HP 9000 Containers A.01.06 on HP Integrity – Administrator's Guide

HP-UX 11i v3

Version 1.06.00 (Feb 2011)

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Preface

This document describes how to install HP 9000 Containers A.01.06 on HP-UX 11i v3, how to transition application environment from an HP 9000 server to an HP 9000 container, how to perform configuration and management tasks, and how to troubleshoot issues. It also lists the known limitations of the HP 9000 Containers and provides an overview of the file system layout.

Intended Audience

This document is intended for system administrators, solution architects and others involved in transitioning applications from legacy HP 9000 servers to HP-UX 11i v3 on newer HP Integrity hardware using HP 9000 Containers, and in managing the transitioned environment.

Typographic Conventions

The following conventions have been used in the document.

`$` A dollar sign represents the system shell prompt

Related Information

For more information on HP 9000 Containers product, refer to
http://www.hp.com/go/hp9000-containers

For information about the products used for building HP 9000 Containers

- HP ARIES dynamic binary translator
  http://www.hp.com/go/aries

- HP-UX Secure Resource Partitions
  http://www.hp.com/go/srp

For information about the HP OverEasy portfolio of products, visit
http://www.hp.com/go/overeasy

For information on HP Integrity servers, HP-UX 11i v3 and VSE, visit
http://www.hp.com/go/integrity
http://www.hp.com/go/hpux11i
http://www.hp.com/go/vse

Revision History

Revision	Date	Section	Change summary
1.05	Oct 30, 2010	NA	Initial version
1.06.00	Feb 3, 2011	2.1	Perl and SecureShell dependencies
		3.2	HP 9000 Containers A.01.06 enhancements
		3.4	Updates to Ignite-UX recovery process
		3.7	Additional configuration steps
		4.3	Internals of configuration
		5.8	Configuring multiple IP addresses
		5.10.2	Workaround for current Ignite-UX limitation
		8.2	Triaging HP 9000 container access issues

1. Introduction

1.1 Product Overview

HP 9000 Containers is a set of tools that enable quick transition of application environment from an HP 9000 server to an HP-UX 11i v3 OS instance on an HP Integrity server. It provides a mechanism to *re-host* the complete HP 9000 user-space environment without the need to re-compile or re-install individual application or re-construct application ecosystem, and with minimal re-configuration and application inventory preparation effort.

The transitioned applications will reside in a `chroot` environment (called the HP 9000-container) along with the HP 9000 commands and libraries. The HP 9000 container will have its own IP address which can be used to login, start/stop applications and network. An HP 9000 container can be started, stopped, exported, imported and deleted. However, it cannot support HP 9000 HP-UX kernel, kernel intrusive applications, system administration commands and system management related applications inside it.

HP 9000 Containers solution is built using two key HP-UX technologies – the HP ARIES dynamic binary translator, which has proven to be a reliable tool to transition well-behaved HP 9000 applications without recompilation, and HP-UX Secure Resource Partitions (SRP) which provide secure isolated execution environments within the same HP-UX 11i v3 operating system instance.

1.2 HP 9000 Containers A.01.06 Support Summary

Supported	**Not supported**
Transitioning HP 9000 application environment to a `chroot` environment on HP Integrity server	HP 9000 HP-UX kernel
HP-UX 11i (HP 9000) to HP-UX 11i v3 (Integrity)	HP 9000 environments prior to HP-UX 11i v1
Populate environment from existing HP 9000 servers	Pre-populated HP-UX 11i HP 9000 components inside HP 9000 containers
One HP 9000 container per HP-UX instance - consolidation to be enabled using HP-VM	Multiple HP 9000 containers per HP-UX instance
Transition all application binaries and configuration files on a server in one shot	Tools for data migration
Separate IP address, virtual *hostname* to login and start/stop applications	System administration tools, management applications and related services
Access to HP 9000 Containers through secure shell (SSH) based protocols	Access to HP 9000 containers through `telnet`, `ftp`, `remsh`, `rlogin` or `rcp` (no `inetd` support)
Non-SD (software distributor) installation and patching	Patching or installation using SD (software distributor) within the HP 9000 container
Life cycle management – start, stop, export. Import, delete	Online migration
Well-behaved, pure user space applications that perform no system management tasks	Support for kernel intrusive applications, device drivers, applications that perform system management related tasks

1.3 Consolidating HP 9000 Servers

HP 9000 Containers A.01.06 does not support creation of multiple HP 9000 Containers on the same HP-UX instance because a part of the file system will have to be shared with the HP-UX 11i v3 system. However, HP 9000 Containers may be deployed on HP-UX 11i v3 instance using HP VSE (HP-VM, vPar, nPar). This provides the means to consolidate multiple HP 9000 servers onto a single HP Integrity server.

1.4 Where to use HP 9000 Containers

HP 9000 Containers is recommended to be used where

- Upgrading or porting to native Integrity version of applications is infeasible.
- ISV application license agreements allow for copy over to a new platform or can be migrated.
- Applications intended to be transitioned are pure user-space and also not related to system administration or management.
- Traditional ARIES migration is deemed to be too costly because of one or more of the following reasons
  - There's not enough information about the application inventory (list of applications, executables, libraries, configuration files, inter-dependencies) that reside on the HP 9000 server(s).
  - The number of servers targeted for migration is large and there are not enough resources to do individual application transition.
  - There's a dependency on legacy stand-alone development environments which are not supported by HP XPADE.
- Where limitations as described in HP 9000 Containers Limitations are acceptable

1.5 ISV software licensing and support

ISV product license and support issues need to be discussed with the respective application vendors directly. HP does not own issues relates to software license migration during application transition to a new platform. If application licensing policy explicitly prohibits copying to a new server, the customer is advised to apply for fresh licenses before they start using HP 9000 Containers.

For further details, refer to "**Support**" section on HP 9000 Containers web portal (http://www.hp.com/go/hp9000-containers)

1.6 Support policy

Refer to "**Support**" section on HP 9000 Containers web portal (http://www.hp.com/go/hp9000-containers)

2. Installation and Configuration

2.1 Pre-requisites

2.1.1 HP-UX 11i v3 (March 2010 update or later)

Each HP 9000 container has to be configured on a fresh HP-UX 11i v3 instance. This instance could be an HP-VM guest. There should not be any applications installed on the system when HP 9000 Containers is being setup. It is also recommended that the system be used solely for the purpose of hosting the HP 9000 container. Creation of multiple HP 9000 containers or native SRPs on the same HP-UX 11I v3 OS instance is not supported in this release.

2.1.2 HP-UX Secure Resource Partitions (SRP) v2 (A.02.01 or later)

HP-UX Secure Resource Partitions (SRP) provides lifecycle management and isolation from the host system for HP 9000 Containers. For download and installation instructions, refer https://h20392.www2.hp.com/portal/swdepot/displayInstallInfo.do?productNumber=HP-UX-SRP

2.1.3 HP ARIES patch PHSS_41099 or later

Download and install the most recent HP ARIES patch for HP-UX 11i v3 from HP IT Resource Center http://itrc.hp.com

2.1.4 Perl v5.8.8 or later

Check the `perl` version on the system

```
$ perl -v
```

If it is below 5.8.8, get the latest version from https://h20392.www2.hp.com/portal/swdepot/displayProductInfo.do?productNumber=PERL

2.1.5 HP-UX SecureShell A.05.00.012 or later

Check the SecureShell version on the system

```
$ swlist | grep SecureShell
```

If it is below A.05.00.012, get the latest version from https://h20392.www2.hp.com/portal/swdepot/displayProductInfo.do?productNumber=T1471AA

2.2 Configuring HP-UX Secure Resource Partitions

Login as root user and run

```
$ srp_sys -setup
```

Accept default values for all parameters except for the ones related to PRM and IPfilter configuration. PRM is not supported or required at the SRP layer for HP 9000 Containers A.01.06 since creation of multiple HP 9000 Containers on the same HP-UX instance is not supported. Resource partitioning has to be done at the HP-VM layer (if applicable). Specifically, the following questions have to be answered in the negative

```
prm (Process Resource Management) [y] n  <enter>
Would you like to add the memory record? [y] n
Would you like to load and activate PRM configuration? [y] n
Would you like to enable PRM when the system is rebooted? [y] n
Would you like to enable the IPfilter module? [y] n
```

Reboot the server for the configuration to take effect.

