AIX 5.2 Workload Partitions for AIX 7

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This edition applies to AIX Version 7.1 and to all subsequent releases and modifications until otherwise indicated in new editions.

Contents

About this document

Workload partitions (WPARs) are a virtualized operating system environment within a single instance of the AIX® operating system. WPARs secure and isolate the environment for the processes and signals that are used by enterprise applications. This topic explains how to create and manage WPARs on AIX.

Highlighting

The following highlighting conventions are used in this book:

Bold	Identifies commands, subroutines, keywords, files, structures, directories, and other items whose names are predefined by the system. Also identifies graphical objects such as buttons, labels, and icons that the user selects.
Italics	Identifies parameters whose actual names or values are to be supplied by the user.
`Monospace`	Identifies examples of specific data values, examples of text similar to what you might see displayed, examples of portions of program code similar to what you might write as a programmer, messages from the system, or information you should actually type.

Case-sensitivity in AIX

Everything in the AIX operating system is case-sensitive, which means that it distinguishes between uppercase and lowercase letters. For example, you can use the **ls** command to list files. If you type LS, the system responds that the command `is not found`. Likewise, **FILEA**, **FiLea**, and **filea** are three distinct file names, even if they reside in the same directory. To avoid causing undesirable actions to be performed, always ensure that you use the correct case.

ISO 9000

ISO 9000 registered quality systems were used in the development and manufacturing of this product.

IBM AIX 5.2 Workload Partitions for AIX 7

Workload partitions (WPARs) are virtualized operating system environments within a single instance of the AIX operating system. WPARs secure and isolate the environment for the processes and signals that are used by enterprise applications.

Applications running in an AIX 5.2 WPAR use AIX 5.2 commands and libraries. If you have applications that have not been certified on newer versions of AIX, the AIX 5.2 commands and libraries provides a way to run them in an AIX 5.2 environment on top of AIX 7.1. Such a setup allows running those applications on currently available hardware that might not support the use of AIX 5.2 as the base operating system. The AIX 5.2 WPARs are also referred to as *versioned WPARs*. A versioned WPAR is always a system WPAR, and is not shared. Versioned WPARs own writable /opt and /usr file systems.

Prerequisites for AIX 5.2 Workload Partitions

The prerequisites for AIX 5.2 Workload partitions are as follows:
- Versioned WPARs only support POWER7™ hardware.
- Versioned WPARs can be installed only on an AIX 7.1 operating system.
- The latest available, and supported version of AIX 5.2 is technology level (TL) 10, and service pack (SP) 8. Therefore, any backup image that is used to create an AIX 5.2 WPAR must be from an AIX 5.2 system running the latest version.

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AIX WPAR concepts

The WPAR environment is somewhat different from the standard AIX operating system environment. Various aspects of the system, such as networking and resource controls, function differently in the WPAR environment.

Differences in the WPAR environment

While the WPAR environment is similar to the environment for an application on a stand-alone system, there are differences that some applications recognize.

Applications might recognize differences in the following areas:

Device access
> Some devices are accessible within a WPAR by default. Storage devices might be mounted as file systems from the global environment into the WPAR or they can be exported to the WPAR so that file systems can be created/mounted/removed from within the WPAR.

Default privilege
> The WPAR root user does not have the same level of access as the root user in the global environment by default.

Shared kernel
> For applications that provide kernel extensions, the user-level application execution environment is compartmentalized between WPAR instances. However, the shared kernel recognizes all WPAR instances and must maintain the compartmentalization.

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Statistic and tuning virtualization

While several AIX system utilities have been enabled to work either fully or partially in a WPAR, there are some utilities that work only in the global environment (for example, the **mpstat** utility and the **sar** utility). Because all WPAR instances share the same kernel and certain kernel subsystems are optimized for system-wide usage, it is not possible to tune all kernel subsystem parameters from a WPAR.

Network configuration

You cannot modify the network configuration (for example, addresses and routes) inside a WPAR. The default configuration of a WPAR prevents applications from using any raw sockets, but system administrators can enable them.

Restrictions and limitations in the WPAR environment

This section lists the restriction and limitations in the WPAR environment.

The following functionality is unavailable within a WPAR:
- PowerHA™
- RSCT
- NFS Server
- WLM controls
- WPAR management
- Kernel tuning

If the WPAR Manager licensed program is installed, there are additional restrictions on WPARs which are enabled for live mobility:
- The WPAR must either be a rootvg WPAR or NFS-based.
- The WPAR cannot have kerberos-protected NFS mounts.
- DMAPI cannot be used within the WPAR.
- Applications within the WPAR cannot use raw logical volume or disks.
- Applications cannot open accessing /dev/mem or /dev/kmem.
- The WPAR cannot have kernel extensions exported to them.
- Files which have been mapped cannot be unlinked at the time of mobility.
- Processes cannot have stopped/debugged threads at the time of mobility.
- Processes which have been launched from the **clogin** command cannot exist at the time of mobility.
- See additional restrictions for Compatibility Testing for Application Mobility.

Restrictions and limitations within a versioned WPAR

A versioned WPAR provides a different version runtime environment than the global system. Versioned WPARs have some limitations as compared to native system WPARs.

The following functionality is unavailable within a versioned WPAR:
- File systems cannot be shared with other WPARs.
- Commands and features not supported by the AIX version of the runtime environment are not supported in the WPAR, even though they may be available in the global system.
- Adapters might not be exported to a versioned WPAR.
- If local storage devices are used for the WPAR, standard JFS file systems are not supported. JFS file systems from the system image are converted to JFS2 file systems when local storage devices are used for the versioned WPAR.
- Some commands from the AIX 7.1 environment replace commands from the original AIX environment used to populate the versioned WPAR, including, but not limited to the following types of commands:

- File system commands
- Logical volume commands
- System performance commands

To see the files within a versioned WPAR that are replaced by native or alternate programs, run the following command within the versioned WPAR:

```
ODMDIR=/usr/lib/objrepos odmget overlay | awk '$1=="path" {print $3}'
```

Unlike native system WPARs, it is possible for applications running within a versioned WPAR to access a limited number of symbols through the /dev/kmem interface in read-only mode. The accessible symbols are:

- avenrun
- cpuinfo
- enter_dbg
- iostat
- pacefork
- sysinfo
- tickadj
- v_exempt_secs
- v_min_process
- v_repage_hi
- v_repage_proc
- v_sec_wait
- vmker
- vmminfo

Devices

To function properly, some applications require the use of system devices.

You can export a limited set of devices or storage adapters to one or more partitions. Devices that can be exported include Fibre-Channel attached storage devices such as SCSI disk, CD, and tape devices. Applications that require access to non-exportable devices are restricted to running in the global environment. The following pseudo devices are exported to WPARs by default:

- /dev/audit
- /dev/clone
- /dev/console
- /dev/error
- /dev/errorctl
- /dev/null
- /dev/nvram
- /dev/random
- /dev/sad
- /dev/tty
- /dev/urandom
- /dev/xti/tcp
- /dev/xti/tcp6
- /dev/xti/udp
- /dev/xti/udp6

- `/dev/xti/unixdg`
- `/dev/xti/unixst`
- `/dev/zero`

Devices that are exported to workload portions must operate safely and securely in the WPAR environment.

Related concepts

"Devices in WPARs" on page 7
Different types of devices are supported by the AIX operating system, although the initial support of devices in the WPAR is limited to fiber-attached storage devices, fiber channel adaptors, and virtual Small Computer System Interface (SCSI) disks.

Networking

A WPAR can have one or more network addresses assigned to support network login and network services.

You must have the following information to configure networking:

- The name of the global network interface (for example, en0, en1, et0, or et1) to associate with the address. In the global environment, the IP address assigned to a WPAR appears as an alias address associated with this interface.
- The IPv4 or IPv6 address to assign to the partition.
- The network mask for IPv4 addresses or prefix length for IPv6 addresses to apply to define the local subnet.

