SHOW IMAGE command to see what has been loaded. Because you are reaching a breakpoint early in the boot process, there are very few images. See Example 9–3. Notice that SYS$BASE_IMAGE has an asterisk next to it. This is the currently set image, and all symbols currently loaded in the debugger come from that image.

Example 9–3 Connecting to the Target System

```
DBG> connect %node_name TSTSYS
%DEBUG-I-INIBRK, target system interrupted
%DEBUG-I-DYNMODSET, setting module SYSTEM_ROUTINES
DBG> show image
 image name                      set    base address          end address

 ERRORLOG                        no     0000000000000000      FFFFFFFFFFFFFFFF
    NPRO0                               FFFFFFFF80084000      FFFFFFFF80086FFF
    NPRW1                               FFFFFFFF80CA3600      FFFFFFFF80CA3BFF
 EXEC_INIT                       no     FFFFFFFF8306E000      FFFFFFFF830A2000
*SYS$BASE_IMAGE                  yes    0000000000000000      FFFFFFFFFFFFFFFF
    NPRO0                               FFFFFFFF80002000      FFFFFFFF8000EDFF
    NPRW1                               FFFFFFFF80C05C00      FFFFFFFF80C2AFFF
 SYS$CNBTDRIVER                  no     0000000000000000      FFFFFFFFFFFFFFFF
    NPRO0                               FFFFFFFF8001A000      FFFFFFFF8001AFFF
    NPRW1                               FFFFFFFF80C2D600      FFFFFFFF80C2D9FF
 SYS$CPU_ROUTINES_0402           no     0000000000000000      FFFFFFFFFFFFFFFF
    NPRO0                               FFFFFFFF80010000      FFFFFFFF800191FF
    NPRW1                               FFFFFFFF80C2B000      FFFFFFFF80C2D5FF
 SYS$ESBTDRIVER                  no     0000000000000000      FFFFFFFFFFFFFFFF
    NPRO0                               FFFFFFFF8002C000      FFFFFFFF8002E1FF
    NPRW1                               FFFFFFFF80C30C00      FFFFFFFF80C30FFF
 SYS$NISCA_BTDRIVER              no     0000000000000000      FFFFFFFFFFFFFFFF
    NPRO0                               FFFFFFFF8001C000      FFFFFFFF8002ADFF
    NPRW1                               FFFFFFFF80C2DA00      FFFFFFFF80C30BFF
 SYS$OPDRIVER                    no     0000000000000000      FFFFFFFFFFFFFFFF
    NPRO0                               FFFFFFFF80030000      FFFFFFFF800337FF
    NPRW1                               FFFFFFFF80C31000      FFFFFFFF80C319FF
 SYS$PUBLIC_VECTORS              no     0000000000000000      FFFFFFFFFFFFFFFF
    NPRO0                               FFFFFFFF80000000      FFFFFFFF80001FFF
    NPRW1                               FFFFFFFF80C00000      FFFFFFFF80C05BFF
 SYSTEM_DEBUG                    no     FFFFFFFF82FFE000      FFFFFFFF83056000
 SYSTEM_PRIMITIVES_MIN           no     0000000000000000      FFFFFFFFFFFFFFFF
    NPRO0                               FFFFFFFF80034000      FFFFFFFF800775FF
    NPRW1                               FFFFFFFF80C31A00      FFFFFFFF80CA11FF
 SYSTEM_SYNCHRONIZATION_UNI      no     0000000000000000      FFFFFFFFFFFFFFFF
    NPRO0                               FFFFFFFF80078000      FFFFFFFF800835FF
    NPRW1                               FFFFFFFF80CA1200      FFFFFFFF80CA35FF

 total images: 12                bytes allocated: 1517736
```

Example 9–4 shows the target system's console display during the connect sequence. Note that for security reasons, the name of the host system, the user's name, and process ID are displayed.

Example 9–4 Target System Connection Display

```
DBGTK: Connection attempt from host HSTSYS  user GUEST      process 2E801C2F
DBGTK: Connection attempt succeeded
```

To set a breakpoint at the first routine in the C_TEST_ROUTINES module of the SYSTEM_DEBUG.EXE execlet, do the following:

1. Load the symbols for the SYSTEM_DEBUG image with the DEBUG SET IMAGE command.
2. Use the SET MODULE command to obtain the symbols for the module.
3. Set the language to be C and set a breakpoint at the routine test_c_code.

   The language must be set because C is case sensitive and test_c_code needs to be specified in lowercase. The language is normally set to the language of the main image, in this example SYS$BASE_IMAGE.EXE. Currently that is not C.

Example 9–5 Setting a Breakpoint

```
DBG> set image system_debug
DBG> show module
module name                   symbols   language   size

AUX_TARGET                    no        C         15928
BUFSRV_TARGET                 no        C         11288
BUGCHECK_CODES                no        BLISS     26064
CRTLPRINTF                    no        C         29920
C_TEST_ROUTINES               no        C          3808
FATAL_EXC                     no        C          1592
HIGH_ADDRESS                  no        C           372
LIB$CALLING_STANDARD_AUX      no        MACRO64    1680
LINMGR_TARGET                 no        C         13320
LOW_ADDRESS                   no        C           368
OBJMGR                        no        C          5040
PLUMGR                        no        C         19796
POOL                          no        C           116
PROTOMGR_TARGET               no        C         17868
SOCMGR                        no        C          3324
SYS$DOINIT                    no        AMACRO    81740
TARGET_KERNEL                 no        C        207244
TMRMGR_TARGET                 no        C          3516
XDELTA                        no        BLISS    189940
XDELTA_ISRS                   no        MACRO64    2428

total modules: 20.            bytes allocated: 1585168.
```

(continued on next page)

Example 9–5 (Cont.) Setting a Breakpoint

```
DBG> set module c_test_routines
DBG> show module c_test_routines
module name                    symbols    size

C_TEST_ROUTINES                yes        3808

total C modules: 1.            bytes allocated: 1592264.
DBG> set language c
DBG> show symbol test_c_code*
routine C_TEST_ROUTINES\test_c_code5
routine C_TEST_ROUTINES\test_c_code4
routine C_TEST_ROUTINES\test_c_code3
routine C_TEST_ROUTINES\test_c_code2
routine C_TEST_ROUTINES\test_c_code
DBG> set break test_c_code
```

Now that the breakpoint is set, you can proceed and activate the breakpoint. When that occurs, the debugger tries to open the source code for that location in the same place as where the module was compiled. Because that is not the same place as on your system, you need to tell the debugger where to find the source code. This is done with the debugger's SET SOURCE command, which takes a search list as a parameter so you can make it point to many places.

Example 9–6 Finding the Source Code

```
DBG> set source/latest sys$examples,sys$library
DBG> go
break at routine C_TEST_ROUTINES\test_c_code
   166:     x = xdt$fregsav[0];
```

Now that the debugger has access to the source, you can put the debugger into screen mode to see exactly where you are and the code surrounding it.

Example 9–7 Using the Set Mode Screen Command

```
DBG> Set Mode Screen; Set Step Nosource

- SRC: module C_TEST_ROUTINES -scroll-source------------------------------------
   151:     xdt$fregsav[5] = in64;
   152:     xdt$fregsav[6] = in32;
   153:     if (xdt$fregsav[9] > 0)
   154:         *pVar =  (*pVar + xdt$fregsav[17])%xdt$fregsav[9];
   155:     else
   156:         *pVar = (*pVar + xdt$fregsav[17]);
   157:     xdt$fregsav[7] = test_c_code3(10);
   158:     xdt$fregsav[3] = test;
   159:     return xdt$fregsav[23];
   160: }
   161: void test_c_code(void)
   162: {
   163:     int x,y;
   164:     int64 x64,y64;
   165:
-> 166:     x = xdt$fregsav[0];
   167:     y = xdt$fregsav[1];
   168:     x64 = xdt$fregsav[2];
   169:     y64 = xdt$fregsav[3];
   170:     xdt$fregsav[14] = test_c_code2(x64+y64,x+y,x64+x,&y64);
   171:     test_c_code4();
   172:     return;
   173: }
- OUT -output-------------------------------------------------------------------



- PROMPT -error-program-prompt--------------------------------------------------


DBG>
```

Now, you want to set another breakpoint inside the test_c_code3 routine. You use the debugger's SCROLL/UP command (8 on the keypad) to move to that routine and see that line 146 would be a good place to set the breakpoint. It is at a recursive call. Then you proceed to that breakpoint with the GO command.