For more information on the configuration parameters refer to *HP-UX Secure Resource Partitions (SRP) A.02.01 (or later) Administrator's Guide*

2.3 Installing HP 9000 Containers

The HP 9000 Containers depot contains tools to configure and manage an HP 9000 container on an Integrity HP-UX 11i v3 server. To install and verify the depot, run the commands

```
$ swinstall –s <path>/HP9000-Containers_A.01.06.depot \*
$ swverify HP9000-Containers
```

3. Transitioning from HP 9000 server

This chapter describes the essential steps that need to be followed in transitioning the entire application environment from an HP 9000 server running HP-UX 11i operating system to an HP 9000 container on an HP-UX 11i v3 instance running on an HP Integrity server.

3.1 Overview

The transition process from an HP 9000 server to an HP 9000 container typically involves the following sequence of activities.

- Migrate user accounts to the HP Integrity server
- Create the HP 9000 server file system image
- Recover HP 9000 files on the HP Integrity server
- Complete HP Integrity system configuration
- Create and configure an SRP compartment
- Setup and configure the HP 9000 container
- Start the HP 9000 container and test applications
- Tweak the HP 9000 container, if needed

The transition steps are also detailed in the transition guide as part of the HP 9000 Containers product under the path `/opt/HP9000—Containers/docs/transition-guide.txt`.

Note that data migration related issues have to be addressed separately. HP 9000 Containers do not provide any new tools or documentation in that space.

3.2 Migrating Users and Groups

Users and groups have to be transitioned from the HP 9000 server to the HP-UX 11i v3 system before the complete HP 9000 image is recovered. This is needed to ensure that the files are recovered with proper ownership and permissions.

3.2.1 Recover `/etc` directory

The input for the user migration process is a copy of the `/etc` directory from the HP 9000 server. For example, get a `tar` archive and recover it under `/tmp/hp9000_etc` on the HP 9000 server. It may also be possible to just recover `/etc` from the complete file system image.

3.2.2 System configuration

- If *trusted mode* was being used on the HP 9000 server, enable the same on the target system via SMH.
- If *shadow registers* was enabled on the HP 9000 server, enable the same on the target system using `pwconv` arguments.

3.2.3 Merge users and groups

HP 9000 Containers A.01.06 (and later versions) provides a tool to automate the process of user and group merge. Run the tool as

```
$ /opt/HP9000-Containers/bin/hp9000_conf_users \
  <path to recovered /etc directory>
```

Check the log file `/var/opt/HP9000-Containers/logs/user_config.log` for any errors or warnings from the merge.

3.2.4 Configure NIS and LDAP clients, if needed

NIS client configuration is copied from HP 9000 server automatically as part of the user merge. Check `/etc/rc.config.d/namesvrs` to verify the same. If NIS is indeed being used, re-start the client using

```
$ /sbin/init.d/nis.client stop
$ /sbin/init.d/nis.client start
```

LDAP client configuration is not automatically copied. Follow the usual steps to setup LDAP client on the HP-UX 11I v3 Integrity system and start the client.

3.3 Creating the HP 9000 Server Image

3.3.1 Image creation process overview

Archive all required directories from the HP 9000 server. Some directories such as `/tmp` and `/var/adm/crash` may be excluded if they are known to contain no relevant files. However, make sure that all basic HP-UX directories are archived including `/bin`, `/lib`, `/etc`, `/home`, `/opt`, `/sbin`, `/usr`, and `/var`. For NFS-mounted directories, there may be an option to mount them on the Integrity server instead of copying.

The image creation can be done using any method/utility that can eventually make the files visible under an alternate root directory and which can preserve file ownership and file permission. Some of the common tools that can be used are `pax` and `fbackup`. Imaging of files can be done at a system level or at individual directory level. The choice is to be made with due diligence. Some of the considerations may include availability of storage space as well as memory and I/O overhead of the archival method. However, it is advised that application data be copied over all together to prevent inconsistencies.

It may be possible to re-use existing images created by standard backup applications, if they can be recovered into an alternate path, either using the application itself or by manually running some commands. For example, see Recovering HP 9000 files on how to recover from HP Ignite-UX network recovery archive.

It is recommended that all applications on the server be stopped before making the image. This is to prevent transient files from being copied over. These transient files can cause unexpected behavior when applications are re-started inside the HP 9000 container.

3.3.2 Using `fbackup` for image creation of HP 9000 files

The following describes how to use `fbackup` for archiving all the required directories in a single session. If image creation is being done on a live production server, consider opting for multiple sessions, say one each for a sub-directory of '/', to reduce memory and I/O overhead. See "`man fbackup`" for more detailed information.

- Prepare a graph file with the include-exclude list.

  Following are contents of a graph file for a system level backup

  ```
  i /
  e /var/adm/crash
  ```

  For a directory level backup, the graph file could be

  ```
  i /var
  e /var/adm/crash
  ```

NFS mounted directories are excluded by default. It is not necessary to specify "e" for them explicitly in graph file. See "man fbackup" to know how NFS directories can be included in the archival process.

- Compute the total space requirement for the archive.

  Login as root to the HP 9000 server and run "du -sk" on all the directories in the list to be included/excluded. Add the sizes of the "i" directories and subtract sizes of the "e" directories. Also reduce sizes for any subdirectories that are actually NFS mounted, unless they are explicitly targeted for archival.

- Decide where fbackup is going to write the archive.

  It could be a tape or a local/remote file. See "man fbackup" for more details. If output is to a file ensure that largefiles is supported on the file system and there is enough free space to copy the archive.

  ```
  $ fsadm <file system root directory>
  $ df -k <file system root directory>
  ```

- Running fbackup

  If there is a need to "copy" NFS mounted directories to target server (as opposed to mounting them on the new system) then an additional option "-n" needs to be specified in the following command line.

  ```
  $ /usr/sbin/fbackup -0 -f <output device or file path> \
    -g <graph file path> -I <index file> -V <volume file>\
    2>&1 | tee <fbackup log file>
  ```

  Here "index file" and "volume file" are output files that will be created at the end. Check <fbackup log file> for errors. Some temporary files like those in /var/tmp or /var/spool/sockets/pwgr may appear in the error log, these can be ignored.

  Do not use "kill -9" on fbackup.

3.4 Recovering HP 9000 Files

3.4.1 Recovery process overview

Do not attempt recovering HP 9000 files until all the HP 9000 users have been migrated. This is necessary to ensure proper file ownership upon recovery. The exact recovery mechanism would depend on what archival method/utility was used. If fbackup was used, the recovery can be done using frecover as described in the next section.

Recover the directories under an "alternate root" on the HP Integrity server. We refer to the alternate root as <hp9000_root> in the sections to follow. Decide where on the file system <hp9000_root> can reside on HP Integrity HP-UX 11i v3 server. There is a hard requirement that the path leading up to <hp9000_root> (starting from /) be owned by root:sys (owner=root, group=sys) or root:root and have 0755 permission. Hence this new root directory cannot be created under any standard directory such as /opt and /var which are owned by bin:bin. The recommendation is to create this directory under '/' and name it by an identifiable name such as "/<hp9000 server name>_root.

It is possible to have this alternate root mounted from a logical volume, which is a necessary requirement if this setup is being done on the primary node of a Serviceguard cluster and the intention is to use the `SRP package` model for failover configuration. More information can be found in the chapter Integration with Serviceguard.

Ensure that there is enough space to store the recovered HP 9000 files under `<hp9000_root>`, Provision an additional 8 GB for internal use by the HP 9000 Containers. This will be used during HP 9000 container setup to backup HP 9000 commands and other files that need to be moved out of their existing locations and for copying HP-UX 11i v3 PA-RISC system libraries, if needed.