If the name of the WPAR resolves to a network address, that address is used as the default network address for the WPAR. You can create a WPAR with no network addresses assigned. In this case, the only external mechanism to access the partition is the **clogin** command from the global environment. The **clogin** command provides a limited function terminal to access the WPAR. It is suggested that WPARs be configured to at least have a private network configured from the global environment so that a network login function such as rlogin or telnet can be used to access the WPAR.

Global environment

The global environment has an all-encompassing view of processes, IPC, file systems, devices, and other user-level objects and system-level objects within an AIX system.

This environment allows you to view and interact with processes, file systems and other system components that are assigned to an active WPAR on the system. The global environment is the same as the traditional AIX login environment.

You can create new WPARs only in the global environment. You cannot create new WPARs in other WPARs. Many administrative tasks can be performed only from the global environment. Many commands also behave differently when they are run in the global environment than they do in the WPAR environment.

Security

WPARs provide an isolated application environment that minimizes potential interactions with system objects or processes outside the WPAR. Even though a WPAR is using the same operating system instance as other WPARs or the global environment, the ability to view or interact with processes or devices outside the partition is limited.

In system workload partitions, the ability to interact with the global environment's file systems is limited. For non-persistent system objects, such as IPC and processes, constraints are implemented in the following ways:

- Marking system objects as being owned by an individual WPAR
- Denying users or applications in one WPAR the ability to view or interact with system objects owned by other WPARs

Interaction with persistent objects, such as files and devices, is also limited by maintaining separate file systems local to an individual partition. For persistent objects, constraints are implemented in the following ways:

- Creating and mounting unique file systems separate from file systems available in other WPARs
- Mounting shared, read-only file systems using the **namefs** mount type from the global environment
- Maintaining an environment within the local file system mounts for all processes using the **chroot** command

WPAR isolation

System WPARs and application WPARs are isolated from other partitions. Users cannot subvert the isolation constraints.

WPAR isolation limits the operating environment in the following ways:

- Default configuration of only certain pseudo devices in the /dev directory
- Removal of devices, such as /dev/mem and /dev/kmem, that give a more global view of the system
- Modified behavior of both the reboot command and the halt command to reboot or halt the only the specified systemWPAR, not the entire system

WPAR isolation also prevents users from performing the following administrative tasks:

- Adjusting the system clock
- Manipulating process accounting
- Binding processes to a specific processor
- Exceeding certain system limits, even by privileged users
- Using fine grain timers less than 10 milliseconds
- Manipulating certain machine-level serviceability tools
- Loading or unloading system-level device drivers or kernel extensions
- Manipulating system paging space and certain system-level tuning parameters
- Using certain file system-level operations, such as extension, contraction, or defragmentation

System workload partitions are integrated with the AIX RBAC system, so each system workload partition can have security privileges assigned. The settings are not applicable for application workload partitions.

Note: Workload partition isolation can also constrain the use of computational resources, such as system memory and processor processing time.

Resource controls

WPARs support up to 8192 resource-controlled workload partitions. The number of non-resource-controlled WPARs that can be created is constrained only by the availability of global environment memory and disk space resources. However, a maximum of 8192 can be active at any time.

You can change the resource controls for a WPAR dynamically using the **chwpar** command. If the process or thread limit is reduced on an active WPAR, processes or threads are not terminated, but new process or thread creation is not allowed until the total count falls below the specified limit. For example, if a WPAR has 200 active processes and you change the total process limit on the WPAR to 170, then the system will not terminate the extra 30 processes. New process creation within the WPAR is not allowed until the process count falls below 170. You can enable resource controls for a WPAR when it is created. You can also change the controls on an existing WPAR using SMIT or using the **chwpar** command with the **-R active = yes** option.

Processor use and memory use controls

Processor use controls and memory use controls allow you to allocate processor and memory resources for the global environment.

You can use share-based allocation or percentage-based allocation for processor and memory resources.

Note: Both share-based controls and percentage-based controls can be specified. In the event of conflict, the percentage-based controls take precedence.

Share-based allocation

The percentage of CPU or memory to allocate to the WPAR is determined by dividing the number of shares by the total number of shares allocated to all active WPARs. The number of shares represents how much of a particular resource a WPAR receives relative to the other WPARs.

For example, if there are three active WPARs (A, B, and C) with shares for a particular resource of 15, 10, and 5, allocation targets would be the following:

WPAR A, 15/30 or 50%

WPAR B, 10/30 or 33%

WPAR C, 5/30 or 17%

Allocation targets adjust with the number of active workload partitions. If partition A is inactive, then the allocation targets would be the following:

WPAR B, 10/15 or 66%

WPAR C, 5/15 or 33%

Share-based allocation is specified by using the **shares_CPU** option with the **mkwpar** command or the **chwpar** command.

Percentage-based allocation

The percentage of CPU or memory to allocate to the WPAR is determined by the following user-specified values:

min%

The minimum amount of a resource that should be made available to the WPAR. If the actual consumption is below this value, the WPAR will be given highest priority access to the resource. The possible values are 0 to 100, with a default value of 0.

soft%

The maximum amount of a resource that a WPAR can use when there is contention for that resource. If the WPAR's consumption exceeds this value, the WPAR will be given the lowest priority access to the resource. If there is no contention for the resource, the WPAR is allowed to consume as many resources as it requires. The possible values are .01 to 100, with a default value of 100.

hard%

The maximum amount of a resource that a WPAR can consume, even when there is no contention. If the class reaches this limit, it will not be allowed to consume any more of the resource until its consumption percentage falls below the limit. The possible values are .01 to 100, with a default value of 100.

Note: Using hard maximum limits can have a significant impact on system or application performance if not used appropriately. Because imposing hard limits can result in unused system resources, in most cases, soft maximum limits are more appropriate.

Devices in WPARs

Different types of devices are supported by the AIX operating system, although the initial support of devices in the WPAR is limited to fiber-attached storage devices, fiber channel adaptors, and virtual Small Computer System Interface (SCSI) disks.

Inactive WPAR

With an inactive WPAR, a storage device can be allocated and de-allocated to any number of WPARs. The first WPAR that starts takes ownership of the device, which means that device will be unconfigured in the global environment and reconfigured in the WPAR. You can not make any configuration changes on the device in the global environment when the device is in use by the WPAR. There are no restrictions on removing a device from an inactive WPAR.

Active WPAR

There are two ways that a device can be allocated to an active WPAR.

- If a device is not in use by another WPAR, the **cfgmgr** command allocates the device to the WPAR and makes the device available for use in the WPAR.
- If a device is in use by another WPAR, it is added to the WPAR file configuration. This device is not made accessible to the WPAR because it is already in use by another WPAR.

When an active WPAR has control of a device, the device is in the defined state in the global environment. No configuration operations are allowed on the device as long as it is in the global environment. Commands such as **mkdev, chdev, rmdev,** and **cfgmgr** will not work on the device. In order for the global environment to take control of the device, it has to be deallocated from the WPAR that has control over it.

Related concepts

"Devices" on page 3
To function properly, some applications require the use of system devices.

"Rootvg WPARs" on page 11
A system WPAR which is configured with its own root volume group on one or more dedicated storage devices is called a rootvg WPAR. Configuring a rootvg WPAR gives the WPAR administrator complete control over managing the storage devices exported to the WPAR, the volume groups on those devices, and the logical volumes and file systems within those volume groups. A system WPAR which is not a rootvg WPAR does not have its own root volume group, but has file systems created in logical volumes created out of the root volume group of the global system.

Deploying a device

A device can be allocated to a WPAR when the WPAR is created or added to the WPAR in a later operation.

In order for a device to be allocated to a WPAR, the device must be in the available state or the defined state in the global environment. To deploy a device it must be in the available state or the defined state.

Allocating a device

The allocation process consists of providing a storage device that can be used by the WPAR.