Example 9–8 Using the SCROLL/UP DEBUG Command

```
- SRC: module C_TEST_ROUTINES -scroll-source------------------------------------
   133: void test_c_code4(void)
   134: {
   135:     int i,k;
   136:     for(k=0;k<1000;k++)
   137:       {
   138:          test_c_code5(&i);
   139:       }
   140:     return;
   141: }
   142: int test_c_code3(int subrtnCount)
   143: {
   144:     subrtnCount = subrtnCount - 1;
   145:     if (subrtnCount != 0)
   146:         subrtnCount = test_c_code3(subrtnCount);
   147:     return subrtnCount;
   148: }
   149: int test_c_code2(int64 in64,int in32, int64 test, int64* pVar)
   150: {
   151:     xdt$fregsav[5] = in64;
   152:     xdt$fregsav[6] = in32;
   153:     if (xdt$fregsav[9] > 0)
   154:         *pVar =  (*pVar + xdt$fregsav[17])%xdt$fregsav[9];
   155:     else
- OUT -output-------------------------------------------------------------------







- PROMPT -error-program-prompt--------------------------------------------------


DBG> Scroll/Up
DBG> set break %line 146
DBG> go
DBG>
```

When you reach that breakpoint, the source code display is updated to show where you currently are, which is indicated by an arrow. A message also appears in the OUT display indicating you reach the breakpoint at that line.

Example 9–9 Breakpoint Display

```
- SRC: module C_TEST_ROUTINES -scroll-source------------------------------------
   135:     int i,k;
   136:     for(k=0;k<1000;k++)
   137:       {
   138:          test_c_code5(&i);
   139:       }
   140:     return;
   141: }
   142: int test_c_code3(int subrtnCount)
   143: {
   144:     subrtnCount = subrtnCount - 1;
   145:     if (subrtnCount != 0)
-> 146:         subrtnCount = test_c_code3(subrtnCount);
   147:     return subrtnCount;
   148: }
   149: int test_c_code2(int64 in64,int in32, int64 test, int64* pVar)
   150: {
   151:     xdt$fregsav[5] = in64;
   152:     xdt$fregsav[6] = in32;
   153:     if (xdt$fregsav[9] > 0)
   154:         *pVar =  (*pVar + xdt$fregsav[17])%xdt$fregsav[9];
   155:     else
   156:         *pVar = (*pVar + xdt$fregsav[17]);
   157:     xdt$fregsav[7] = test_c_code3(10);
- OUT -output-------------------------------------------------------------------
break at C_TEST_ROUTINES\test_c_code3\%LINE 146







- PROMPT -error-program-prompt--------------------------------------------------


DBG> Scroll/Up
DBG> set break %line 146
DBG> go
DBG>
```

Now you try the debugger's STEP command. The default behavior for STEP is STEP/OVER, unlike XDELTA and DELTA, which is STEP/INTO, so, normally you would expect to step to line 147 in the code. However, because you have a breakpoint inside test_c_code3 that is called at line 146, you will reach that event first.

Example 9–10 Using the Debug Step Command

```
- SRC: module C_TEST_ROUTINES -scroll-source------------------------------------
   135:     int i,k;
   136:     for(k=0;k<1000;k++)
   137:       {
   138:          test_c_code5(&i);
   139:       }
   140:     return;
   141: }
   142: int test_c_code3(int subrtnCount)
   143: {
   144:     subrtnCount = subrtnCount - 1;
   145:     if (subrtnCount != 0)
-> 146:         subrtnCount = test_c_code3(subrtnCount);
   147:     return subrtnCount;
   148: }
   149: int test_c_code2(int64 in64,int in32, int64 test, int64* pVar)
   150: {
   151:     xdt$fregsav[5] = in64;
   152:     xdt$fregsav[6] = in32;
   153:     if (xdt$fregsav[9] > 0)
   154:         *pVar =  (*pVar + xdt$fregsav[17])%xdt$fregsav[9];
   155:     else
   156:         *pVar = (*pVar + xdt$fregsav[17]);
   157:     xdt$fregsav[7] = test_c_code3(10);
- OUT -output-------------------------------------------------------------------
break at C_TEST_ROUTINES\test_c_code3\%LINE 146
break at C_TEST_ROUTINES\test_c_code3\%LINE 146






- PROMPT -error-program-prompt--------------------------------------------------

DBG>
DBG> set break %line 146
DBG> go
DBG> Step
DBG>
```

Now, you try a couple of other commands, EXAMINE and SHOW CALLS. The EXAMINE command allows you to look at all the C variables. Note that the C_TEST_ROUTINES module is compiled with the /NOOPTIMIZE switch which allows access to all variables. The SHOW CALLS command shows you the call sequence from the beginning of the stack. In this case, you started out in the image EXEC_INIT. (The debugger prefixes all images other than the main image with SHARE$ so it shows up as SHARE$EXEC_INIT.)

Example 9–11 Using the Examine and Show Calls Commands

```
- SRC: module C_TEST_ROUTINES -scroll-source------------------------------------
   135:     int i,k;
   136:     for(k=0;k<1000;k++)
   137:       {
   138:          test_c_code5(&i);
   139:       }
   140:     return;
   141: }
   142: int test_c_code3(int subrtnCount)
   143: {
   144:     subrtnCount = subrtnCount - 1;
   145:     if (subrtnCount != 0)
-> 146:         subrtnCount = test_c_code3(subrtnCount);
   147:     return subrtnCount;
   148: }
   149: int test_c_code2(int64 in64,int in32, int64 test, int64* pVar)
   150: {
   151:     xdt$fregsav[5] = in64;
   152:     xdt$fregsav[6] = in32;
   153:     if (xdt$fregsav[9] > 0)
   154:         *pVar =  (*pVar + xdt$fregsav[17])%xdt$fregsav[9];
   155:     else
   156:         *pVar = (*pVar + xdt$fregsav[17]);
   157:     xdt$fregsav[7] = test_c_code3(10);
- OUT -output-------------------------------------------------------------------
break at C_TEST_ROUTINES\test_c_code3\%LINE 146
break at C_TEST_ROUTINES\test_c_code3\%LINE 146
C_TEST_ROUTINES\test_c_code3\subrtnCount:       8
 module name     routine name      line           rel PC           abs PC
*C_TEST_ROUTINES test_c_code3       146       00000000000000C4 FFFFFFFF83002D64
*C_TEST_ROUTINES test_c_code3       146       00000000000000D4 FFFFFFFF83002D74
*C_TEST_ROUTINES test_c_code2       157       00000000000001A0 FFFFFFFF83002E40
*C_TEST_ROUTINES test_c_code        170       0000000000000260 FFFFFFFF83002F00
*XDELTA          XDT$SYSDBG_INIT   9371       0000000000000058 FFFFFFFF83052238
*SYS$DOINIT      INI$DOINIT        1488       0000000000000098 FFFFFFFF830520B8
 SHARE$EXEC_INIT                              0000000000018C74 FFFFFFFF83086C74
 SHARE$EXEC_INIT                              0000000000014BD0 FFFFFFFF83082BD0


- PROMPT -error-program-prompt--------------------------------------------------
DBG>
DBG> set break %line 146
DBG> go
DBG> Step
DBG> examine subrtnCount
DBG> show calls
DBG>
```

If you want to proceed because you are done debugging this code, first cancel all the breakpoints and then enter the GO command. Notice, however, that you do not keep running but receive a message that you have stepped to line 147. This happens because the STEP command used earlier never completed. It was interrupted by the breakpoint on line 146.

Note that the debugger remembers all step events and only removes them once they have completed.