3.4.2 Using `Ignite-UX` network recovery archive

It Ignite-UX network recovery archive exists for the HP 9000 server; it can be used to get the files replicated on the target server. However, Ignite-UX application cannot itself be used to do the recovery. It currently does not support recovering the files under an alternate root, and also does system compatibility checks which might fail.

Steps to recover from an Ignite-UX network recovery archive

- Identify the archive

  The network archive, by default, will reside on the Ignite-UX server under `/var/opt/ignite/recovery/archives/<HP 9000-host-name>`

- Copy the archive file onto the Integrity server (or make it visible via a NFS-mount)
- Change to HP 9000 root directory on Integrity server
  ```
  $ cd <hp9000_root>
  ```

- Recover the image

  ```
  $ gzcat <image-file-path> | pax -r -p e   # for .gz archives
  $ zcat <image-file-path> | pax -r -p e    # for .Z archives
  ```

- Verify the image

  Check if all directories from the HP 9000 server have been recovered. If not, archive and bring over those separately. Also check directory ownership and permissions.

3.4.3 Using `Ignite-UX` tape recovery archive

It Ignite-UX tape recovery archive exists for the HP 9000 server; it can be used to get the files replicated on the target server. However, Ignite-UX application itself cannot be used to do the recovery. It currently does not support recovering the files under an alternate root, and also does system compatibility checks which might fail.

Steps to recover from an Ignite-UX tape recovery archive

- Insert the tape into a compatible drive on the HP Integrity server
- Extract the archive into file system
  ```
  $ copy_boot_tape -u /dev/rmt/0mn -d <directory>
  ```

- Identify the file in the extract that corresponds to the file system image. This will typically be the largest file in the extract. For HP-UX 11i v1, it is usually named `file0002`.

- Change to alternate root and extract the image
  ```
  $ cd <hp9000_root>
  $ tar -xvf <file-name>
  ```

3.4.4 Using `frecover` for recovering HP 9000 files

The following describes how to use `frecover` to get the archive extracted on the HP Integrity server under an alternate root

- Verify the archive integrity. For each backup file do

```
$ /usr/sbin/frecover -N -f <backup device or file path> \
  -I <recover index file path>

$ diff <recover index file> <corresponding backup index \
  file saved during backup session>
```

- Running `frecover` on the image

```
$ cd <hp9000_root>
```

Ensure that you are inside the alternate root so that `frecover` does not overwrite files on the host HP-UX 11i v3 system root.

```
$ /usr/sbin/frecover -x -X -f <backup device or file> \
  2>&1 > <log file> &
```

Repeat for other backup files, if any.

Do not use "`kill -9`" on `frecover`.

3.4.5 Post recovery steps

After the recovery is completed, directories that have not been copied over have to be created manually and assigned proper ownership and permissions.

For example,

```
$ mkdir <hp9000_root>/var/adm/crash
$ chmod 0755 <hp9000_root>/var/adm/crash
$ chown root:root <hp9000_root>/var/adm/crash
```

3.5 Completing HP-UX 11i v3 Integrity System Configuration

3.5.1 Kernel tunable parameters

This is not currently automated. Get a `kmtune` output from the HP 9000 server and compare against values on the HP-UX 11i v3 system. A rule of thumb is to look closely at those values that are set to a higher value on the HP 9000 server. The following tool can be used to identify those parameters that are higher or missing.

```
$ /opt/HP9000-Containers/bin/hp9000_conf_tunables \
  <kmtune output file from HP 9000 server>
```

Check `/var/opt/HP9000-Containers/logs/updated_tunables.log` for the report that the tool generates.

Tunable base page size is not supported with HP 9000 Containers. Ensure that the kernel tunable parameter `base_pagesize` is set to its default value of 4 KB.

3.5.2 Configuring `sendmail`

Copy any specific configuration from HP 9000 `/etc/mail/sendmail.cf`. `/etc/mail/aliases` etc to HP-UX 11i v3 `/etc/mail`.

3.5.3 Configuring `printers`

Store/restore the `spooler` configuration, if any, from the HP 9000 HP-UX 11i server using SAM/SMH.

3.6 Configuring an HP-UX SRP Compartment

3.6.1 Decide the SRP compartment name

By default, the SRP compartment name will be used as the host name for the HP 9000 container. HP 9000 Containers A.01.06 supports only host names less than or equal to 8 characters in length. Hence if the compartment name is to be used as host name, select one that adheres to the restriction. The alternative is to use a longer name and configure the host name as described later in this document.

3.6.2 Create an HP-UX SRP compartment

Login as root to the HP-UX 11i v3 server and run

```
$ srp –add <srp_name>
```

Ensure that the following parameters are configured

- IP address: compartment IP address (different from host system IP address but in the same `subnet`)
- Network interface name: LAN interface to be associated with the IP address
- Subnet mask: as configured in `/etc/rc.config.d/netconf`
- Gateway server IP address: as configured in `/etc/rc.config.d/netconf`

If this setup is being done on the primary node in a Serviceguard cluster, and the intention is to use the *`SRP package model`*

- Before creating the compartment ensure that the SRP home `/var/hpsrp/<srp_name>` has been mounted from the shared logical volume.
- Answer "`no`" for "`Assign IP address at SRP startup time?`"
- Answer "`no`" for "`Autostart SRP at system boot?`"

For details on other SRP parameters refer to *HP-UX Secure Resource Partitions (SRP) A.02.01 (or later) Administrator's Guide*.

3.6.3 Adding `sshd` template to the SRP

Run the following command to add sshd template

```
$ srp –add <srp_name> -t sshd –b
```

3.6.4 Testing SRP compartment start and stop operations

Start the compartment

```
$ srp –start <srp_name>
```

All startup messages should say [`OK`]

Check for compartment specific `sshd` using

```
$ srp_ps <srp_name> –ef | grep sshd
$ ps –ef | grep sshd
```

Stop the compartment using

```
$ srp –stop <srp_name>
```

All shutdown messages should say [OK].

3.7 Configuring the HP 9000 Container

3.7.1 Adding hp9000 template to the SRP

Run the command

```
$ srp –add <srp_name> -t hp9000
```

Enter the requested values when prompted.

```
Services to add: [cmpt. provision]   <enter>
Extracted root path for HP 9000 files [] <enter hp9000_root path>
```

The process may take about10 minutes – do not interrupt. Wait until the configuration is complete and the following messages appear.

```
add compartment rules succeeded

HP 9000 Container configuration completed
Log file <log file path>

add provision service succeeded
```

Check the log file for any errors in HP 9000 Container configuration.

Verify the template using

```
$ srp –list <srp_name>

<srp_name>      base        admin, cmpt, init, login, network
                sshd        cmpt, provision
                hp9000      cmpt, provision
```

3.7.2 Reverting configuration (if needed)

In case of any issues or errors during configuration, revert the template addition using

```
$ srp –delete <srp_name> -t hp9000

delete compartment rules succeeded

HP 9000 Container cleanup completed
Log file <log file path>

delete provision service succeeded
```

Check log file for any errors in HP 9000 Container cleanup.

3.7.3 Configuring virtual host name

By default, the SRP compartment name is also used as a virtual host name for the HP 9000 container

- Add an entry corresponding to the `hostname` in the native host HP-UX 11i v3 `/etc/hosts` file (with the associated compartment IP address).
- Add the `hostname` in `/etc/mail/sendmail.cw`, if needed.

- If the hostname needs change, edit configuration files `.ariesrc` and `.aries64rc` in `<hp9000_root>`. Change `-cmpt_host_name <srp_name>` to `-cmpt_host_name <new host name>`. Currently HP 9000 Containers support only host names which are less than or equal to 8 characters in length.
- If Serviceguard is intended to be used with the HP 9000 container in the classic model, the HP 9000 container on each node will have a different IP address (but same compartment name) and hence it is advisable to configure different virtual host names on each node
- Configure applications inside the HP 9000 container with new host name. This may need modification to configuration files. Some applications also tend to store the hostname in databases or using internal formats – refer application documentation on how to do re-configuration. If such information is not available, or the steps for re-configuration are too complex, then re-using the HP 9000 system hostname for the HP 9000 container may be the only option.
- If application license depends on the host name, and it cannot be migrated, you would need to re-use HP 9000 server hostname.