A device can be allocated to more than one WPAR, but can be used only by one WPAR at a time. To allocate a device when creating the WPAR, run the following command:

```
mkwpar -D devname=<device name> -n <wpar name>
```

For a rootvg WPAR, the device to hold the rootvg must be specified, as in the following example:

```
mkwpar -D devname=<device name> rootvg=yes -n <wpar name>
```

The -D parameter can be repeated to specify multiple storage devices.

To allocate a device to an existing WPAR, run the following command:
```
chwpar -D devname=<device name> <wpar name>
```

Additional disks can be allocated to a WPARs root volume group with the following command:
```
chwpar -D devname=<device name> rootvg=yes <wpar name>
```

To remove a device from an active or non-active WPAR, run the following command from the global environment:
```
chwpar -K -D devname=<device name> <wpar name>
```

When the command for an inactive WPAR runs successfully, the device is removed from the WPAR configuration. However, for an active WPAR, the command attempts to unconfigure the device from the WPAR. If the device is in use, the unconfiguration operation fails and the command to remove the device from the WPAR fails. When the command for an active WPAR runs successfully, the device in the WPAR changes from the available state to the defined state.

Configuring a device in a WPAR

Every device that is configured in the WPAR has an ODM entry in the WPAR.

The storage device has a parent device that is a virtualized device. You can not make any configuration changes on the parent device in the WPAR, or modify any management paths to the device.

The following commands are used to configure and manage the global environment, and are also used in the same manner to configure and manage devices in the WPAR:

- **mkdev**
- **chdev**
- **rmdev**
- **lsdev**
- **cfgmgr**
- **lsattr**
- **lspath**

Managing file systems for a device

When the device is configured in a rootvg WPAR, commands that are used to create and manage volume groups, logical volumes, and file systems operate in the same manner as in the global environment.

To create and modify volume groups, use the following commands:

- **mkvg**
- **importvg**
- **importvg**
- **extendvg**
- **importvg**

To create and modify logical volumes, use the following commands:

- **mklv**
- **chlv**

To create and modify file systems, use the following commands:

- **mkfs**
- **chfs**

For more information about the commands, see Commands.

System WPARs

System WPARs are autonomous virtual system environments with their own private file systems, users and groups, login, network space and administrative domain.

Most traditional system services are virtualized at the WPAR level, and they can be independently used and managed within each WPAR. While the system WPAR environment is largely partitioned and isolated, read-only file systems might be shared between WPARs to facilitate the sharing of application data and text. Versioned WPARs can only be non-shared system WPARs.

Shared and non-shared system WPARs

By default, a system WPAR shares the /usr file system and the /opt file systems from the global environment using read-only **namefs** mounts. You can configure WPARs to have non-shared, writable /usr file system and /opt file system.

To configure a non-shared system WPAR, run the **mkwpar** command with the **-l** flag.

You can also configure a non-shared system WPAR by specifying writable file systems of one of the following types for the /usr file system and the /opt file system:

- directory
- jfs
- jfs2
- nfs

If you create a non-shared system WPAR, all files from the /usr file system and the /opt file system in the global environment are copied to the WPAR. The administrator must allocate enough space in the WPAR file systems for the files.

System software in non-shared system WPARs must be kept at the same system level as the global environment in order to avoid unexpected results.

File systems for system WPARs

System WPARs have their own file systems similar to stand-alone AIX.

System WPARs can be created with local file system spaces, which are constructed from isolated sections of the file system space for the global environment or with a WPAR owned root volume group.

When the system WPAR has isolated file system spaces, each file system is owned and managed by the global environment. For a WPAR owned root volume group, dedicated storage devices must be allocated to the WPAR and each file system is owned and managed by the WPAR.

Global isolated file system spaces

The default location for the file system spaces are in the /wpars directory of the global environment. The initial process for each WPAR is moved to the correct path in the global file system using the **chroot** command. All processes run within the WPAR appear in the base directory for the WPAR. For example, users in a WPAR would see the /wpars/part1/usr directory as the /usr directory.

The file system configuration for a WPAR is specified when the WPAR is created. You can either use the system defaults or customize each file system. Some of the file systems in a system WPAR are local to the partition while others can be shared with the global environment.

The following JFS2 file systems are created with inline logs and populated similar to a stand-alone AIX system with the following sizes:

- / (64 MB)
- /tmp (96 MB)
- /var (128 MB)
- /home (32 MB)

Note: The initial sizes of these file systems could change depending on the system requirements and storage characteristics.

The following JFS2 file systems are shared from the global environment using **namefs** mounts with the followed permissions:

- /usr (read-only permissions)
- /opt (read-only permissions)
- /proc (read-write permissions)

You can specify the use of a flat file system structure for part or all of a WPAR namespace by specifying that one or more directories can be local to a parent directory. This structure means that no distinct file system is created for the parent directory. The sizes of the file systems or directories to be populated in the WPAR must be large enough to hold the files for that partition. This structure simplifies the number of file systems to manage for a partition, but it loses the granularity of control over user files populating the file system. The flat file system structure might be a viable option for servers running in the WPAR that do not offer system login privileges to users.

File systems in a rootvg WPAR

When a system WPAR is created with its own root volume group by using the **mkwpar** command with the **–D** flag and specifying the **disk name devname=***hdisk name* and the **rootvg=yes** option, the root file systems are created in a separate volume group that is owned and managed by the WPAR. For example, two disks can be allocated for the root volume group by using these options **-D devname=hdisk5 rootvg=yes -D devname=hdisk6 rootvg=yes**. The following JFS2 file systems are created within the WPAR-owned root volume group with inline logs, and populated similar to a stand-alone AIX system:

- /
- /admin
- /home
- /tmp
- /var

Note: The initial sizes of these file systems can change depending on the system requirements and storage characteristics.

If a non-shared system WPAR is created that owns the root volume group, the /usr file system and /opt file system are created and populated within the WPAR owned root volume group. Versioned WPARs always have non-shared /usr and /opt file systems. Otherwise, the /usr file system and /opt file system are shared from the global environment by using namefs mounts.

Note: The logical volume names used within a rootvg WPAR are the same as those typically used on an AIX system. For example, /dev/hd4 would be the logical volume name for the root / file system and /dev/hd11admin for the /admin file system.

The WPAR administrator can change the file system characteristics of any file system that resides within the WPAR-owned root volume group.

Rootvg WPARs

A system WPAR which is configured with its own root volume group on one or more dedicated storage devices is called a rootvg WPAR. Configuring a rootvg WPAR gives the WPAR administrator complete control over managing the storage devices exported to the WPAR, the volume groups on those devices, and the logical volumes and file systems within those volume groups. A system WPAR which is not a rootvg WPAR does not have its own root volume group, but has file systems created in logical volumes created out of the root volume group of the global system.

For a rootvg WPAR, storage devices must be exported (or allocated) to the WPAR when it is created. After it has been created, the **chwpar** command can be used to allocate additional disks to the WPARs root volume group or, if it contains multiple disks, to deallocate a disk from the WPARs root volume group. It is not possible to change a WPAR without its own root volume group into a rootvg WPAR after it has been created.

Rootvg WPARs can be configured to support live application mobility when used in combination with *IBM® PowerVM™ Workload Partitions Manager™ for AIX*.

"File systems for system WPARs" on page 9

A configuration with a WPAR owned root volume group (a RootVG WPAR) helps to isolate the file systems and volume groups of a WPAR from the global system.

Rootvg WPAR mobility considerations

A WPAR whose file systems are all NFS mounted or all SAN based is eligible for Live Application Mobility, wherein a workload running in a WPAR on one LPAR might be moved to another compatible LPAR and execution resumed at the same point. This relocation of a WPAR involves moving its executable code to the target LPAR, while keeping the application data on the same storage devices. Thus, the storage devices containing the file systems must be visible and accessible from both LPARs.

Note: IBM PowerVM Workload Partitions Manager for AIX (WPAR Manager) is required for WPAR mobility.