Example 9–12 Canceling the Breakpoints

```
- SRC: module C_TEST_ROUTINES -scroll-source-----------------------------------
   136:     for(k=0;k<1000;k++)
   137:       {
   138:          test_c_code5(&i);
   139:       }
   140:     return;
   141: }
   142: int test_c_code3(int subrtnCount)
   143: {
   144:     subrtnCount = subrtnCount - 1;
   145:     if (subrtnCount != 0)
   146:         subrtnCount = test_c_code3(subrtnCount);
-> 147:     return subrtnCount;
   148: }
   149: int test_c_code2(int64 in64,int in32, int64 test, int64* pVar)
   150: {
   151:     xdt$fregsav[5] = in64;
   152:     xdt$fregsav[6] = in32;
   153:     if (xdt$fregsav[9] > 0)
   154:         *pVar =  (*pVar + xdt$fregsav[17])%xdt$fregsav[9];
   155:     else
   156:         *pVar = (*pVar + xdt$fregsav[17]);
   157:     xdt$fregsav[7] = test_c_code3(10);
   158:     xdt$fregsav[3] = test;
- OUT -output------------------------------------------------------------------
break at C_TEST_ROUTINES\test_c_code3\%LINE 146
break at C_TEST_ROUTINES\test_c_code3\%LINE 146
C_TEST_ROUTINES\test_c_code3\subrtnCount:       8
 module name     routine name      line           rel PC           abs PC
*C_TEST_ROUTINES test_c_code3       146       00000000000000C4 FFFFFFFF83002D64
*C_TEST_ROUTINES test_c_code3       146       00000000000000D4 FFFFFFFF83002D74
*C_TEST_ROUTINES test_c_code2       157       00000000000001A0 FFFFFFFF83002E40
*C_TEST_ROUTINES test_c_code        170       0000000000000260 FFFFFFFF83002F00
*XDELTA          XDT$SYSDBG_INIT   9371       0000000000000058 FFFFFFFF83052238
*SYS$DOINIT      INI$DOINIT        1488       0000000000000098 FFFFFFFF830520B8
 SHARE$EXEC_INIT                              0000000000018C74 FFFFFFFF83086C74
 SHARE$EXEC_INIT                              0000000000014BD0 FFFFFFFF83082BD0
stepped to C_TEST_ROUTINES\test_c_code3\%LINE 147

- PROMPT -error-program-prompt-------------------------------------------------
DBG> go
DBG> Step
DBG> examine subrtnCount
DBG> show calls
DBG> cancel break/all
DBG> go
DBG>
```

The STEP/RETURN command, a different type of step command, single steps assembly code until it finds a return instruction. This command is useful if you want to see the return value for the routine, which is done here by examining the R0 register.

For more information about using other STEP command qualifiers, see the *OpenVMS Debugger Manual*.

Example 9–13 Using the Step/Return Command

```
- SRC: module C_TEST_ROUTINES -scroll-source------------------------------------
   137:      {
   138:         test_c_code5(&i);
   139:      }
   140:     return;
   141: }
   142: int test_c_code3(int subrtnCount)
   143: {
   144:     subrtnCount = subrtnCount - 1;
   145:     if (subrtnCount != 0)
   146:         subrtnCount = test_c_code3(subrtnCount);
   147:     return subrtnCount;
-> 148: }
   149: int test_c_code2(int64 in64,int in32, int64 test, int64* pVar)
   150: {
   151:     xdt$fregsav[5] = in64;
   152:     xdt$fregsav[6] = in32;
   153:     if (xdt$fregsav[9] > 0)
   154:         *pVar =  (*pVar + xdt$fregsav[17])%xdt$fregsav[9];
   155:     else
   156:         *pVar = (*pVar + xdt$fregsav[17]);
   157:     xdt$fregsav[7] = test_c_code3(10);
   158:     xdt$fregsav[3] = test;
   159:     return xdt$fregsav[23];
- OUT -output-------------------------------------------------------------------
break at C_TEST_ROUTINES\test_c_code3\%LINE 146
break at C_TEST_ROUTINES\test_c_code3\%LINE 146
C_TEST_ROUTINES\test_c_code3\subrtnCount:       8
 module name     routine name      line           rel PC           abs PC
*C_TEST_ROUTINES test_c_code3       146       00000000000000C4 FFFFFFFF83002D64
*C_TEST_ROUTINES test_c_code3       146       00000000000000D4 FFFFFFFF83002D74
*C_TEST_ROUTINES test_c_code2       157       00000000000001A0 FFFFFFFF83002E40
*C_TEST_ROUTINES test_c_code        170       0000000000000260 FFFFFFFF83002F00
*XDELTA          XDT$SYSDBG_INIT   9371       0000000000000058 FFFFFFFF83052238
*SYS$DOINIT      INI$DOINIT        1488       0000000000000098 FFFFFFFF830520B8
 SHARE$EXEC_INIT                              0000000000018C74 FFFFFFFF83086C74
 SHARE$EXEC_INIT                              0000000000014BD0 FFFFFFFF83082BD0
stepped to C_TEST_ROUTINES\test_c_code3\%LINE 147
stepped on return from C_TEST_ROUTINES\test_c_code3\%LINE 147 to C_TEST_ROUTINES\test_c_code3\%LINE 148
C_TEST_ROUTINES\test_c_code3\%R0:       0
- PROMPT -error-program-prompt--------------------------------------------------
DBG> examine subrtnCount
DBG> show calls
DBG> cancel break/all
DBG> go
DBG> step/return
DBG> examine r0
DBG>
```

After you finish the SCD session, enter the GO command to leave this module. You will encounter another INI$BRK breakpoint at the end of EXEC_INIT. An error message indicating there are no source lines for address 80002010 is displayed, because debug information on this image or module is not available.

Also notice that there is no message in the OUT display for this event. That is because INI$BRKs are special breakpoints that are handled as SS$_DEBUG signals. They are a method for the system code to break into the debugger and there is no real breakpoint in the code.

Example 9–14 Source Lines Error Message

```
- SRC: module SYSTEM_ROUTINES -scroll-source------------------------------------
 15896: Source line not available
 15897: Source line not available
   .
   .
   .
 15906: Source line not available
->5907: Source line not available
 15908: Source line not available
   .
   .
   .
 15917: Source line not available
 15918: Source line not available
- OUT -output-------------------------------------------------------------------
break at C_TEST_ROUTINES\test_c_code3\%LINE 146
break at C_TEST_ROUTINES\test_c_code3\%LINE 146
C_TEST_ROUTINES\test_c_code3\subrtnCount:      8
 module name     routine name      line           rel PC           abs PC
*C_TEST_ROUTINES test_c_code3       146       00000000000000C4 FFFFFFFF83002D64
*C_TEST_ROUTINES test_c_code3       146       00000000000000D4 FFFFFFFF83002D74
*C_TEST_ROUTINES test_c_code2       157       00000000000001A0 FFFFFFFF83002E40
*C_TEST_ROUTINES test_c_code        170       0000000000000260 FFFFFFFF83002F00
*XDELTA          XDT$SYSDBG_INIT   9371       0000000000000058 FFFFFFFF83052238
*SYS$DOINIT      INI$DOINIT        1488       0000000000000098 FFFFFFFF830520B8
 SHARE$EXEC_INIT                              0000000000018C74 FFFFFFFF83086C74
 SHARE$EXEC_INIT                              0000000000014BD0 FFFFFFFF83082BD0
stepped to C_TEST_ROUTINES\test_c_code3\%LINE 147
stepped on return from C_TEST_ROUTINES\test_c_code3\%LINE 147 to C_TEST_ROUTINES\test_c_code3\%LINE 148
C_TEST_ROUTINES\test_c_code3\%R0:      0
- PROMPT -error-program-prompt--------------------------------------------------
DBG> examine r0
DBG> go
%DEBUG-I-INIBRK, target system interrupted
%DEBUG-I-DYNIMGSET, setting image SYS$BASE_IMAGE
%DEBUG-W-SCRUNAOPNSRC, unable to open source file SYS$COMMON:[SYSLIB]SYSTEM_ROUTINES.M64;
-RMS-E-FNF, file not found
DBG>
```

Enter the SHOW IMAGE command. You will see more images displayed as the boot path has progressed further.

Finally, enter GO, allowing the target system to boot completely, because there are no more breakpoints in the boot path. The debugger will wait for another event to occur.