3.7.4 Configuring IP address

- Configure applications inside the HP 9000 container to listen to the SRP's own IP address. It is recommended that they are not left to listen on all IP address on the host system. Some applications store the IP address in the databases – refer to application documentation on how to do re-configuration.
- If application license depends on IP address and it cannot be migrated, or if application re-configuration for IP address is too complex. you will need to use the HP 9000 system IP address for the HP 9000 container
- Refer to Modifying IP address configuration for details on how to modify IP address configuration

3.7.5 Configuring additional IP addresses

- Applications inside an HP 9000 container may need to use multiple IP addresses. Analyze the configuration in `<hp9000_root>/etc-hp9000/rc.config.d/netconf` to identify how many IP addresses were configured on the HP 9000 server.
- If Serviceguard is intended to be used with the HP 9000 container in the classic model, applications may need to use an additional floating IP address which will be managed by Serviceguard
- Refer to Modifying IP address configuration for details on how to do this configuration

3.7.6 Configuring mount points

To configure file system mount points

- Perform mount on the native HP-UX 11i v3 system.
- Add mount configuration to `/etc/fstab` if needed.
- If auto mounts are to be enabled, add to `/etc/auto_master or /etc/auto.direct`. and restart the `autofs` daemon

```
$/sbin/rc1.d/K565autofs stop
$ /sbin/rc2.d/S435autofs start
```

- Make the mount point visible inside the HP 9000 container

```
$ /opt/HP9000-Containers/bin/hp9000_link_dir \
  <directory> <srp_name>
```

3.7.7 Configuring HP 9000 startup services

As part of HP 9000 container setup most system startup services are deleted from the HP 9000 RC directories. The heuristic used is that all services that appear in HP 9000 `swlist` are moved out of `<hp9000-root>/sbin/init.d` with some exceptions, If there are applications which were installed using SD, related daemons may also have been removed due to the heuristic. The list of startup scripts that have been removed is in `/var/hpsrp/<srp_name>/var/HP9000-Containers/hp9000_services.done`. If any of the deleted services need to be restored

- Copy over the service script from `<hp9000-root/sbin-hp9000/init.d>` which is a backed up copy of the original directory.
- Create the S & K links to the script in the rc directories similar to what is there in `<hp9000-root/sbin-hp9000/rc#.d>`
- Open the service script, identify the config file and ensure that the file is present under host 11i v3 `/etc/rc.config.d`. If the config file is missing copy over to `/etc/rc.config.d/` from `<hp9000-root>/etc-hp9000/rc.config.d`

3.7.8 Configuring non-local users

Local users are added to a container login group automatically as part of addition of the `hp9000` template and this group is allowed access to the SRP using RBAC. If non local users or (groups of users) have to be given access to the container, follow instructions in User Account Management for the same.

3.7.9 Configuring DCE services

HP 9000 Containers A.01.06 provides a tool to enable DCE client and server daemons inside an HP 9000 container.

```
$ /opt/HP9000-Containers/bin/hp9000_dce_setup <srp_name>
```

If the tool reports that it found DCE server configuration and if there are DCE clients on other servers that point to this server, the host name and IP address of the HP 9000 container have to be changed to the values on the HP 9000 server to prevent re-configuring all clients.

If the tool reports that it found DCE client configuration, and if the HP 9000 container is using a different hostname and IP address from that of the HP 9000 server, add this new client to the DCE server using `dce_config`. If this is not feasible, then the only option is to re-use the hostname and IP address from the HP 9000 server.

Edit IP address configuration in `/etc/opt/security/pe_site`, if needed.

3.7.10 Configuring trusted users

- Check `/tcb/files/auth` on the HP-UX 11i v3 system and see if the trusted mode users have been merged from `<hp9000_root>/tcb`
- Check the log file `/var/opt/HP9000-Containers/logs/migrated_users` and see if any of the UIDs have changed as part of the user merge. If there are UIDs have changed, the same need to be reflected in `/tcb/files/auth`. For example, if the log file reports that UID of "user1" has changed, edit the `u_id` field in `/tcb/files/auth/u/user1`
- Enable auditing via SMH, if needed. The audit IDs will be automatically picked up from the files in `/tcb/files/auth`.

3.7.11 Configuring root cron jobs

As part of HP 9000 container setup, all `cron` jobs configured by root are moved out because they may contain system administration related jobs which are not supported within the HP 9000 container. If any of the root `cron` jobs need to be run in the HP 9000 container, it can be re-configured using `crontab` command or by restoring entries from the backup file `<hp9000_root>/var/spool/cron/crontabs/root-hp9000`

3.7.12 Creating cron jobs for application re-spawn

HP 9000 Containers A.01.06 does not support application re-spawn through `/etc/inittab` specification. A workaround might be to write up a script which checks for the related processes and re-start them if not running. This can be made a cron job inside the HP 9000 container. Support for `inittab` will be available in a future release.

3.8 Testing the HP 9000 Container

If this configuration is being done on the primary node of a Serviceguard cluster and the intention is to use the SRP package model, refer to Using SRP package model for details on how to start the HP 9000 container for testing. Otherwise, start the SRP

```
$ srp -start <srp_name>
```

All startup messages should say `[OK]`. Look for any startup error messages in `/var/hpsrp/<srp_name>/etc/rc.log`

Login to the HP 9000 container

```
$ ssh user@<srp-ip-addr>
```

Start applications as normally done on an HP 9000 server and start testing.

3.9 Tweaking the HP 9000 Container

In some cases, additional configuration may be required to get applications working in the HP 9000 container. Following tweaks/tunings may be helpful for specific cases.

3.9.1 Configuring ARIES for more threads

The number of threads that a 32-bit application can spawn on ARIES is limited by the value of kernel tunable parameter `pa_maxssiz_32bit`. With default value, `85` threads can be spawned. For every additional thread, the value has to be increased by 215 KB. So if an application needs `300` threads, `pa_maxssiz_32bit` has to be increased by `300*215*1024`. In addition to tuning the kernel tunable parameter, ARIES needs to be configured to support more threads. Create an `.ariesrc` file in application directory or user home directory (or re-use the one in root directory) and add

```
# start config for more threads
<executable path name> -mem_tune heap_max
# end config for more threads
```

3.9.2 Switching to HP-UX 11i v3 HP 9000 libraries

Applications inside the HP 9000 container, by default, use the system libraries which are brought over from the HP 9000 server. However it can be configured to use HP-UX 11i v3 HP 9000 libraries instead.

Login to the `INIT` compartment as `root` and run

```
$ srp -stop <srp_name>
$ srp -add <srp_name> -t libv3 -b
```

This may take about 5 minutes as the HP-UX 11i v3 libraries are copied into the HP 9000 container and any application libraries are merged in.