A typical configuration might include two SAN based disks containing the rootvg of the WPAR, with a third SAN based disk exported to the WPAR and containing a separate volume group with application data. This gives the WPAR administrator complete control over creating new file systems or resizing the existing file systems within those volume groups. If the intent is to be able to relocate the WPAR,the WPAR Manager can be used to create the WPAR, as well as to move it between LPARs.

Related concepts

"Devices in WPARs" on page 7
Different types of devices are supported by the AIX operating system, although the initial support of devices in the WPAR is limited to fiber-attached storage devices, fiber channel adaptors, and virtual Small Computer System Interface (SCSI) disks.

Related tasks

"Creating a writable directory under a shared directory" on page 18
You can create a writable directory beneath a shared directory using a symbolic link from the global environment.

Configuring system WPARs

You can create and configure system WPARs using the **mkwpar** command and the **chwpar** command.

When you create a system WPAR, a configuration profile is stored in the WPAR database. You can export this profile to create a specification file that contains the exact same configuration information for that WPAR. All WPARs must be created by an authorized administrator in the global environment.

Note: These topics provide specific examples of how to run WPAR-related commands. For complete documentation of all options for a specific command, see the related information for that task.

Naming the system WPAR

You must provide a name for the system WPAR. You can provide a name using the **mkwpar** command with the **-n** flag.

You can specify the name for the system WPAR using the following command:

```
mkwpar -n wpar_name
```

You can also change the name of a system WPAR using the **chwpar** command. You can only change the name of a system WPAR when it is stopped and in the defined state. To change the name of a system WPAR, run the following command:

```
chwpar -n new_name old_name
```

Creating a system WPAR

You can create a new system WPAR with the **mkwpar** command.

Each WPAR has an isolated network environment with unique IP addresses and a unique hostname. You can access WPARs through standard networking programs, such as telnet, ftp, and rlogin (depending on the services running in the WPAR). Before you create a WPAR, you should log in as the root user and complete one of the following prerequisites:

- Choose a name for the WPAR that maps to an IP address for your network.
- Add an entry for the new system WPAR to the /etc/hosts file on the server. The entry should include the host name for the WPAR and the name of the WPAR as follows:

  ```
  9.3.18.10 WPARname.austin.ibm.com WPARname
  ```

To create a new system WPAR, complete the following steps.

1. Verify that the network recognizes your workload partition address by entering the following command:

   ```
   #host WPARname
   ```

   The return should look similar to the following:

   ```
   WPARname.austin.ibm.com is 9.3.18.10,  Aliases:  WPARname
   ```

2. Configure the WPAR by running the following command:

   ```
   mkwpar -n WPARname
   ```

The initial output of the **mkwpar** command should look similar to the following:

```
mkwpar -n WPARname mkwpar:
Creating filesystems...
    /
    /home
    /opt
    /proc
    /tmp
    /usr
    /var
populate: Mounting all workload partition file systems
x ./usr
x ./lib
x ./audit
```

```
x ./dev
x ./etc
x ./etc/check_config.files
x ./etc/consdef
x ./etc/cronlog.conf
x ./etc/csh.cshrc
x ./etc/csh.login
x ./etc/dlpi.conf
x ./etc/dumpdates
x ./etc/environment
x ./etc/ewlm
x ./etc/ewlm/limits
x ./etc/filesystems
x ./etc/group
x ./etc/inittab
x ./etc/magic
x ./etc/motd
...
```

Each system WPAR has an isolated section of the system's file space configured for the root directory, the /home directory, the /usr directory and other file systems. Creation and configuration of this space is reflected in the above output from the **mkwpar** command. The return from the **mkwpar** command continues with output similar to the following:

```
x ./home
x ./home/guest
x ./home/lost+found
+-----------------------------------------------------------------------------+
Pre-installation Verification...
+-----------------------------------------------------------------------------+
Verifying selections...done
Verifying requisites...done
Results...

SUCCESSES
---------
Filesets listed in this section passed pre-installation verification
and will be installed.
...
```

Each system workload partition has its own /dev directory. Creation and configuration of this space is reflected in the populate: Exporting workload partition devices output from the **mkwpar** command. Not all of the devices on the system can be shared among the WPARs so the WPAR's /dev directory is a sparse version of the /dev directory on the global environment. The **mkwpar** command then continues with the installation of several AIX base system file sets into the WPAR. At the end of the installation phase, you should see output similar to the following:

```
Finished processing all filesets. (Total time:  1 mins 4 secs).

Please wait...

    /usr/sbin/rsct/install/bin/ctposti
0513-071 The ctcas Subsystem has been added.
0513-071 The ctrmc Subsystem has been added.
done
+-----------------------------------------------------------------------------+
Summaries:
+-----------------------------------------------------------------------------+
Installation Summary
--------------------
Name                        Level      Part      Event      Result
-------------------------------------------------------------------------------
Tivoli_Management_Agent.cli 3.7.1.0    ROOT      APPLY      SUCCESS
```

```
bos.acct                    5.3.0.9500      ROOT        APPLY       SUCCESS
bos.diag.util               5.3.0.40        ROOT        APPLY       SUCCESS
bos.mh                      5.3.0.40        ROOT        APPLY       SUCCESS
bos.net.ncs                 5.3.0.0         ROOT        APPLY       SUCCESS
bos.net.nfs.client          5.3.0.9500      ROOT        APPLY       SUCCESS
bos.net.nis.client          5.3.0.40        ROOT        APPLY       SUCCESS
bos.net.snapp               5.3.0.0         ROOT        APPLY       SUCCESS
bos.net.tcp.client          5.3.0.9500      ROOT        APPLY       SUCCESS
bos.net.tcp.server          5.3.0.9500      ROOT        APPLY       SUCCESS
bos.net.uucp                5.3.0.40        ROOT        APPLY       SUCCESS
...
bos.net.ipsec.rte           5.3.0.9500      ROOT        APPLY       SUCCESS
bos.perf.tune               5.3.0.9500      ROOT        APPLY       SUCCESS
devices.chrp.base.diag      5.3.0.40        ROOT        APPLY       SUCCESS
bos.net.ipsec.keymgt        5.3.0.9500      ROOT        APPLY       SUCCESS
ifor_ls.base.cli            5.3.0.30        ROOT        APPLY       SUCCESS
lum.base.cli                5.1.0.0         ROOT        APPLY       SUCCESS
bos.suma                    5.3.0.40        ROOT        APPLY       SUCCESS
mkwpar: Workload partition WPARname created successfully.
To start the workload partition, execute the following as root: startwpar [-v] 'WPARname'
```

The configuration of the system WPAR is now complete.

Creating a versioned WPAR

You can create a new Versioned WPAR with the **mkwpar** command.

Each WPAR has an isolated network environment with unique IP addresses and a unique host name. You can access WPARs through standard networking programs, such as telnet, FTP, and rlogin (depending on the services running in the WPAR). Before you create a WPAR, you must log in as the root user and perform one of the following prerequisites:

- Select a name for the WPAR that maps to an IP address for your network.
- Add an entry for the new versioned WPAR to the /etc/hosts file on the server. The entry must include the host name for the WPAR and the name of the WPAR:

  `9.3.18.10 WPARname.austin.ibm.com WPARname`

To create a new versioned WPAR, complete the following steps.

1. Verify that the network recognizes your workload partition address by entering the following command:

   host WPARname

   The return looks similar to the following:

   `WPARname.austin.ibm.com is 9.3.18.10, Aliases: WPARname`

2. Create a **mksysb** image of an AIX 5.2 system that provides the content for your versioned WPAR:

   `mksysb -i /mksysb_images/backupname`

   Copy, or NFS-mount this backup image to the system where the WPAR is to be created.