Example 9–15 Using the Show Image Command

```
- SRC: module SYSTEM_ROUTINES -scroll-source-----------------------------------
 15896: Source line not available
 15897: Source line not available
   .
   .
   .
 15906: Source line not available
->5907: Source line not available
 15908: Source line not available
   .
   .
   .
 15917: Source line not available
 15918: Source line not available
- OUT -output-----------------------------------------------------------------
    PRO2                                 FFFFFFFF8329C000       FFFFFFFF832A2DFF
 SYSLICENSE                    no     0000000000000000       FFFFFFFFFFFFFFFF
    NPRO0                                FFFFFFFF80188000       FFFFFFFF801883FF
    NPRW1                                FFFFFFFF80CCC000       FFFFFFFF80CCC5FF
    PRO2                                 FFFFFFFF8321E000       FFFFFFFF832247FF
    PRW3                                 FFFFFFFF83226000       FFFFFFFF832265FF
 SYSTEM_DEBUG                  yes    FFFFFFFF82FFE000       FFFFFFFF83056000
 SYSTEM_PRIMITIVES_MIN         no     0000000000000000       FFFFFFFFFFFFFFFF
    NPRO0                                FFFFFFFF80034000       FFFFFFFF800775FF
    NPRW1                                FFFFFFFF80C31A00       FFFFFFFF80CA11FF
 SYSTEM_SYNCHRONIZATION_UNI    no     0000000000000000       FFFFFFFFFFFFFFFF
    NPRO0                                FFFFFFFF80078000       FFFFFFFF800835FF
    NPRW1                                FFFFFFFF80CA1200       FFFFFFFF80CA35FF

 total images: 40              bytes allocated: 2803296
- PROMPT -error-program-prompt------------------------------------------------
%DEBUG-I-INIBRK, target system interrupted
%DEBUG-I-DYNIMGSET, setting image SYS$BASE_IMAGE
%DEBUG-W-SCRUNAOPNSRC, unable to open source file X6P3_RESD$:[SYSLIB]SYSTEM_ROUTINES.M64;
-RMS-E-FNF, file not found
DBG> show image
DBG> go
```

10

The OpenVMS Alpha System Dump Debugger

This chapter describes the OpenVMS Alpha System Dump Debugger (SDD) and how you can use it to analyze system crash dumps.

SDD is similar in concept to SCD as described in Chapter 9. Where SCD allows connection to a running system with control of the system's execution and the examination and modification of variables, SDD allows analysis of memory as recorded in a system dump.

Use of the SDD usually involves two systems, although all the required environment can be set up on a single system. The description that follows assumes that two systems are being used:

- The build system, where the image that causes the system crash has been built
- The test system, where the image is executed and the system crash occurs

In common with SCD, the OpenVMS debugger's user interface allows you to specify variable names, routine names, and so on, precisely as they appear in your source code. Also, SDD can display the source code where the software was executing at the time of the system crash.

SDD recognizes the syntax, data typing, operators, expressions, scoping rules, and other constructs of a given language. If your code or driver is written in more than one language, you can change the debugging context from one language to another during a debugging session.

To use SDD, you must do the following:

- Build the system image or device driver that is causing the system crash.
- Boot a system, including the system image or device driver, and perform the necessary steps to cause the system crash.
- Reboot the system and save the dump file.
- Invoke SDD, which is integrated with the OpenVMS debugger.

The following sections cover these tasks in more detail, describe the available user-interface options, summarize applicable OpenVMS Debugger commands, and provide a sample SDD session.

10.1 User-Interface Options

SDD has the following user-interface options.

- A DECwindows Motif interface for workstations.

  When using this interface, you interact with SDD by using a mouse and pointer to choose items from menus, click on buttons, select names in windows, and so on.

Note that you can also use OpenVMS Debugger commands with the DECwindows Motif interface.

- A character cell interface for terminals and workstations.

  When using this interface, you interact with SDD by entering commands at a prompt. The sections in this chapter describe how to use the system dump debugger with the character cell interface.

  For more information about using the OpenVMS DECwindows Motif interface and OpenVMS Debugger commands with SDD, see the *OpenVMS Debugger Manual*.

10.2 Preparing a System Dump to Be Analyzed

To prepare a system dump for analysis, perform the following steps:

1. Compile the sources you will want to analyze, and use the /DEBUG (mandatory) and /NOOPT (preferred) qualifiers.

   Note

   Because you are analyzing a snapshot of the system, it is not as vital to use unoptimized code as it is with the system code debugger. But note that you cannot access all variables. SDD may report that they are optimized away.

2. Link your image using the /DSF (debug symbol file) qualifier. Do not use the /DEBUG qualifier, which is for debugging user programs. The /DSF qualifier takes an optional filename argument similar to the /EXE qualifier. For more information, see the *OpenVMS Linker Utility Manual*. If you specify a name in the /EXE qualifier, you will need to specify the same name for the /DSF qualifier. For example, you would use the following command:

   ```
   $ LINK/EXE=EXE$:MY_EXECLET/DSF=EXE$:MY_EXECLET OPTIONS_FILE/OPT
   ```

   The .DSF and .EXE file names must be the same. Only the extensions will be different, that is, .DSF and .EXE.

   The contents of the .EXE file should be exactly the same as if you had linked without the /DSF qualifier. The .DSF file will contain the image header and all the debug symbol tables for .EXE file. It is not an executable file, and cannot be run or loaded.

3. Put the .EXE file on your test system.
4. Boot the test system and perform the necessary steps to cause the system crash.
5. Reboot the test system and copy the dump to the build system using the System Dump Analyzer (SDA) command COPY. See Chapter 4.

10.3 Setting Up the Test System

The only requirement for the test system is that the .DSF file matching the .EXE file that causes the crash is available on the build system.

There are no other steps necessary in the setup of the test system. With the system image copied to the test system, it can be booted in any way necessary to produce the system crash. Since SDD can analyze most system crash dumps, any system can be used, from a standalone system to a member of a production cluster.

Note

It is assumed that the test system has a dump file large enough for the system dump to be recorded. Any dump style may be used (full or selective, compressed or uncompressed). A properly AUTOGENed system will meet these requirements.

10.4 Setting Up the Build System

To set up the build system, you need access to all system images and drivers that were loaded on the test system. You should have access to a source listings kit or a copy of the following directories:

```
SYS$LOADABLE_IMAGES:
SYS$LIBRARY:
SYS$MESSAGE:
```

You need all the .EXE files in those directories. The .DSF files are available with the OpenVMS Alpha source listings kit.

Optionally, you need access to the source files for the images to be debugged. SDD will look for the source files in the directory where they were compiled. You must use the SET SOURCE command to point SDD to the location of the source code files if they are not in the directories used when the image was built. For an example of the SET SOURCE command, see Section 10.9.

Before you can analyze a system dump with SDD, you must set up the logical name DBGHK$IMAGE_PATH, which must be set up as a search list to the area where the system images or .DSF files are kept. For example, if the copies are in the following directories:

```
DEVICE:[SYS$LDR]
DEVICE:[SYSLIB]
DEVICE:[SYSMSG]
```

you would define DBGHK$IMAGE_PATH as follows:

```
$ define dbghk$image_path DEVICE:[SYS$LDR],DEVICE:[SYSLIB],DEVICE:[SYSMSG]
```

This works well for analyzing a system dump using all the images normally loaded on a given system. However, you might be using SDD to analyze new code either in an execlet or a new driver. Because that image is most likely in your default directory, you must define the logical name as follows:

```
$ define dbghk$image_path [],DEVICE:[SYS$LDR],DEVICE:[SYSLIB],DEVICE:[SYSMSG]
```

If SDD cannot find one of the images through this search path, a warning message is displayed. SDD will continue initialization as long as it finds at least one image. If SDD cannot find the SYS$BASE_IMAGE file, which is the OpenVMS Alpha operating system's main image file, an error message is displayed and the debugger exits.

If and when this happens, check the directory for the image files and compare it to what was loaded on the test system.

10.5 Starting the System Dump Debugger

To start SDD on the build system, enter the following command.

```
$ DEBUG/KEEP
```

SDD displays the DBG> prompt. With the DBGHK$IMAGE_PATH logical name defined, you can invoke the ANALYZE/CRASH_DUMP command and optional qualifier /IMAGE_PATH.

To use the ANALYZE/CRASH_DUMP command and optional qualifier (/IMAGE_PATH) to analyze the dump in file <file-name> enter the following command:

```
DBG> ANALYZE/CRASH_DUMP file-name
```

The /IMAGE_PATH qualifier is optional. If you do not use this qualifier, SDD uses the DBGHK$IMAGE_PATH logical name as the default. The /IMAGE_PATH qualifier is a quick way to change the logical name. However, when you use it, you cannot specify a search list. You can use only a logical name or a device and directory, although the logical name can be a search list.