4. HP 9000 Containers File Set Layout

4.1 Overview

There are "three root directories" and corresponding file sets on an HP-UX 11i v3 OS instance that is hosting an HP 9000 container

- The native HP-UX 11i v3 root (/)
- HP-UX SRP compartment root (/var/hpsrp/<srp_name>)
- The HP 9000 container root (/<hp9000_root>)

The HP 9000 container file system is fairly, but not completely, isolated from the HP-UX 11i v3 file system. The file system layout, with the HP 9000 container configured, is depicted in Figure 4.1

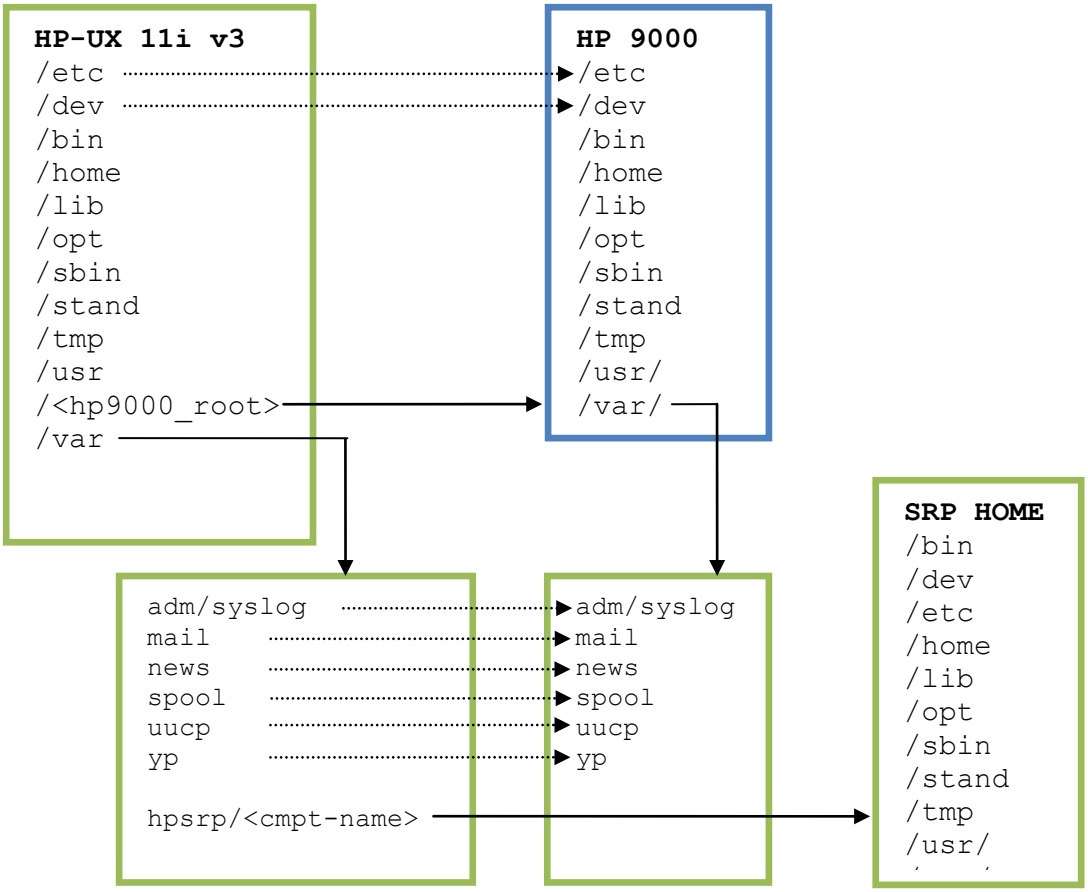

Figure 4.1: Overview of HP-UX 11i v3 Integrity file system configured with HP 9000 Container

4.2 Shared Directories

No HP 9000 system services are started inside HP 9000 Containers A.01.06 apart from `cron` daemon and `ptydaemon`. Applications inside the HP 9000 container are expected to interact with system services that are running in the HP-UX 11i v3 host system. In order to enable this, some of the system directories have to be shared between the HP 9000 container and the host system. While this has some disadvantages from isolation point of view, it does provide benefits in being able to free the HP 9000 container from depending on legacy services.

List of shared directories

- /dev
- /etc
- /net
- /tcb
- /usr/lib/hpux32
- /usr/lib/hpux64
- /var/adm/syslog
- /var/mail
- /var/news
- /var/opt/dce/rpc
- /var/uucp
- /var/yp
- All subdirectories of /var/spool, except for /var/spool/cron

In addition, file system mount points may also have to be shared if they need to be accessed from within the HP 9000 container. Refer to *Configuring file system mount and export points* on how to implement mount point sharing.

Sharing is implemented through local file system (LOFS) a.k.a. loop-back mounts to HP 9000 directories from corresponding native directories. These LOFS mounts will be performed as part of the HP 9000 container startup. This is enabled by configuring /var/hpsrp/<srp_name>/etc/fstab. These mounts are critical and need to be always active for applications to function correctly inside the HP 9000 container.

As part of HP 9000 container setup, files from HP 9000 /etc that may be related to applications are merged into the host system /etc. This is not done for other shared directories because applications are generally not expected to install files there.

4.3 Configuration internals

The hp9000_conf_users script copies local users, groups and namespace configuration from HP 9000 to the HP-UX 11i v3 system. It

- Adds all entries in the /etc/passwd and /etc/group are copied as such except where there is a user name, group name, UID or GID conflict.
- Resolves GID and UID conflicts by assigning new IDs and modifying the entries to correspond to the same. The UID mapping can be found in /var/opt/HP9000-Containers/logs/migrated_users and the GID mapping in /var/opt/HP9000-Containers/migrated_groups
- Merges configuration in /etc/nsswitch.conf, /etc/rc.config.d/namesvrs, /etc/rc.config.d/namesvrs_dns and /etc/hosts.

At the time of adding hp9000 template to the SRP, the following occur

- Adds HP 9000 users to a login group and grant that group access to the SRP using roleadm command with role SRPlogin-<srp_name>
- Configures /var/hpsrp/<srp_name>/etc/cmpt/fstab with the loop back mounts that are required to implement directory sharing
- Merges files from <hp9000_root>/etc and <hp9000_root>/tcb into the corresponding directories on the HP-UX 11I v3 system based on some heuristics. The list of files merged is printed into the log file /var/opt/HP9000-Containers/logs/hp9000_setup_<srp_name>.log
- Creates a set of symbolic links in <hp9000_root>/usr/lib/security
- Backs up HP 9000 directories /usr/bin, /usr/sbin, /usr/lbin. /usr/contrib/bin and /sbin. The backups will have same name but –hp9000 suffix. After this remove unsupported commands from the original

directories The list of unsupported commands can be found in `/opt/HP9000-Containers/config/unsupported_coammnds`

- Deletes unsupported system daemons from `<hp9000_root>/sbin/init.d` (and the corresponding RC links). The list of supported system services can be found in `/opt/HP9000-Containers/config/hp9000_services`. The HP 9000 container specific RC script is copied to `/var/hpsrp/<srp_name>/sbin/init.d`
- Move root crontab file so that system administration related cron jobs don't get automatically enables in the container.

4.4 HP 9000 Containers directories

HP 9000 Containers depot installation creates the following directories under `/opt/HP9000-Containers/`

`bin` – setup, cleanup and management scripts
`config` – configuration for setup
`docs` – documentation

The HP 9000 container configuration logs can be found at `/var/opt/HP9000-Containers/logs`.

When an HP 9000 container is setup, the configuration information (and record of changed made to native HP-UX 11i v3 directories) is stored under `/var/hpsrp/<srp_name>/var/HP9000-Containers`. This information is critical to be preserved in order to be able to do a proper cleanup if and when the HP 9000 container is to be deleted or replaced.

5. HP 9000 Containers Administration

The HP 9000 container resembles a system only for tasks that are related to applications such as starting, stopping and monitoring them. System administration commands are not, in general, available inside HP 9000 containers. Most of the administration tasks for the HP 9000 Containers have to be performed from the native HP-UX 11i v3 host system. The host HP-UX instance is referred to as the `INIT compartment` in the following sections in accordance with HP-UX SRP terminology.

5.1 Administrator privileges

The `root` user of the host system is also the root user for the HP 9000 container. However, it is possible to assign administrator users who will be allowed to do lifecycle management on the HP 9000 container. This is implemented using RBAC (Role Based Access Control).

5.1.1 Adding an administrator

To add a new administrator, login to `INIT` compartment as root and run the command

```
$ roleadm –add <user-name> SRPadmin-<srp_name>
```

5.1.2 Deleting an administrator

Login to the INIT compartment as `root` and run

```
$ roleadm –delete <user-name> SRPadmin-<srp_name>
```

5.2 Startup and Shutdown

The HP 9000 container can be started and shutdown, without rebooting the host system, by using life cycle management facilities provided by HP-UX SRP.