3. Install versioned WPAR SMIT, and required installation images from the installation media. Example, using NIM:

   `nimclient -o cust -a lpp_source=wparlppsource -a installp_flags=aXY -a filesets="vwpar.images vwpar.sysmgt"`

   An example from command line: `installp -qaXYd installation_device vwpar.images vwpar.sysmgt`

4. Configure the WPAR by running the following command:

   `mkwpar -n WPARname -C -B /mksysb_images/backupname`

   The initial output of the **mkwpar** command looks similar to the following:

```
mkwpar: Extracting file system information from backup...
mkwpar: Creating file systems...
 /
ATTENTION: Logical volume 'hd4' is not unique. Renaming to 'wlv0'.
Creating logical volume 'wlv0' specified in image.data
Creating file system '/' specified in image.data
 /bff
Creating logical volume 'lv00' specified in image.data
Creating file system '/bff' specified in image.data
 /home
ATTENTION: Logical volume 'hd1' is not unique. Renaming to 'wlv1'.
Creating logical volume 'wlv1' specified in image.data
Creating file system '/home' specified in image.data
 /opt
ATTENTION: Logical volume 'hd10opt' is not unique. Renaming to 'wlv2'.
Creating logical volume 'wlv2' specified in image.data
Creating file system '/opt' specified in image.data
 /proc
 /tmp
ATTENTION: Logical volume 'hd3' is not unique. Renaming to 'wlv3'.
Creating logical volume 'wlv3' specified in image.data
Creating file system '/tmp' specified in image.data
 /usr
ATTENTION: Logical volume 'hd2' is not unique. Renaming to 'wlv4'.
Creating logical volume 'wlv4' specified in image.data
Creating file system '/usr' specified in image.data
 /var
ATTENTION: Logical volume 'hd9var' is not unique. Renaming to 'wlv5'.
Creating logical volume 'wlv5' specified in image.data
Creating file system '/var' specified in image.data
Mounting all workload partition file systems.
New volume on /mnt/my52backup.bff:
 Cluster 51200 bytes (100 blocks).
    Volume number 1
    Date of backup: Wed Sep  9 13:50:34 2009
    Files backed up by name
    User root
x        5477 ./bosinst.data
x        7931 ./image.data
x       55973 ./tmp/vgdata/rootvg/backup.data
x           0 ./bff
x           0 ./bff/lost+found
x           0 ./opt
...
```

It continues restoring all files from the mksysb image. Each system WPAR has an isolated section of
the system's file space configured for the root directory, the /home directory, the /usr directory and
other file systems. Creation and configuration of this space is reflected in the above output from the
mkwpar command. After restoring all the files, the output from the **mkwpar** command then
continues with the installation of several file sets into the WPAR. At the end of the installation phase,
you should see output similar to the following:

```
installp: APPLYING software
for: vwpar.52 7.1.0.0 .
       . .


. . << Copyright notice  for vwpar.52 >> .  . . . . . . . Licensed
 Materials - Property of IBM

 Copyright
   International Business Machines Corp. 2010. All

 rights reserved. US
 Government Users Restricted Rights - Use, duplication or disclosure restricted
 by GSA ADP Schedule Contract with IBM Corp. .
```

```
 . . . . <<  End of copyright notice for cre.base >>. . . .

 Finished processing all filesets.  (Total time:  29 secs).


 +-----------------------------------------------------------------------------+
                               Summaries:
 +-----------------------------------------------------------------------------+

 Installation Summary
 --------------------
 Name                      Level        Part       Event       Result
 -----------------------------------------------------------------------------
 bos.wpars                 7.1.0.0      USR        APPLY       SUCCESS
 bos.wpars                 7.1.0.0      ROOT       APPLY       SUCCESS
 wio.common                7.1.0.0      USR        APPLY       SUCCESS
 wio.common                7.1.0.0      ROOT       APPLY       SUCCESS
 vwpar.52                  7.1.0.0      USR        APPLY       SUCCESS
 vwpar.52                  7.1.0.0      ROOT       APPLY       SUCCESS
 Workload partition WPARname created successfully.
 mkwpar: 0960-390 To start the workload partition, execute the following as root:
  startwpar [-v] 'WPARname'
```

The configuration of the system WPAR is now complete.

Additional software required for Live Application Mobility of AIX 5.2 WPARs:

If Workload partition Manager is installed on the hosting AIX system and the versioned WPAR is created with the WPAR options to create a checkpointable WPAR, additional software must be installed within the AIX 5.2 WPAR before a mobility operation might be started on the AIX system. The following software must be applied within each versioned WPAR environment that is to be configured for live mobility:

- APAR IZ72315

The software for APAR I272315 is included on the product installation media under directory /aix52_updates.

File system and network considerations

File system considerations: By default, the file system characterizations for a versioned WPAR are derived from the characteristics of the source system from which the backup was made. The logical volume characteristics from the backup are not used by default. The **-M** flag of **mkwpar** might be used to set file system characteristics as with a regular WPAR. It is the responsibility of the administrator to determine the amount of space required for the WPAR if **-M** is used.

There are additional options that can be used to govern the file system characteristics of a versioned WPAR:

- -g - sets default volume group to use for the WPAR. The default is rootvg.
- -L shrink=yes - Use only the minimum file system space for the WPAR.
- -L ignore_lvs=no - Use the logical volume characteristics from the backup for the WPAR. Use only if you have a strong understanding of LVM, as the characteristics from the backup can conflict with logical volumes on the target system.
- -L image_data=none - Ignore all file system characteristics from the backup. There must be (**-M**) mount specifications for the base file systems (/, /usr, /opt, /home, /tmp, and /var) in this case or else the default characteristics for a regular WPAR is used.

Network considerations: Network characteristics from a restored system are not preserved. The network characteristics are established from the network and host name specifications used when creating the versioned WPAR.

Versioned Workload partitions

A versioned workload partition (WPAR) provides a different version runtime environment than the global system. They do have some limitations as compared to native system WPARs. A versioned WPAR has an AIX 5.2 runtime environment and runs on a global system with a newer level of AIX. The AIX commands and libraries inside the WPAR support AIX 5.2 syntax and semantics, even though the AIX kernel on the system is running a newer level. Applications running in the WPAR need not be aware that the global system is a different version. However, there are some limitations related to running in any WPAR that might affect some applications.

For more information about the differences in WPAR, see "Differences in the WPAR environment" on page 1

Steps to create a versioned WPAR

To create a versioned WPAR you must have a stand-alone system running a supported version of AIX (currently just 5.2) and a set of applications that you want to move to a WPAR.

1. Use the **mksysb** command to create a backup image from your stand-alone system.
2. Make the backup image accessible from the target system where the versioned WPAR is to be created. This can be remote access as with an NFS mount, or the backup image can be copied to the target system. The bos.wpars package must be installed on the target system.
3. Install the required versioned WPAR file sets on the target system.
4. Use the **mkwpar** command with the **-B** <backup_image> and **-C** options to create the versioned WPAR.
5. Use the **startwpar** command to start the WPAR.

For more information, see "Creating a versioned WPAR" on page 14.

SMIT panels for administering versioned WPARs are available using SMIT fastpath **vwpar**.

Configuring directories and file systems for system WPARs

You can override the default location of the file systems for a system WPAR using the **mkwpar** command with the **-d** option.

By default, the file systems for a new system WPAR are located in the /wpars/*wpar_name* directory.

You can override the default location using the following command:

```
mkwpar -n wpar_name -d /newfs/wpar_name
```

For safety and security, the specified base directory must meet the following criteria:

- The directory must be empty.
- The directory must not be a registered file system in the /etc/filesystems directory.
- The directory must have permissions of 755 (rwxr-xr-x).
- The parent directory of the base directory (/*newfs*, in the example) must have permissions of 700 (rwx------).

You can also change the base directory of an existing system WPAR, using the following command:

```
chwpar -d /newfs/newbase wpar_name
```

The same criteria apply for changing the base directory with the **chwpar** command. The base directory can only be changed on a stopped system WPAR.

File system customization for system WPARs

You can customize the file systems for a system WPAR using the **mkwpar** command with the **-M** option. A WPAR may use namefs mounts from any type of file system which supports POSIX file system semantics when mounted with a namefs mount. If the namefs mount is used for the root file system of the WPAR, than the file system being used must support the creation and use of block and character devices within the WPAR.