Usually, SDD obtains the source file name from the object file. This is put there by the compiler when the source is compiled with the /DEBUG qualifier. The SET SOURCE command can take a list of paths as a parameter. It treats them as a search list.

10.6 Summary of System Dump Debugger Commands

Only a subset of OpenVMS debugger commands can be used in SDD. The following are a few examples of commands that you can use in SDD:

- Commands to manipulate the source display, such as TYPE and SCROLL
- Commands used in OpenVMS debugger command programs, such as DO and IF
- Commands that affect output formats, such as SET RADIX
- Commands that manipulate symbols and scope, such as EVALUATE, SET LANGUAGE, and CANCEL SCOPE
- Commands that read the contents of memory and registers, such as EXAMINE

Examples of commands that **cannot** be used in SDD are as follows:

- Commands that cause code to be executed, such as STEP and GO
- Commands that manipulate breakpoints, such as SET BREAK and CANCEL BREAK
- Commands that modify memory or registers, such as DEPOSIT

You can also use the OpenVMS debugger command SDA to examine the system dump with System Dump Analyzer semantics. This command, which is not available when debugging user programs, is described in the next section.

10.7 Using System Dump Analyzer Commands

Once a dump file has been opened, you can use the commands listed in the previous section to examine the system dump. You can also use some System Dump Analyzer (SDA) commands, such as SHOW SUMMARY and SHOW DEVICE. This feature allows the system programmer to take advantage of the strengths of both the OpenVMS Debugger and SDA to examine the system dump and to debug system programs such as device drivers, without having to invoke both the OpenVMS debugger and SDA separately.

To obtain access to SDA commands, you simply type "SDA" at the OpenVMS Debugger prompt ("DBG>") at any time after the dump file has been opened. SDA initializes itself and then outputs the "SDA>" prompt. Enter SDA commands as required. (See Chapter 4 for more information.) To return to the OpenVMS Debugger, you enter "EXIT" at the "SDA>" prompt. Optionally, you may invoke SDA to perform a single command and then return immediately to the OpenVMS Debugger, as in the following example:

```
DBG> SDA SHOW SUMMARY
```

SDA may be reentered at any time, with or without the optional SDA command. Once SDA has been initialized, the SDA> prompt is output more quickly on subsequent occasions.

Note that there are some limitations on the use of SDA from within SDD:

- You cannot switch between processes, whether requested explicitly (SET PROCESS <name>) or implicitly (SHOW PROCESS <name>). The exception to this is that access to the system process is possible.
- You cannot switch between CPUs.
- SDA has no knowledge of the OpenVMS debugger's Motif or Windows interfaces. Therefore, all SDA input and output occurs at the terminal or window where the OpenVMS debugger was originally invoked. Also, while using SDA, the OpenVMS debugger window is not refreshed; you must exit SDA to allow the OpenVMS debugger window to be refreshed.
- When you invoke SDA from SDD with an immediate command, and that command produces a full screen of output, SDA displays the message "Press RETURN for more." followed by the "SDA>" prompt before continuing. At this prompt, if you enter another SDA command, SDA does not automatically return to SDD upon completion. To do this, you must enter an EXIT command.

If the need arises to switch between processes or CPUs in the system dump, then you must invoke SDA separately using the DCL command ANALYZE/CRASH_DUMP.

10.8 Limitations of the System Dump Debugger

SDD provides a narrow window into the context of the system that was current at the time that the system crashed (stack, process, CPU, and so on). It does not provide full access to every part of the system as is provided by SDA. However, it does provide a view of the failed system using the semantics of the OpenVMS debugger—source correlation and display, call frame traversal, examination of variables by name, language constructs, and so on.

SDD therefore provides an additional approach to analyzing system dumps that is difficult to realize with SDA, often allowing quicker resolution of system crashes than is possible with SDA alone. When SDD cannot provide the needed data from the system dump, you should use SDA instead.

10.9 Access to Symbols in OpenVMS Executive Images

For a discussion and explanation of how the OpenVMS debugger accesses symbols in OpenVMS executive images, see Section 9.11.

10.10 Sample System Dump Debugging Session

This section provides a sample session that shows the use of some OpenVMS debugger commands as they apply to the system dump debugger. The examples in this section show how to work with a dump created as follows:

1. Follow the steps in Section 9.12, up to and including Example 8-9 (Breakpoint Display).
2. When the breakpoint at line 146 is reached, enter the OpenVMS debugger command to clear R27 and then continue:

   ```
   DBG> DEPOSIT R27=0
   DBG> GO
   ```

3. The system then crashes and a dump is written.
4. When the system reboots, copy the contents of SYS$SYSTEM:SYSDUMP.DMP to the build system with SDA:

   ```
   $ analyze/crash sys$system:sysdump.dmp

    OpenVMS (TM) Alpha system dump analyzer
    ...analyzing a selective memory dump...

    %SDA-W-NOTSAVED, global pages not saved in the dump file
    Dump taken on  1-JAN-1998 00:00:00.00
    INVEXCEPTN, Exception while above ASTDEL

    SDA> copy hstsys::sysdump.dmp
    SDA>
   ```

To reproduce this sample session, you need access to the SYSTEM_DEBUG.DSF matching the SYSTEM_DEBUG.EXE file on your test system and to the source file C_TEST_ROUTINES.C, which is available in SYS$EXAMPLES.

The example begins by invoking the system dump debugger's character cell interface on the build system.

Example 10–1 Invoking the System Dump Debugger

```
$ define dbg$decw$display " "
$ debug/keep

         OpenVMS Alpha Debug64 Version V7.2-019

DBG>
```

Use the ANALYZE/CRASH_DUMP command to open the system dump. In this example, the logical name DBGHK$IMAGE_PATH is used for the image path, so the command qualifier /IMAGE_PATH is not being used. You may need to use it.

When you have opened the dump file, the DBG> prompt is displayed. You should now do the following:

1. Set the language to be C, the language of the module that was active at the time of the system crash.
2. Set the source directory to the location of the source of the module. Use the debugger's SET SOURCE command, which takes a search list as a parameter so you can make it point to many places.

Example 10–2 Accessing the System Dump

```
DBG> analyze/crash_dump sysdump.dmp
%SDA-W-NOTSAVED, global pages not saved in the dump file
%DEBUG-I-INIBRK, target system interrupted
%DEBUG-I-DYNIMGSET, setting image SYSTEM_DEBUG
%DEBUG-I-DYNMODSET, setting module C_TEST_ROUTINES
DBG> set language c
DBG> set source/latest sys$examples,sys$library
DBG>
```

Now that the debugger has access to the source, you can put the debugger into screen mode to see exactly where you are and the code surrounding it.

Example 10–3 Displaying the Source Code

```
DBG> Set Mode Screen; Set Step Nosource

- SRC: module C_TEST_ROUTINES -scroll-source------------------------------------
   135:     int i,k;
   136:     for(k=0;k<1000;k++)
   137:       {
   138:          test_c_code5(&i);
   139:       }
   140:     return;
   141: }
   142: int test_c_code3(int subrtnCount)
   143: {
   144:     subrtnCount = subrtnCount - 1;
   145:     if (subrtnCount != 0)
-> 146:         subrtnCount = test_c_code3(subrtnCount);
   147:     return subrtnCount;
   148: }
   149: int test_c_code2(int64 in64,int in32, int64 test, int64* pVar)
   150: {
   151:     xdt$fregsav[5] = in64;
   152:     xdt$fregsav[6] = in32;
   153:     if (xdt$fregsav[9] > 0)
   154:         *pVar =  (*pVar + xdt$fregsav[17])%xdt$fregsav[9];
   155:     else
   156:         *pVar = (*pVar + xdt$fregsav[17]);
   157:     xdt$fregsav[7] = test_c_code3(10);
- OUT -output-------------------------------------------------------------------








- PROMPT -error-program-prompt--------------------------------------------------



DBG>
```

Now, you try a couple of other commands, EXAMINE and SHOW CALLS. The EXAMINE command allows you to look at all the C variables. Note that the C_TEST_ROUTINES module is compiled with the /NOOPTIMIZE switch which allows access to all variables. The SHOW CALLS command shows you the call sequence from the beginning of the stack. In this case, you started out in the image EXEC_INIT. (The debugger prefixes all images other than the main image with SHARE$ so it shows up as SHARE$EXEC_INIT.)