5.2.1 Starting the HP 9000 container

Login to the INIT compartment as a user with administrative privileges on the SRP compartment and run:

```
$ srp –start <srp_name>
```

Check `/var/hpsrp/<srp_name>/etc/rc.log` and ensure all compartment services and application daemons have been started successfully.

5.2.2 Shutting down the HP 9000 container

Login to the INIT compartment as a user with administrative privileges on the SRP compartment and run:

```
$ srp –stop <srp_name>
```

Check `/var/hpsrp/<srp_name>/etc/rc.log` for service and application daemon shutdown logs.

5.2.3 Configuration for automatic startup at system boot time

The SRP compartment can be configured/de-configured to start at system boot time by modifying `START_SRP` configuration in `/etc/rc.config.d/srpconf file`.

5.3 User Account Management

5.3.1 The HP 9000 container login group

As part of HP 9000 container configuration, a group "<srp_name>-login" is created and this group is allowed access to the SRP compartment. All local users from HP 9000 /etc/passwd file are added to this auxiliary group..

5.3.2 Adding a new user

- Login to the INIT compartment as root and run "useradd" as usual. There's NO need to prefix <hp9000_root> directory in this step while specifying the home directory.
- Create home directory inside the <hp9000_root> directory. Set permission for home directory to 0755.
- Add user to one of the HP 9000 container login groups. Names of default login groups (created at setup time) start with <srp_name>-login

```
$ groupmod -a -l <username> srp_name>-login
```

5.3.3 Adding all users of a group

If all members of a group should be allowed access to SRP compartment, use

```
$ roleadm assign \&<group-name> SRPlogin-<srp_name>
```

This can be used, for example, to add more HP 9000 container login groups when the number of users is too large to fit in a single /etc/group line.

5.3.4 Disallow all members of a group access

Login to the INIT compartment as root and run

```
$ roleadm revoke \&<group-name> SRPlogin-<srp_name>
```

5.4 Configuring SSH Authorization Keys

5.4.1 Automatic login to the HP 9000 Containers

Enabling automatic login to the HP 9000 Containers using SSH authorization keys requires home directories to be created *outside* the HP 9000 container (in the INIT compartment). Following is the sequence of steps to enable automatic login to HP 9000 container:

- For every user who needs to use SSH authorization keys, create a home directory on the native system (INIT compartment) with same path as inside the HP 9000 container. Change permissions of home directory to 0755 and ownership of directory to the individual user.
- The user should login to the native system (INIT compartment) and create a $HOME/.ssh directory with 0700 permissions.
- The user can login to the client systems (from where automatic login is to be allowed) and generate a ssh key

```
$ ssh-keygen -t dsa
```

- Append the contents of $HOME/.ssh/id_dsa.pub on the client system to $HOME/.ssh/authorized_keys on the target system (INIT compartment).
- Ensure that permissions of $HOME/.ssh/authorized_keys are 0644.

5.4.2 Automatic login from the HP 9000 container

Keys can be generated from within the HP 9000 container and transferred to the target server. No additional steps are required.

5.5 Configuring File System Mount and Export Points

File system mounts and unmounts cannot be done from within the HP 9000 container. The mounts need to be performed from the `INIT` compartment and the mount points made visible inside the HP 9000 container through loop back (`LOFS`) mounts. Consequently umount should be done for both the loop back and the native mount point. The HP 9000 Containers depot provides helper scripts (`hp9000_link_dir` and `hp9000_unlink_dir`) to assist with this.

5.5.1 File system mount

If the mount is to be configured in Serviceguard packages, please refer to chapter Integration with Serviceguard

Configuring and doing mounts for an HP 9000 container which is not in a Serviceguard cluster involves the following steps.

- Configure `/etc/fstab`. if the operation is to be persistent.
- Configure `/etc/auto_master` or `/etc/auto.direct` for auto mount.
- Create the mount point on the native system (`INIT` compartment) using HP-UX 11i v3 `mount` command and do the mount in the `INIT` compartment.
- If the mount point is not under `/etc` or `/dev` or any of the other directories that are already shared, run `hp9000_link_dir` script to make the mount point accessible inside the HP 9000 container. The script takes the mount point and the SRP compartment name as arguments.

When `hp9000_link_dir <mnt_point> <srp_name>` is run, it does the following:

- Create <`hp9000_root/mnt_point`> if it does not exist
- Do a loop back mount using
  `$ mount -F lofs <mnt_point> <hp9000_root/mnt_point>`
- Add the loop back mount configuration to `/var/hpsrp/<srp_name>/etc/fstab` If the mount on <`mnt_point`> is configured in native `/etc/fstab`, `/etc/auto_master` or `/etc/auto.direct`
- Add SRP compartment rule to allow access to <`mnt_point`>

Example 1

Suppose `/dev/vg11/lv3` needs to be mounted on `/mnt` and made visible inside an HP 9000 SRP compartment named `mySRP`

- Login to the native system (the `INIT` compartment) as `root`.
- Add configuration to `/etc/fstab` if needed.
- Run commands

```
$ mkdir /mnt (if not already there)
$ mount /dev/vg11/lv3 /mnt
$ /opt/HP9000-Containers/bin/hp9000_link_dir /mnt mySRP
```

Example 2

Suppose to the same HP 9000 SRP compartment, an NFS mount has to be configured on `/proj`.

- Login to the native system (the `INIT` compartment) as `root` user.
- Add configuration to `/etc/fstab` if needed.
- Run commands

```
$ mkdir /proj
$ mount -F nfs mach1:/proj /proj
$ /opt/HP9000-Containers/bin/hp9000_link_dir /proj mySRP
```

5.5.2 File system unmount

Undoing mount points for the HP 9000 container, involves the following steps:

- Remove entry from native system (the `INIT` compartment) `/etc/fstab`, `/etc/auto_master or /etc/auto.direct` if the operation needs to be persistent.
- Run `hp9000_unlink_dir` script from the HP 9000 container directory to make the mount point no longer accessible inside the HP 9000 container. The script takes the mount point and compartment name as arguments.
- Run native `umount`

When `hp9000_unlink_dir <mnt_point> <srp_name>` is run, it does the following:

- If `<mnt_point>` is no longer configured in native `/etc/fstab`, `/etc/auto_master` or `/etc/auto.direct` remove the loop back mount configuration from `/var/hpsrp/<srp_name>/etc/fstab`
- If the above was done, also delete the SRP compartment rule
- Undo any active loop back mount using

```
$ umount <hp9000_root/mnt_point>
```

Example 1

Suppose `/mnt` has to be `unmounted`

- Login to the native system (the `INIT` compartment) as `root` user.
- Remove configuration from `/etc/fstab` if necessary
- Run commands

```
$ /opt/HP9000-Containers/bin/hp9000_link_dir /mnt mySRP
$ umount /mnt
```

5.5.3 NFS exports

- Configure the NFS exports in `INIT` compartment
- Specify the complete path `<hp9000_root/dir>`, where `dir` was the directory which was originally exported from the HP 9000 system.
- On the client systems, make sure that the host name configured is of the native HP-UX 11i v3 server, and NOT of the HP 9000 container.

5.6 Patching the HP 9000 container

HP 9000 Containers A.01.06 does not support software/system patching using HP-UX SD (Software Distributor). For application patching using custom installers, login to the HP 9000 container and follow the patching instructions as applicable on an HP 9000 server.