The following file system types are supported using the **vfs** attribute of the **-M** option:
* JFS
* JFS2
* NFS
* Namefs

You can also specify that a directory should be created instead of a file system by specifying vfs=directory. Specify this attribute in situations where you do not want to maintain a large number of separate file systems.

Creating a writable directory under a shared directory

You can create a writable directory beneath a shared directory using a symbolic link from the global environment.

If you are customizing software within a system WPAR, it might be useful or necessary to have a writable directory beneath a directory shared from the global environment. For example, it is common for open source software to install into a /usr/local directory hierarchy by default. In order to accommodate an unshared, writable /usr/local directory hierarchy, the global environment administrator must create a writable /usr/local directory. Create a file system called /wpars/wparname/usr/local with the type=wparname option.

Related concepts

"Rootvg WPARs" on page 11
A system WPAR which is configured with its own root volume group on one or more dedicated storage devices is called a rootvg WPAR. Configuring a rootvg WPAR gives the WPAR administrator complete control over managing the storage devices exported to the WPAR, the volume groups on those devices, and the logical volumes and file systems within those volume groups. A system WPAR which is not a rootvg WPAR does not have its own root volume group, but has file systems created in logical volumes created out of the root volume group of the global system.

Rootvg WPARs

A system WPAR which is configured with its own root volume group on one or more dedicated storage devices is called a rootvg WPAR. Configuring a rootvg WPAR gives the WPAR administrator complete control over managing the storage devices exported to the WPAR, the volume groups on those devices, and the logical volumes and file systems within those volume groups. A system WPAR which is not a rootvg WPAR does not have its own root volume group, but has file systems created in logical volumes created out of the root volume group of the global system.

For a rootvg WPAR, storage devices must be exported (or allocated) to the WPAR when it is created. After it has been created, the **chwpar** command can be used to allocate additional disks to the WPARs root volume group or, if it contains multiple disks, to deallocate a disk from the WPARs root volume group. It is not possible to change a WPAR without its own root volume group into a rootvg WPAR after it has been created.

Rootvg WPARs can be configured to support live application mobility when used in combination with *IBM PowerVM Workload Partitions Manager for AIX*.

"File systems for system WPARs" on page 9

A configuration with a WPAR owned root volume group (a RootVG WPAR) helps to isolate the file systems and volume groups of a WPAR from the global system.

Rootvg WPAR mobility considerations

A WPAR whose file systems are all NFS mounted or all SAN based is eligible for Live Application Mobility, wherein a workload running in a WPAR on one LPAR might be moved to another compatible LPAR and execution resumed at the same point. This relocation of a WPAR involves moving its executable code to the target LPAR, while keeping the application data on the same storage devices. Thus, the storage devices containing the file systems must be visible and accessible from both LPARs.

Note: IBM PowerVM Workload Partitions Manager for AIX (WPAR Manager) is required for WPAR mobility.

A typical configuration might include two SAN based disks containing the rootvg of the WPAR, with a third SAN based disk exported to the WPAR and containing a separate volume group with application data. This gives the WPAR administrator complete control over creating new file systems or resizing the existing file systems within those volume groups. If the intent is to be able to relocate the WPAR,the WPAR Manager can be used to create the WPAR, as well as to move it between LPARs.

Related concepts

"Devices in WPARs" on page 7
Different types of devices are supported by the AIX operating system, although the initial support of devices in the WPAR is limited to fiber-attached storage devices, fiber channel adaptors, and virtual Small Computer System Interface (SCSI) disks.

Related tasks

"Creating a writable directory under a shared directory" on page 18
You can create a writable directory beneath a shared directory using a symbolic link from the global environment.

Configuring networks for system WPARs

You can configure the network for a system WPAR using the **-h** flag or the **-N** flag for the **mkwpar** command or the **chwpar** command.

If you do not specify any network information when you create a system WPAR, and the name of the WPAR resolves to an IP address on the same network as any active global interface, the **mkwpar** command automatically configures the network for the WPAR. If the WPAR does not resolve, you can specify zero or more network configurations using the **-N** flag for the **mkwpar** command or the **chwpar** command. All network changes can be performed on active or inactive WPARs. The changes take effect immediately.

Each network requires its own instance of the **-N** flag. The **-N** flag specifies network configuration attributes, and is used to separate the `attribute=value` pairs by blank spaces. You can specify more than one **-N** flag to configure multiple IP addresses. For example:

```
mkwpar -n wpar_name -N interface=en0 address=224.128.9.3 \
netmask=255.255.255.0 broadcast=224.128.9.255 -N interface=en1 \
address=192.168.0.3 netmask=255.255.255.0 broadcast=192.168.0.255
```

To configure a system WPAR with a network address of 224.128.9.3 using the en0 interface for the global environment, run the following command:

```
mkwpar -n wpar_name -N interface=en0 address=224.128.9.3 \
netmask=255.255.255.0 broadcast=224.128.9.255
```

To configure a system WPAR with an IPv6 network address of fe80::200:254 using the en3 interface from the global environment, run the following command:

```
mkwpar -n wpar_name -N interface=en3 address6=fe80::200:254 prefixlen=64
```

You can also use the **-N** flag with the **chwpar** command to add additional networks on a previously defined system WPAR. To add a network, run the following command:

```
chwpar -N address=224.128.9.4 wpar_name
```

If you want to change the network settings for a system WPAR, use the **address** attribute to identify the network you want to change. For example, to change the netmask and broadcast address of the network at 224.128.9.3, run the following command:

```
chwpar -N address=224.128.9.3 netmask=255.255.255.128 \
broadcast=224.128.9.127 wpar_name
```

Changing the host name for a system WPAR

By default, the name for a system WPAR is used as its host name. You can use the **-h** flag with the **mkwpar** command or the **chwpar** command to change the host name for a system WPAR.

To override the default host name when you create a system WPAR, run the following **mkwpar** command:

```
mkwpar -n wpar_name -h wpar_hostname
```

To change the host name for an existing system WPAR, run the following **chwpar** command:

```
chwpar -h new_hostname wpar_name
```

Removing a network from a system WPAR

You can remove a network from a system WPAR using the **chwpar** command with the **-K** flag.

To remove a network from the system WPAR, run the following **chwpar** command, using the address of the network to identify it:

```
chwpar -K -N address=124.128.9.3 wpar_name
```

Note: There is no direct way to change the address of a system WPAR network; you must remove the old network with the **chwpar -K** command and add the network with the new address.

Configuring domain resolution for system WPARs

You can configure the domain resolution for system WPARs using the **-r** flag for the **mkwpar** command.

Files such as the /etc/resolv.conf file do not exist in system WPARs by default.

To copy the global environment's domain resolution configuration into the system WPARs, run the following command:

```
mkwpar -n wpar_name -r
```

Running this command copies the following files into the system WPARs, if they exist in the global environment:
- /etc/resolv.conf
- /etc/hosts
- /etc/netsvc.conf
- /etc/irs.conf
- /etc/networks

If the NSORDER environmental variable is set in the environment where you run the **mkwpar** command, the variable is added to the /etc/environment file for the new system WPAR.

The **-r** flag is not supported by the **chwpar** command. Any changes to the domain resolution configuration of an existing WPAR must be made by manually editing the relevant files.

Configuring WPAR-specific routing

You can configure a WPAR to use its own routing table using the **-i** flag and the **-I** flag for the **mkwpar** command, the **wparexec** command, or the **chwpar** command.

By default, system and application workload partitions with active network connections share the global system's routing table. To enable WPAR-specific routing for a WPAR when you are creating the WPAR, add the **-i** flag to the command line of the **mkwpar** command or the **wparexec** command. For system WPARs:

```
mkwpar -n wpar_name -N network_attributes -i ...
```

For application WPARs:

```
wparexec -N network_attributes -i ... -- /path/to/application arg1 arg2 ... argN
```

Using these commands will automatically create loopback, broadcast, and subnet routes appropriate to each configured address. If you do not specify any explicit routing table entries, the WPAR will only be able to communicate within its own subnets. You can configure explicit routing table entries with **-I** flag when you create the WPAR. You can configure zero or more explicit routing table entries. Each entry requires its own instance of the **-I** flag. Destination and gateway addresses can be specified by symbolic name or IP address.