Example 10–4 Using the Examine and Show Calls Commands

```
DBG> Set Mode Screen; Set Step Nosource

- SRC: module C_TEST_ROUTINES -scroll-source------------------------------------
   135:     int i,k;
   136:     for(k=0;k<1000;k++)
   137:       {
   138:          test_c_code5(&i);
   139:       }
   140:     return;
   141: }
   142: int test_c_code3(int subrtnCount)
   143: {
   144:     subrtnCount = subrtnCount - 1;
   145:     if (subrtnCount != 0)
-> 146:         subrtnCount = test_c_code3(subrtnCount);
   147:     return subrtnCount;
   148: }
   149: int test_c_code2(int64 in64,int in32, int64 test, int64* pVar)
   150: {
   151:     xdt$fregsav[5] = in64;
   152:     xdt$fregsav[6] = in32;
   153:     if (xdt$fregsav[9] > 0)
   154:         *pVar =  (*pVar + xdt$fregsav[17])%xdt$fregsav[9];
   155:     else
   156:         *pVar = (*pVar + xdt$fregsav[17]);
   157:     xdt$fregsav[7] = test_c_code3(10);
- OUT -output-------------------------------------------------------------------
C_TEST_ROUTINES\test_c_code3\subrtnCount:       9
 module name     routine name     line          rel PC           abs PC
*C_TEST_ROUTINES test_c_code3      146      00000000000000CC FFFFFFFF83002D6C
*C_TEST_ROUTINES test_c_code2      157      00000000000001A0 FFFFFFFF83002E40
*C_TEST_ROUTINES test_c_code       170      0000000000000260 FFFFFFFF83002F00
*XDELTA          XDT$SYSDBG_INIT   9371     0000000000000058 FFFFFFFF83052238
*SYS$DOINIT      INI$DOINIT       1488      0000000000000098 FFFFFFFF830520B8
 SHARE$EXEC_INIT                            0000000000018C74 FFFFFFFF83086C74
 SHARE$EXEC_INIT                            0000000000014BD0 FFFFFFFF83082BD0


- PROMPT -error-program-prompt--------------------------------------------------


DBG> e subrtnCount
DBG> show calls
DBG>
```

Part III

OpenVMS Watchpoint Utility

Part 3 describes the Watchpoint utility. It presents how to use the Watchpoint utility by doing the following:

- Loading the watchpoint driver
- Creating and deleting watchpoints
- Looking at watchpoint driver data
- Acquiring collected watchpoint data
- Looking at the protection attributes and access fault mechanism
- Looking at some watchpoint restrictions

11 The Watchpoint Utility

This chapter describes the Watchpoint utility (WP), which enables you to monitor write access to user-specified locations. The chapter contains the following sections:

Section 11.1 presents an introduction of the Watchpoint utility.

Section 11.2 describes how to load the watchpoint driver.

Section 11.3 describes the creation and deletion of watchpoints and the constraints upon watchpoint locations.

Section 11.4 contains detailed descriptions of the watchpoint driver data structures, knowledge of which may be required to analyze collected watchpoint data.

Section 11.5 discusses acquiring collected watchpoint data.

Section 11.6 describes the watchpoint protection facility.

Section 11.7 describes its restrictions.

11.1 Introduction

A watchpoint is a data field to which write access is monitored. The field is from 1 to 8 bytes long and must be contained within a single page. Typically, watchpoints are in nonpaged pool. However, subject to certain constraints (see Section 11.3.1), they can be defined in other areas of system space. The Watchpoint facility can simultaneously monitor a large number (50 or more) watchpoints.

The utility is implemented in the WPDRIVER device driver and the utility program WP. This document concentrates on the device driver, which can be invoked directly or through the WP utility.

For information on the WP utility, see its help files, which can be displayed with the following DCL command:

```
$ HELP/LIBRARY=SYS$HELP:WP
```

Once the driver has been loaded, a suitably privileged user can designate a watchpoint in system space. Any write to a location designated as a watchpoint is trapped. Information is recorded about the write, including its time, the register contents, and the program counter (PC) and processor status longword (PSL) of the writing instruction. Optionally, one or both of the following user-specified actions can be taken:

- An XDELTA breakpoint[1] or SCD breakpoint which occurs just after the write to the watchpoint

[1] For simplicity, this chapter only mentions XDELTA. Any reference to XDELTA breakpoints also implies SCD breakpoints.

- A fatal watchpoint bugcheck which occurs just after the write to the watchpoint

You define a watchpoint by issuing QIO requests to the watchpoint driver; entering commands to the WP utility, which issues requests to the driver; or, from kernel mode code, invoking a routine within the watchpoint driver.

The WPDRIVER data structures store information about writes to a watchpoint. This information can be obtained either through QIO requests to the WPDRIVER, commands to the WP utility, XDELTA commands issued during a requested breakpoint, or SDA commands issued during the analysis of a requested crashdump.

11.2 Initializing the Watchpoint Utility

From a process with CMKRNL privilege, run the SYSMAN utility to load the watchpoint driver, SYS$WPDRIVER.EXE. Enter the following commands:

```
$ RUN SYS$SYSTEM:SYSMAN
SYSMAN> IO CONNECT WPA0:/NOADAPTER/DRIVER=SYS$WPDRIVER
SYSMAN> EXIT
```

SYSMAN creates system I/O data structures for the pseudo-device WPA0, loads WPDRIVER, and invokes its initialization routines. WPDRIVER initialization includes the following actions:

- Allocating nonpaged pool and physical memory for WPDRIVER data structures
- Appropriating the SCB vector specific to access violations
- Recording in system space the addresses of the WPDRIVER routines invoked by kernel mode code to create and delete watchpoints

Memory requirements for WPDRIVER and its data structures are:

- Device driver and UCB—approximately 3K bytes of nonpaged pool
- Trace table and a related array—36 bytes for each of system parameter WPTTE_SIZE trace table entries
- Watchpoint restore entries—system parameter WPRE_SIZE pages of physically contiguous memory
- Each watchpoint—176 bytes of nonpaged pool

It is advisable to load the watchpoint driver relatively soon after system initialization to ensure its allocation of physically contiguous memory. If the driver cannot allocate enough physically contiguous memory, it does not set WPA0: online. If the unit is offline, you will not be able to use the watchpoint utility.

11.3 Creating and Deleting Watchpoints

There are three different ways to create and delete watchpoints:

- An image can assign a channel to device WPA0: and then request the Queue I/O Request ($QIO) system service to create or delete a watchpoint.
- Code running in kernel mode can dispatch directly to routines within the WPDRIVER to create and delete watchpoints.
- You can enter commands to the WP utility.

The first two methods are described in detail in the sections that follow.

11.3.1 Using the $QIO Interface

An image first assigns a channel to the pseudo-device WPA0: and then issues a $QIO request on that channel. The process must have the privilege PHY_IO; otherwise, the $QIO request is rejected with the error SS$_NOPRIV.

Table 11–1 shows the functions that the driver supports.

Table 11–1 Driver Supported Functions

Function	Activity
IO$_ACCESS	Creates a watchpoint
IO$_DEACCESS	Deletes a watchpoint
IO$_RDSTATS	Receives trace information on a watchpoint

The IO$_ACCESS function requires the following device/function dependent arguments:

- P2—Length of the watchpoint. A number larger than 8 is reduced to 8.
- P3—Starting address of the watchpoint area.

The following are the constraints on the watchpoint area. It must be:

- Nonpageable system space.
- Write-accessible from kernel mode.
- Within one page. If it is not, the requested length is reduced to what will fit within the page containing the starting address.
- Within a page accessed only from kernel mode and by instructions that incur no pagefaults.
- Within a page whose protection is not altered while the watchpoint is in place.
- Outside of certain address ranges. These are the WPDRIVER code, its data structures, and the system page table.

Because of the current behavior of the driver, there is an additional requirement that there be no “unexpected” access violations referencing a page containing a watchpoint. See Section 11.7 for further details.