5.7 Changing HP 9000 container virtual host name

HP 9000 Containers A.01.06 supports only 8 character long host names. In addition, applications need to be stopped and re-started for the configuration to take effect. Using "`hostname`" command to change host name for the HP 9000 container is not supported. The HP 9000 Containers have a "`virtual`" hostname which is not known to the underlying operating system. This host name is configured through ARIES configuration files. To change HP 9000 container virtual host name,

- Login as `root` user to the INIT compartment
- Open the `<hp9000_root>/.ariesrc` file
- Replace `-cmpt_host_name <old-name>` by `-cmpt_host_name <new name>`
- Repeat the same steps in `<hp9000_root>/.aries64rc` file
- Update `/etc/hosts` with new mapping
- Re-configure applications with new hostname
- Stop the HP 9000 container

  ```
  $ srp -stop <srp_name>
  ```

- Start the HP 9000 container

  ```
  $ srp -stop <srp_name>
  ```

5.8 Modifying IP address configuration

5.8.1 Changing HP 9000 container IP address or subnet

- Login to the HP-UX 11i v3 host system as root
- Stop the HP 9000 container

  ```
  $ srp -stop <srp_name>
  ```

- Re-configure SRP

  ```
  $ srp -replace <srp_name> -t base -s network
  ```

  Enter new IP address, gateway and subnet mask. Do not leave any of these to default since SRP does not automatically pick up original values.

- Re-configure `sshd`

  Open the SRP sshd configuration file (by default `(/var/hpsrp/<srp_name>/opt/ssh/sshd_config`) and edit `the ListenAddress` parameter towards the end of the file.

  ```
  ListenAddress <new IP-address>
  ```

- Re-configure applications with new IP address.
- If there are additional IP addresses that need to be used by the container, ensure that the same are specified via interface parameters in the file `/etc/cmpt/<srp_name>.rules`

  ```
  interface    <IP address>
  ```

- Activate any rules file changes

  ```
  $ setrules
  ```

- Update `/etc/hosts` to reflect new mapping.
- Start the HP 9000 container

  ```
  $ srp -start <srp_name>
  ```

5.8.2 Adding a new IP address for the HP 9000 container

- Configure the new IP address on the HP-UX 11I v3 system, associating it with a new or existing LAN interface
- Modify the compartment rules file `/etc/cmpt/<srp_name>.rules` to allow applications inside the HP 9000 container to use the new IP address. You need to add a line to the rules file as follows

  ```
  interface     <new IP address>
  ```

- Activate the rules file changes

  ```
  $ setrules
  ```

- This interface will not be automatically brought up at SRP startup time. Hence you need to ensure that it is brought up at system boot time.

5.8.3 Changing native HP-UX 11i v3 system IP address

In addition to following usual steps for IP address change on the HP-UX 11i v3 system hosting the HP 9000 container, native `sshd` needs to be re-configured to listen specifically on the new IP address.

Login to the HP-UX 11i v3 server as `root`, open the sshd configuration file (default `/opt/ssh/etc/sshd_config`) and edit the `ListenAddress` parameter towards the end of the file.

```
ListenAddress <new IP-address>
```

Re-start sshd

```
$ /sbin/init.d/secsh stop
$ /sbin/init.d/secsh start
```

5.9 Monitoring applications in HP 9000 containers

To list only processes running inside an HP 9000 container use

```
$ srp_ps <srp_name> <ps options>
```

To invoke a command in the context of an HP 9000 container use

```
$ srp_su <srp_name> \
  root -c "chroot <hp9000_root> <command full path>"
```

The above command syntax could be used to invoke monitor scripts, for example. it can also be used to start, stop, or interact with applications in the context of the HP 9000 container from the `INIT` compartment, if need be.

5.10 HP 9000 Containers Migration and Backup

5.10.1 Migrating/backing up an HP 9000 container

HP 9000 Containers A.01.06 shares a part of the HP 9000 container file system with the host HP-UX system as described in HP 9000 Containers File Set Layout. Because of this, and since only one HP 9000 container is supported on an HP-UX OS instance, it is recommended that a system wide backup (or HP-VM cloning) be used to migrate the HP 9000 container along with the configuration.

5.10.2 Using Ignite-UX with HP 9000 containers

Ignite-UX can be used to create and restore HP-UX system images. There is one known issue in recovering an image which has Secure Resource Partitions activated. The symptom is that during the recovery, the client will be unable to access the Ignite server via NFS and cannot ping other systems. This issue will be addressed along with March 2011 release. There is also a web release for Ignite-UX version 0.7.12 in the same timeframe.

There is a workaround for this now. When given an opportunity to break to a shell. Select option #3 and run the command from the shell

```
$ cmpt_tune -d
```

Then exit, and tell the system to reboot. The recovery should continue from this point. Once complete re-enable compartments using

```
$ cmpt_tune -e
```

5.10.3 Backing up system configuration for SRP

Refer to *HP-UX Secure Resource Partitions (SRP) A.02.01 (or later) Administrator's Guide* for details on using "`srp -backup`" for backing up system configuration for SRP compartment.

5.10.4 Using SRP export feature for backup

"`srp -export`" can be used to backup SRP configuration data as well as any file sets that are associated with the SRP compartment. The SRP should be in stopped state in order to be able to use this feature. For usage details, and on the recovery process, refer to *HP-UX Secure Resource Partitions (SRP) A.02.01 (or later) Administrator's Guide.*

To save the HP 9000 container configuration data include only `/var/hpsrp/<srp_name>` as the file set to be copied.

```
$ srp -export <srp_name> -xfile <exchange file> \
  -b export_copy_dirs=/var/hpsrp/<srp_name> ok_export_dirs=yes
```

If any directory from within the HP 9000 container also needs to be backed up, include them in the file set.

5.10.5 Combining other backup software

It is possible to use other backup mechanisms for files inside the HP 9000 root directory and use "`srp -export`" for backing up configuration data. One way to do this is to attempt running HP 9000 backup software inside the HP 9000 container. This might fail If the software uses some system administration related commands which are unavailable inside the HP 9000 container.

The alternate option would be to install backup software in the `INIT` compartment. Wherever the software needs to be configured to run commands inside the HP 9000 container, use

```
$ srp_su <srp_name> root -c "chroot <hp9000_root> <command full
  path>"
```

6. Integration with Serviceguard

6.1 Overview

HP Serviceguard allows creation of high availability clusters of HP 9000 or HP Integrity servers. Serviceguard can be used with HP 9000 Containers, with some minor changes to how it is used with HP-UX Secure Resource Partitions. The key idea is that it is possible to monitor applications running inside an HP 9000 container, or the HP 9000 container itself, from the HP-UX 11i v3 host system using a combination of `srp_su` and `chroot` commands. Thus Serviceguard has to run in the INIT compartment – it is unsupported inside the HP 9000 container.

There are two models in which SG can be used with HP 9000 Containers.

- The *`classic model`*, where HP 9000 Containers will be up on all failover nodes concurrently but the monitored application will be running inside only one of the HP 9000 Containers at any given time. When an issue is detected, the application will be failed over to one of the other HP 9000 Containers. This model can provide quick migration of existing SG packages and also allow for application level failover. For more information see Using classic model
- The *`SRP package model`*, where the HP 9000 container is active only on one node at a time. When an issue is detected the HP 9000 container is brought up on a failover node. RC scripts need to be written to start applications along with the HP 9000 container startup. This model is a cleaner method, providing better manageability and less storage overhead. For more information including limitations of the model see Using SRP package model

Configuring a Serviceguard cluster for use with HP 9000 Containers involved the following high-level steps

- Setup the Serviceguard cluster
- Do system configuration on each node in the cluster
- Decide which package model to use (classic or SRP package)
- Configure shared logical volumes
- Configure HP 9000 container on primary node
- Configure HP 9000 container on each failover nodes
- Create or migrate monitor script
- Create RC scripts to start applications (SRP package model only)
- Create or migrate Serviceguard package configuration
- Copy package configuration to failover nodes
- Enable the package and test failover

6.2 System Configuration

All nodes in the cluster need to be identical with respect to OE and patch levels. Follow installation and configuration instructions to prepare each node for HP 9000 Containers.

6.3 Using Classic model

6.3.1 Configuring shared logical volumes

Data can be in shared logical volume. The HP 9000 container root file system cannot be shared.

6.3.2 Configuring primary and failover nodes

HP 9000 Containers need to be configured separately on each node in the cluster following the steps described in Transitioning from HP 9000 server. Configure a unique IP address and a unique virtual host name for the HP 9000 container on each server, but use same SRP compartment name to simplify SG package configuration. Here the SRP IP addresses are not managed by SG. You need to have an additional floating IP for applications to use. Once the configuration is completed on each node, start each HP 9000 container and verify that applications can be brought up.