For example, to configure a default route through a gateway with symbolic name gateway.customer.com and a host route to myserver.customer.com through gateway 192.168.1.1:

```
mkwpar -n wpar_name -N network_attributes -i -I rtdest=default rtgateway=gateway.customer.com \
-I rtdest=myserver.customer.com rttype=host rtgateway=192.168.1.1 ...
```

The **netstat -r** command can be used with the **-@** flag to view the WPAR-specific routing table for a WPAR at any time. If WPAR-specific routing is disabled for the queried WPAR, the **netstat -r** command will display the global routes. The output format is identical to that of the **netstat -r** command without the **-@** flag. For example:

```
netstat -r -@ wpar_name
```

You can change the WPAR-specific routing characteristics for both system WPARs and application WPARs using the **chwpar** command. The changes can be performed on active WPARs or inactive WPARs. Changes take effect immediately, and persist across system WPAR reboots. To disable WPAR-specific routing, causing the affected WPAR to begin using the global routing tables, use the following command:

```
chwpar -K -i wpar_name
```

To enable WPAR-specific routing and add a route for destinations in subnet 224.128.9.0/24 through gateway 224.128.9.1 on interface en4, use the following command::

```
chwpar -i -I rtdest=224.128.9.0 rtnetmask=255.255.255.0 rtgateway=224.128.9.1 rtinterface=en4 wpar_name
```

To delete an existing WPAR-specific route entry, you must provide enough information to identify the entry being deleted. In most cases, it is effective to use the same attributes provided when the route was configured. For example, use the following command to remove the route configured in the previous example:

```
chwpar -K -I rtdest=224.128.9.0 rtnetmask=255.255.255.0 rtgateway=224.128.9.1 rtinterface=en4 wpar_name
```

Configuring resource controls for system WPARs

You can configure the resource controls to limit the physical resources a system WPAR has access to using the **-R** flag for the **mkwpar** command and **chwpar** command.

To initialize resource control settings, run the following **mkwpar** command:

```
mkwpar -n wpar_name -R active=yes CPU=10%-20%,50% totalProcesses=1024
```

In this example, the WPAR is entitled to the following system resources:

- A minimum of 10% of the global environment's processors upon request
- A maximum of 20% of the global environment's processors when there is contention
- A maximum of 50% of the global environment's processors when there is no contention
- A maximum of 1024 processes at a time

The **active** attribute can be set to `yes` or `no`. When the **active** attribute is set to `no`, resource controls are disabled, but the settings are maintained in the configuration database.

To change resource control settings dynamically for an existing active or inactive application WPAR run the following **chwpar** command:

```
chwpar -R totalThreads=2048 shares_memory=100 wpar_name
```

Note: You can also use the **-K** flag for the **chwpar** command to remove individual attributes from the profile and restore those controls to their default, as follows:

```
chwpar -K -R totalProcesses shares_CPU wpar_name
```

Using specification files for system WPARs

You can create a WPAR with all of the options from a specification file using the **-f** flag for the **mkwpar** command.

To use a specification file to create a system WPAR, run the **mkwpar** command as follows:

```
mkwpar -f /tmp/specfile1
```

To create a specification file as part of the WPAR creation process, run the following **mkwpar** command with the **-o** flag:

```
mkwpar -n wpar_name -o /tmp/specfile2
```

Note: If the name of the system WPAR is provided in the specification file, the **-n** flag is not required. The specification file reflects the settings being used to create the WPAR.

To generate a specification file without creating the WPAR, run the following **mkwpar** command with the **-w** flag and the **-o** flag:

```
mkwpar -o /tmp/specfile3 -w
```

For a comprehensive description of the format and permitted contents of a specification file, see the `/usr/samples/wpars/sample.spec` file.

Using an `image.data` file for system WPARs

You can use an `image.data` file to specify additional logical volume options and file system options when you create a system WPAR using the **mkwpar** command with the **-L image_data=** flag.

The following restrictions apply to using image.data files with system WPARs:

- WPARs use only the `lv_data` stanza type and the `fs_data` stanza type in an `image.data` file. All other stanza types are ignored.
- If the logical volume device name matches an existing device name on the system, a new name is generated, and a warning is issued.
- The file system paths specified with the **FS_NAME** attribute should correspond to their appearance in the WPAR (for example, the root file system is / and the home file system is /home).
- The base directory for the global environment should not be included in `image.data` paths.
- All file systems must have associated LVs in the `image.data` file.
- All logical volumes must have associated file systems in the `image.data` file.

To create a system WPAR using the logical volume options and file system options in an `image.data` file, run the following command:

```
mkwpar -L image_data=image.data file -n wpar_name
```

Administering WPARs

After you have a WPAR created and configured, you might want to perform tasks such as removing, restoring, and listing WPARs.

Listing WPARs

You can list summary data for system WPARs and application WPARs using the **lswpar** command.

You can list information about one or more WPARs using the **lswpar** command by specifying zero or more workload partition names. The **lswpar** command supports shell-style wildcards.

For example, to list the WPARs on a system with names that start with "mypar_", run the following command:

```
lswpar 'mypar_*'
```

Listing WPAR identifiers

You can list the identifiers for a WPAR using the **lparstat** command or the **uname** command.

WPARs have the following identifiers:

WPAR name
> The name you assign to the WPAR.

WPAR configured ID
> A dynamic identifier that is assigned each time the WPAR is started. For the global environment, the value of this identifier is 0.

WPAR key
> A static identifier that is the same each time you start the WPAR. For the global environment, the value of this identifier is 0.

You can display the WPAR configured ID and the WPAR key by running the **lparstat** command with the **-W** flag. This command also displays processor information that might be helpful for licensing.

To view WPAR identification and processor information, run **lparstat** command with the **-W** flag as follows:

```
lparstat -W
```

To display the WPAR key, run the **uname** command with the **-W** flag as follows:

```
uname -W
```

Logging in to a WPAR

After you configure and activate a system WPAR that does not have a network connection, you can log in to it locally using the **clogin** command.

Note: The **clogin** command provides limited terminal support and some applications may not behave as they would under a full function terminal. The **clogin** command is primarily intended to be used to access the WPAR for maintenance in order to correct WPAR configuration problems. For best results, configure the WPAR to have at least a private network in order to enable network login mechanisms such as rlogin and telnet.

You can log in to a WPAR as the root user or as a different user. You might be prompted for a password when you log in. Output for the **clogin** command is displayed on the console where the command was issued. When you exit the command, the command returns to the global environment.

To log in to a system WPAR for maintenance and create a shell as the root user, run the following command:

```
clogin wpar_name
```

To log in to a system WPAR for maintenance and create a shell as a different user, run the following command:

```
clogin -l username wpar_name
```

Note: You can also log into a system WPAR remotely using the a network-based login command, such as the **rlogin** command, the **telnet** command, or the **rsh** command.

Backing up WPARs

You can back up a WPAR using the **savewpar** command, the **mkcd** command, or the **mkdvd** command.

The **savewpar** command uses the data created by the **mkwpardata** command to back up your WPAR. If these files are not already on your system, the **savewpar** command will call the **mkwpardata** command to create these files. The image files contain the following information:

- A list of logical volumes and their sizes
- A list of file systems and their sizes
- A list of volume groups
- The WPAR name

To back up a WPAR to the default tape device, run the following command:

```
savewpar wparname
```

To back up a WPAR to a file, run the following command:

```
savewpar -f file wparname
```

You can also back up a WPAR to a CD device using the **mkcd -W** command or to a DVD device using the **mkdvd -W** command.

Restoring WPARs

You can restore a WPAR using the **restwpar** command.

You can restore a WPAR from a backup image created by the **savewpar** command, the **mkcd** command, or the **mkdvd** command.