To specify that an XDELTA breakpoint or a fatal bugcheck occur if the watchpoint is written, use the following I/O function code modifiers:

- IO$M_CTRL to request an XDELTA breakpoint
- IO$M_ABORT to request a fatal bugcheck

For an XDELTA breakpoint to be taken, OpenVMS must have been booted specifying that XDELTA and/or the SCD be resident (bit 1 or bit 15 in the boot flags must be set). If both watchpoint options are requested, the XDELTA breakpoint is taken first. At exit from the breakpoint, the driver crashes the system.

A request to create a watchpoint can succeed completely, succeed partially, or fail. Table 11–2 shows the status codes that can be returned in the I/O status block.

Table 11–2 Returned Status Codes

Status Code	Meaning
SS$_NORMAL	Success.
SS$_BUFFEROVF	A watchpoint was established, but its length is less than was requested because the requested watchpoint would have straddled a page boundary.
SS$_EXQUOTA	The watchpoint could not be created because too many watchpoints already exist.
SS$_INSFMEM	The watchpoint could not be created because there was insufficient nonpaged pool to create data structures specific to this watchpoint.
SS$_IVADDR	The requested watchpoint resides in one of the areas in which the WPDRIVER is unable to create watchpoints.
SS$_WASSET	An existing watchpoint either coincides or overlaps with the requested watchpoint.

The following example MACRO program assigns a channel to the WPA0 device and creates a watchpoint of 4 bytes, at starting address 80001068. The program requests neither an XDELTA breakpoint nor a system crash for that watchpoint.

```
          $IODEF
          .PSECT   RWDATA,NOEXE,RD,WRT,LONG
                                    ;
WP_IOSB:  .BLKL    2                ; I/O status block.
WP_ADDR:  .LONG    ^X80001068       ; Address of watchpoint to create.
WP_NAM:   .ASCID   /WPA0:/          ; Device to which to assign channel.
WP_CHAN:  .BLKW    1                ; Channel number.
          .PSECT   PROG,EXE,NOWRT
                                    ;
START:    .CALL_ENTRY

           $ASSIGN_S DEVNAM=WP_NAM,CHAN=WP_CHAN
           BLBC    R0,RETURN

           $QIOW_S CHAN=WP_CHAN,-
                   FUNC=#IO$_ACCESS,-
                   IOSB=WP_IOSB,-
                   P2=#4,-
                   P3=WP_ADDR
           BLBC    R0,RETURN
           MOVL    WP_IOSB,R0       ; Move status to R0.
RETURN:    RET                      ; Return to caller.
          .END     START
```

A watchpoint remains in effect until it is explicitly deleted. (Note, however, that watchpoint definitions do not persist across system reboots.) To delete an existing watchpoint, issue an IO$_DEACCESS QIO request.

The IO$_DEACCESS function requires the following device/function dependent argument: P3 - Starting address of the watchpoint to be deleted.

Table 11–3 shows the status values that are returned in the I/O status block.

Table 11–3 Returned Status Values

Status Value	Meaning
SS$_NORMAL	Success.
SS$_IVADDR	The specified watchpoint does not exist.

Section 11.5 describes the use of the IO$_RDSTATS QIO request.

11.3.2 Invoking WPDRIVER Entry Points from System Routines

When the WPDRIVER is loaded, it initializes two locations in system space with the addresses of routines within the driver. These locations, WP$CREATE_WATCHPOINT and WP$DELETE_WATCHPOINT, enable dispatch to create and delete watchpoint routines within the loaded driver. Input arguments for both routines are passed in registers.

Code running in kernel mode can execute the following instructions:

```
JSB    @G^WP$CREATE_WATCHPOINT ; create a watchpoint
```

and

```
JSB    @G^WP$DELETE_WATCHPOINT ; delete a watchpoint
```

Both these routines save IPL at entry and set it to the fork IPL of the WPDRIVER, IPL 11. Thus, they should not be invoked by code threads running above IPL 11. At exit, the routines restore the entry IPL.

These two locations contain an RSB instruction prior to the loading of the driver. As a result, if a system routine tries to create or delete a watchpoint before the WPDRIVER is loaded, control immediately returns.

WP$CREATE_WATCHPOINT has the following register arguments:

- R0—User-specified watchpoint options
  - Bit 1 equal to 1 specifies that a fatal OPERCRASH bugcheck should occur after a write to the watchpoint area.
  - Bit 2 equal to 1 specifies that an XDELTA breakpoint should occur after a write to the watchpoint area.
- R1—Length of the watchpoint area
- R2—Starting address of the watchpoint area

Status is returned in R0. The status values and their interpretations are identical to those for the QIO interface to create a watchpoint. The only difference is that the SS$_NOPRIV status cannot be returned with this interface.

WPS$DELETE_WATCHPOINT has the following register argument:

- R2—Starting address of the watchpoint area

Status is returned in R0. The status values and their interpretations are identical to those for the QIO interface.

11.4 Data Structures

The WPDRIVER uses three different kinds of data structures:

- One watchpoint restore entry (WPRE) for each page of system space in which one or more active watchpoints are located
- One watchpoint control block (WPCB) for each active watchpoint
- Trace table entries (WPTTEs) in a circular trace buffer which maintains a history of watchpoint writes

These data structures are described in detail and illustrated in the sections that follow.

11.4.1 Watchpoint Restore Entry (WPRE)

There is one WPRE for each system page that contains a watchpoint. That is, if nine watchpoints are defined which are in four different system pages, four WPREs are required to describe those pages. When WPDRIVER is loaded, its initialization routine allocates physically contiguous memory for the maximum number of WPREs. The number of pages to be allocated is specified by system parameter WPRE_SIZE.

The WPDRIVER allocates WPREs starting at the beginning of the table and maintains a tightly packed list. That is, when a WPRE in the middle of those in use is "deallocated," its current contents are replaced with the contents of the last WPRE in use. The number in use at any given time is in the driver variable WP$L_WP_COUNT. The system global EXE$GA_WP_WPRE points to the beginning of the WPRE table.

The WPRE for a page contains information useful for:

- Determining whether a given access violation refers to an address in the page associated with this WPRE
- Restoring the original SPTE value for the associated page
- Reestablishing the modified SPTE value when watchpoints are reenabled
- Invalidating the translation buffer when the SPTE is modified
- Locating the data structures associated with individual watchpoints defined in this system page

11.4.2 Watchpoint Control Blocks (WPCB)

The WPCBs associated with a given system page are singly-linked to a list header in the associated WPRE. A WPCB is allocated from a nonpaged pool when a watchpoint is created. A WPCB contains static information about the watchpoint such as the following:

- Its starting address and length
- Original contents of the watchpoint at the time it was established
- User-specified options for this watchpoint

In addition, the WPCB contains dynamic data associated with the most recent write reference to the watchpoint. This data includes the following:

- Number of times that the watchpoint has been written.
- Address of the first byte within the watchpoint that was modified at the last write reference.

- PC-PSL pair that made the last write reference.
- System time at the last write reference.
- Contents of the general registers at the time of the last write reference.
- A copy of up to 15 bytes of instruction stream data beginning at the program counter (PC) of the instruction that made the last write reference. The amount of instruction stream data that is copied here is the lesser of 15 bytes and the remaining bytes on the page containing the PC.
- Contents of the watchpoint before the last write reference.
- Contents of the watchpoint after the last write reference. This value is presumably the current contents of the watchpoint.
- A pointer to an entry in the global circular trace buffer where all recent references to watchpoints are traced.

11.4.3 Trace Table Entries (WPTTEs)

Whenever a watchpoint is written, all the relevant data is recorded in the WPCB associated with the watchpoint. In addition, to maintain a history, the WPDRIVER copies a subset of the data to the oldest WPTTE in the circular trace buffer. Thus, the circular trace buffer contains a history of the last N references to watchpoints. The driver allocates nonpaged pool to accommodate the number of trace table entries specified by the system parameter WPTTE_SIZE. The WPTTEs for all watchpoints are together in the table, but the ones for a particular watchpoint are chained together.