To restore the backup image from the /dev/rmt1 device, run the following command:

```
restwpar -f/dev/rmt1
```

Removing WPARs

You can remove a WPAR using the **rmwpar** command.

To remove a WPAR, it must be in the defined state, and you must provide the name of the WPAR.

To remove a WPAR, run the following command:

```
 rmwpar wpar_name
```

To stop a WPAR before removing it, run the following **rmwpar** command with the **-s** flag:

```
rmwpar -s wpar_name
```

Starting system WPARs

You can start a system WPAR from the global environment using the **startwpar** command.

To start a system WPAR, run the following command in the global environment:

```
startwpar wpar_name
```

You can also start a system WPAR in maintenance mode. Starting in maintenance mode performs all of the actions of starting the WPAR with the exception of network configuration. You can use this flag to prevent external access to the WPAR while you perform maintenance.

To start a system WPAR in maintenance mode, run the following command in the global environment:

```
startwpar -m wpar_name
```

Note: You cannot start WPARs that rely on NFS-mounted file systems in maintenance mode.

Stopping WPARs

You can stop a WPAR from the global environment using the **stopwpar** command.

Stopping a system WPAR follows a similar paradigm to the **shutdown** command and the halt command for AIX. For application WPARs, running the **stopwpar** command is equivalent to removing the WPAR with the **rmwpar** command.

To stop a system WPAR in the same way that the **shutdown** command stops a system, run the following command:

```
stopwpar wpar_name
```

To stop a system WPAR quickly in the same way that the **halt** command stops a system, run the following command:

```
stopwpar -F wpar_name
```

Using the trace facility with WPARs

You can use the trace facility to isolate system problems by monitoring selected system events in a WPAR.

The following tracing capabilities are available for WPARs:
- Launching a trace from within a WPAR
- Correlating a trace entry to a WPAR
- Filtering which WPAR trace entries to log from the global environment
- Filtering which WPAR entries to report from the global environment
- Running more than one kernel trace at the same time
- Additional trace utility hooks

Note: A maximum of 7 WPARs can run the trace facility at the same time.

By default you cannot run trace facility in a WPAR. To enable the trace facility from a WPAR, you must grant PV_KER_RAS privilege to the WPAR. You can grant this privilege when you run the **mkwpar** command or by running the **chwpar** command with the **-S privs+=PV_KER_RAS** flag.

Modified and enhanced AIX commands for WPARs

Some commands have different or enhanced behavior in a WPAR environment.

The following table shows how the behavior of some commands differs when they are run in a WPAR or run in the global environment. Some commands have different behavior only when certain flags are specified.

Note: For versioned WPARs, the **-@** flag is not recognized, because it is not present in the previous run time. Some commands in a versioned WPAR have added WPAR support, and in those cases, the behavior related to the **-@** flag is described in the following table.

Table 1. Modified and enhanced AIX commands

Command	Flags and arguments	Behavior in a WPAR	Behavior in the global environment
acctcom	- @ *WPAR name*	Not allowed in WPAR.	Executes normally displaying accounting records for WPAR named *WPAR name.*
	-@ *no argument*	Fails with `cannot open /var/adm/pacct` message	Executes normally displaying accounting records for all WPARs; a WPAR name is displayed for each record
	No -@ flag	Executes normally displaying accounting records for the WPAR	Executes normally displaying all accounting records.
accton	No -@ flag	Enables process accounting within the WPAR.	Enables process accounting within the global environment only.
	-@	Not allowed in a WPAR.	Enables process accounting for both WPAR and global processes.
audit	- @ *WPAR name*	Fails with workload partition not found message unless WPAR name is "Global".	Applies auditing command to WPAR named *WPAR name.*
clogin	-C *wpar name command*	Not allowed in a WPAR	Prompts for password and runs command in the WPAR or login if no command is specified
df		Displays information about WPAR mounted file systems only; paths are displayed relative to the WPAR root	Displays information about all file systems; paths are absolute
domainname	No flags	Displays domain name of WPAR	Displays domain name of system
	new domain name	Sets domain name of WPAR if run by WPAR root	Sets the domain name of system if run by global root
hostid	No flags	Displays host ID of WPAR	Displays host ID of system
	IP address | *hex number*	Sets host ID of WPAR if run by WPAR root	Sets host ID of system if run by global root
hostname	No flags	Displays host name of WPAR	Displays host name of system
	new host name	Sets host name of WPAR if run by WPAR root	Sets host name of system if run by global root
ifconfig	All display flags (**-a** and **-l**)	Displays information about the WPAR	Displays information about the global environment
ioo		Does not function in a WPAR	No change in behavior

Table 1. Modified and enhanced AIX commands (continued)

Command	Flags and arguments	Behavior in a WPAR	Behavior in the global environment
ipcrm	Without -@ *argument*	Removes IPC objects associated with the WPAR	Removes IPC objects associated with the global environment
	-@ *WPAR name*	Does not function unless WPAR name is "global"	Removes IPC objects associated with WPAR named *WPAR name*
ipcs	Without -@ *argument*	Displays information about IPC objects created by processes within the WPAR	Displays information about IPC objects created by processes in the global environment; no WPAR-associated objects are displayed
	-@	Displays IPC information for the WPAR where the command is run	Displays information about all IPC objects in the system; the name of the WPAR associated with the object is listed.
	-@ *WPAR name*	Displays no IPC information unless WPAR name is "global;" global case displays information about IPC objects associated with processes within the WPAR	Displays information about IPC objects associated with processes in the WPAR named *WPAR name*
lslpp	-@ *WPAR name*	Fails with an error message	Displays software vital product data for the specified workload partition. Fails if the workload partition is inactive.
mkclass		Only updates the /etc/wlm directory; fails updating kernel data	No change in behavior
mount	No flags	Displays only WPAR-mounted file systems relative to the WPAR root	Displays all mounted file systems with absolute paths
	With flags	Only NFS mounts without **cachefs** allowed	No change in behavior
netstat	-c -C -g -m -M -P -v -Z	These flags are not supported.	Display network information and statistics for the entire system
	All other flags	Display network information and statistics for the WPAR	Display network information and statistics for the entire system
	-@ *WPAR name*	Does not function in a WPAR	Display network information and statistics for the WPAR specified, or all WPARs if *WPAR name* is not specified
nfso		Has read-only functionality in a WPAR	No change in behavior
no	All flags except **-a**	Fails with an error message	No change in behavior if user has the correct privilege
	-a	No change in behavior	No change in behavior if user has the correct privilege

Table 1. Modified and enhanced AIX commands (continued)

Command	Flags and arguments	Behavior in a WPAR	Behavior in the global environment
projctl	All flags except **-qproj**	Fails with a `not owner` message	No change in behavior if user has the correct privilege
	qproj	No change in behavior	No change in behavior if user has the correct privilege
ps	**-e**	Displays all processes in the WPAR	Displays everything within the system; processes are not screened from view unless a specific WPAR name is specified using the -@ *WPAR name* flag
	-@	Displays process information for processes in the WPAR; WPAR name is included in output	Displays process information for all processes in the system; WPAR name is included in output
	-@ WPAR name	Displays no process information unless WPAR name is "global;" global case displays information about processes within the WPAR; WPAR name is included in output	Displays information about processes associated with the WPAR named *WPAR name*; WPAR name is included in output
	-o wpar	Produces a WPAR name header and the name of the WPAR associated with the process; name is always "global"	Produces a WPAR header and the name of the WPAR in which the process is executing
schedo		Does not function in a WPAR	No change in behavior
uname	**-n**	Displays name of the WPAR	Displays node name of the system
vmo		Does not function in a WPAR	No change in behavior
wlmstat	No flags	Displays information about the WPAR class	No change in behavior
	-@	Displays information about the WPAR class	Displays data for WPAR class
wlmtune		Does not function in a WPAR	No change in behavior
wlmcntrl		Does not function in a WPAR	No change in behavior

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