The subset of data in a WPTTE includes the following:

- Starting address of the watchpoint
- Relative offset of the first byte modified on this reference
- Opcode of the instruction that modified the watchpoint
- A relative backpointer to the previous WPTTE of this watchpoint
- PC-PSL of the write reference
- System time of the write reference
- Contents of the watchpoint before this reference

11.5 Analyzing Watchpoint Results

Analyzing watchpoint results is a function of the mode in which the WPDRIVER is used. For example, if you have only one watchpoint and have specified that an XDELTA breakpoint and/or a bugcheck occur on a write to the watchpoint, then when the reference occurs, simply find the program counter (PC) that caused the reference.

This PC (actually the PC of the next instruction) and its processor status longword (PSL) are on the stack at the time of the breakpoint and/or bugcheck. The layout that follows is the stack as it appears within an XDELTA breakpoint. Examined from a crash dump, the stack is similar but does not contain the return address from the JSB to INI$BRK.

```
+--------------------------------------+
|address in WPDRIVER from JSB G^INI$BRK| :SP
|PC of next instruction                |
|PSL at watchpoint access              |
+--------------------------------------+
```

Furthermore, R0 contains the address of the WPCB associated with that watchpoint. You can examine the WPCB to determine the original contents of the watchpoint area and the registers at the time of the write.

Definitions for the watchpoint data structures are in SYS$LIBRARY:LIB.MLB. Build an object module with its symbol definitions by entering the following DCL commands:

```
$ MACRO/OBJ=SYS$LOGIN:WPDEFS SYS$INPUT: + SYS$LIBRARY:LIB/LIB
        $WPCBDEF   GLOBAL   !n.b. GLOBAL must be capitalized
        $WPREDEF   GLOBAL
        $WPTTEDEF  GLOBAL
        .END
CTRL/Z
```

Then, within SDA, you can format watchpoint data structures. For example, enter the following SDA commands:

```
SDA>READ SYS$LOGIN:WPDEFS.OBJ
SDA>FORMAT @R0 /TYPE=WPCB   !type definition is required
SDA>DEF WPTTE = @R0 + WPCB$L_TTE
SDA>FORMAT WPTTE /TYPE=WPTTE
```

An alternative to crashing the system or using XDELTA to get watchpoint information is the QIO function IO$_RDSTAT. This function returns watchpoint control block contents and trace table entries for a particular watchpoint.

It requires the following device/function dependent arguments:

- P1—Address of buffer to receive watchpoint data.
- P2—Length of the buffer. The minimum size buffer of 188 bytes is only large enough for WPCB contents.
- P3—Watchpoint address.

The data returned in the buffer has the format shown in Figure 11–1.

Figure 11–1 Format of Data Returned in Buffer

Number of bytes copied to buffer
Total number of WPTTEs for watchpoint
Number of WPTTEs copied to buffer
WPCB
Most recent WPTTE
Next recent WPTTE
Next WPTTE
Next WPTTE

VM-0970A-AI

11.6 Watchpoint Protection Overview

The overall design of the watchpoint facility uses protection attributes on system pages and the access violation fault mechanism. To establish a watchpoint within a page of system space, the WPDRIVER changes the protection of the page to disallow writes. The WPDRIVER modifies the access violation vector to point to its own routine, WP$ACCVIO.

Any subsequent write to this page causes an access violation and dispatch to WP$ACCVIO. Thus, the WPDRIVER gains control on all write references to watchpoints and can monitor such accesses.

When WP$ACCVIO is entered, it raises IPL to 31 to block all other threads of execution. It first must determine whether the faulting address (whose reference caused the access violation) is within a page containing a watchpoint. However, any major amount of CPU processing at this point might access an area in system space whose protection has been altered to establish watchpoints. As a result, such processing might cause a reentry into WP$ACCVIO. To avoid recursive reentry, WP$ACCVIO first restores all SPTEs that it had modified to their values prior to the establishment of any watchpoints. From this point until this set of SPTEs are remodified, no watchpoints are in effect. Now WP$ACCVIO can determine whether the reference was to a page containing a watchpoint.

To determine whether the reference is to a watchpoint page, WP$ACCVIO compares the faulting address to addresses of pages whose protection has been altered by WPDRIVER. If the faulting address is not in one of these pages, then WP$ACCVIO passes the access violation to the usual OpenVMS service routine, EXE$ACVIOLAT. If the faulting address is within a page containing a watchpoint, more extensive processing is required.

As a temporary measure, WP$ACCVIO first records all data related to the reference in its UCB. It cannot immediately associate the access violation with a particular watchpoint. This ambiguity arises from imprecision in the faulting virtual address recorded at the access violation. The CPU need merely place on the stack “some virtual address in the faulting page.”

As a result, when a reference to a page with a watchpoint results in an access violation, the watchpoint driver first merely captures the data in its UCB. The data captured at this point includes the following:

- PC and PSL of the faulting instruction
- Current system time
- Values of all the general registers from R0 through SP
- A copy of up to 15 bytes of the instruction stream, beginning at the PC previously captured

If the reference later turns out not to be one to a watchpoint, the captured data is discarded. If the reference is to a watchpoint, the data is copied to the WPCB and circular trace buffer.

The watchpoint driver distinguishes between these two possibilities by reexecuting the faulting instruction under a controlled set of circumstances.

Once the instruction has reexecuted, WP$TBIT can determine whether watchpoint data has been modified by comparing the current contents of all watchpoints within the page of interest to the contents that they had prior to this reference. Because the driver has run at IPL 31 since the write access that caused an access violation, any change in the contents is attributable to the reexecuted instruction. If the contents of a watchpoint are different, WP$TBIT copies the data temporarily saved in its UCB to the WPCB associated with this watchpoint and records a subset of this data in a WPTTE.

The driver can cause either or both an XDELTA breakpoint or a bugcheck, depending on what action was requested with the watchpoint definition. If an XDELTA breakpoint was requested, the driver invokes XDELTA. After the user proceeds from the XDELTA breakpoint, if a bugcheck was not requested, the driver restores the SPTEs of pages containing watchpoints, the saved registers and IPL, and REIs to dismiss the exception.

11.7 Restrictions

The WPDRIVER can monitor only those write references to system space addresses that arise in a CPU. I/O devices can write to memory and thereby modify watchpoints without the WPDRIVER's becoming aware of the write.

Because a write access to a watchpoint is determined by comparing the contents of the watchpoint before and after the write, a write of data identical to the original contents is undetectable.

Because the WPDRIVER modifies SPTEs, a device page that directly interprets tables may experience access violations when it attempts to write into a memory page whose protection has been modified to monitor watchpoints. In other words, a page containing a watchpoint should not also contain a buffer for such a controller.

When you create a watchpoint, you should ensure that the system is quiet with respect to activity affecting the watchpoint area. Otherwise, an inconsistent copy of the original contents of the watchpoint area may be saved. WPDRIVER raises IPL to 11 to copy the watchpoint area's original contents. This means that if the area is modified from a thread of execution running as the result of an interrupt above 11, WPDRIVER can copy inconsistent contents. An inconsistent copy of the original contents may result in spuriously detected writes and missed writes.

If the page containing the watchpoint area is written by an instruction that incurs a page fault, the system can crash with a fatal PGFIPLHI bugcheck. As described in the previous section, after detecting an attempt to write to a page with a watchpoint, the WPDRIVER re-executes the writing instruction at IPL 31. Page faults at IPL 31 are not allowed.

If an outer access mode reference to a watchpointed page causes an access violation, the system will likely crash. When an access violation occurs on a page with a watchpoint, the current driver does not probe the intended access and faulting mode against the page's original protection code. Instead, it assumes that any access violation to that page represents a kernel mode instruction that can be reexecuted at IPL 31. The driver's subsequent attempt to REI, restoring a program status longword (PSL) with an outer mode and IPL 31, causes a reserved operand fault and, generally, a fatal INVEXCEPTN bugcheck.

You must be knowledgeable about the accesses to the page with the watchpoint and careful in using the driver. You should test the watchpoint creation on a standalone system. You should leave the watchpoint in effect long enough to have some confidence that pagefaults in instructions accessing that page are unlikely.

An attempt to CONNECT a WPA unit other than zero results in a fatal WPDRVRERR bugcheck.

The WPDRIVER is suitable for use only on a single CPU system. That is, it should not be used on a symmetric multiprocessing system. There are no plans to remove this restriction in the near future.

Index

S

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