6.3.3 Creating monitor scripts

Monitor scripts need to be written to monitor applications appropriately. The scripts need to be placed in some directory under `<hp9000_root>`. You may be able to use existing monitor script if it is compatible with the Serviceguard version on the Integrity HP-UX 11i v3 server. Refer to Serviceguard documentation on how to migrate older packages.

6.3.4 Configuring SG package

Since Serviceguard is running in the `INIT` compartment and applications run within the HP 9000 container, the commands used to monitor and start applications need to be modified to use "`srp_su`" and "`chroot <hp9000_root>`"

If the command is to be run as root user

```
service_cmd "srp_su <srp_name> root -c \"chroot <hp9000_root>
<command-name>\""
```

If the command is to be run as a non-root user

```
service_cmd srp_su <srp_name> root "chroot <hp9000_root>
/usr/bin/su - <user> -c <command-name>"
```

Data related mounts need to be configured to be under `<hp9000)_root>`

```
fs_name /dev/<vg_name>/<data_lv> fs_directory <hp9000_root/data
directory>
```

6.4 Using SRP package model

6.4.1 Configuring shared logical volumes

The recovered HP 9000 file system and the SRP compartment file system should reside in the shared logical volumes. This is in addition to any shared logical volume(s) that may need to be created for application data. On the primary node create a volume group, and within it separate logical volumes for HP 9000 file system image, SRP compartment and application data (if needed). The size requirement for the HP 9000 root logical volume will depend on the size of the HP 9000 backup image that is being brought over. For the SRP compartment logical volume, the size can be as small as 100 MB.

Once the logical volumes have been created and verified on the primary node, export the volume group configuration and import it on all the failover nodes.

6.4.2 Configuring primary node

Steps described in Transitioning from HP 9000 server should be followed only on the primary node. Note that there are specific instructions for integration with Serviceguard, when recovering files, creating the SRP compartment and configuring HP 9000 container.

In the SRP package model, the SRP compartment is failed over and started on the failover node. This does not start applications unless RC scripts are written to start them along with the SRP startup. The RC script should be placed under `<hp9000_root/sbin/init.d>`. For more details on creating RC scripts, refer to `rc` man page.

Follow the below steps to start and test the HP 9000 container

- Enable the SRP IP address and create a host route to the default gateway

```
$ ifconfig <srp-lan-interface> <srp-ip-addr>
  netmask <netmask>
$ /usr/sbin/route add default <gateway-ip-addr> 1 source
  <srp-ip-address>
```

- Start the HP 9000 container

```
$ srp –start <srp_name>
```

  Check `/var/hpsrp/<srp_name>/etc/rc.log` to verify that applications configured in RC scripts have been started properly.

- Login to the HP 9000 container using ssh and test applications.
- Once testing is complete, stop the HP 9000 container

```
$ srp –stop <srp_name>
```

  Check `/var/hpsrp/<srp_name>/etc/rc.log` to verify that applications configured in RC scripts have been stopped properly

- Disable the IP address and remove the route table entry

```
$ ifconfig <srp-lan-interface> 0
$ /usr/sbin/route delete default <gateway-ip-addr> 1 source
  <srp-ip-addr>
```

- Unmount `<hp9000_root>` and `/var/hpsrp/<srp_name>` directories.
- Deactivate the volume group hosting shared logical volumes.

6.4.3 Configuring failover nodes

Once the primary node has been configured, the following steps are to be followed to complete configuration on failover nodes

- On the failover nodes manually carry out steps mentioned in migrating users and groups and completing system configuration
- Copy over `/etc/hosts` from primary to failover nodes.
- Export SRP configuration

```
$ srp -batch –export <srp_name> -xfile <path name of
  exchange file>
```

- Import SRP configuration on each failover node

```
$ cmcp <exchange file> <failover node>:<exchange file>
$ cmexec <failover node> srp –batch –import –xfile
  <exchange file> autostart=no
```

- Run the HP 9000 container failover configure script

```
$ cmexec <failover node> /opt/HP9000-Containers/bin/
  hp9000_conf_failover –s <srp_name> <vg_name>
  <srp_lv_name> <hp9000_lv_name>
```

6.4.4 Creating monitor scripts

Monitor scripts need to be written to monitor applications appropriately. The scripts need to be placed in some directory under <hp9000_root>. You may be able to use existing monitor script if it is compatible with the Serviceguard version on the Integrity server. Refer to Serviceguard documentation on how to migrate older packages.

6.4.5 Configuring SG package

A reference implementation and README for the SRP package model (which is directly applicable to native SRPs) can be found under /opt/hpsrp/ example. For HP 9000 Containers, the following changes have to be made to the SRP package

- In addition to specifying SRP compartment home and any data logical volumes for mount, also specify <hp9000_root>

  ```
  fs_name /dev/<vg_name>/<hp9000_lv_name> fs_directory
  <hp9000_root>
  ```

- Ensure that data mount points are within <hp9000_root> to make them visible inside the HP 9000 container

  ```
  fs_name /dev/<vg_name>/<data_lv> fs_directory <hp9000_root
  /data directory>
  ```

- Monitor script execution commands needs to be modified to include "chroot <hp9000_root> along with srp_su.

  To run monitor script as root user

  ```
  $ service_cmd   "srp_su <srp_name> root -c \"chroot
    <hp9000_root> <monitor_script_path>\""
  ```

  To run monitor script as another user

  ```
  $ service_cmd   "srp_su <srp_name> root -c \"chroot
    <hp9000_root> /usr/bin/su <user> -c <monitor_script
    _path>\""
  ```

6.4.6 Limitations

HP 9000 Containers A.01.06 uses a model which requires part of the file system to be shared with the host HP-UX 11i v3 system as described in HP 9000 Containers File Set Layout. Most of the shared directories hold either temporary files or files that created as part of system administration activities. However, /etc and /tcb are shared directory where applications can potentially install files and also where user credentials are stored. Whenever an application is installed or patched inside the HP 9000 container, or configuration changes are performed in some files under /etc or /tcb it is important to copy the new/updated files to the other nodes in the cluster. This includes. for example, user configuration and password changes.

7 HP 9000 Containers Limitations

7.1 Application Limitations

7.1.1 No support for kernel intrusive applications or those that use privileged instructions

Applications that are kernel intrusive and those that use privileged instructions will not work inside the HP 9000 container. This includes, for example, applications that write into `/dev/kmem`, use kernel module calls or use device drivers.

7.1.2 No support for system management applications

Applications that do tasks that are closely tied to system management such as those dynamically creating or mounting file systems, doing logical and physical volume management, etc will not work inside the HP 9000 container. See section Unsupported Tasks Inside the HP 9000 Container for more information.

The recommendation is to run these applications outside the HP 9000 container (I.e. in the `INIT` compartment). If such applications need to interact (monitor, start, stop etc) with applications inside the HP 9000 container use srp_su with `chroot`

```
$ srp_su <srp_name> \
  root –c "chroot <hp9000_root> <command full path>"
```

7.1.3 No support for use as DHCP, DNS, FTP, LDAP, NFS, NIS or mail server or as an IP router

HP 9000 system startup services are, in general, not supported inside the HP 9000 container. Hence the HP 9000 container cannot be used as a DHCP, DNS, FTP, LDAP, NFS, NIS or mail server.

7.1.4 No support for inittab

Configuring `/etc/inittab` for automatic *spawn* and *re-spawn* of applications is not supported in HP 9000 Containers A.01.06. The recommendation is to configure a cron job as a workaround to monitor and re-start applications.

7.1.5 No support for DCE applications

HP 9000 Containers A.01.06 does not support HP-UX DCE server or client components.

7.1.6 Other Limitations

As documented in HP ARIES Limitations
http://h21007.www2.hp.com/portal/site/dspp/menuitem.863c3e4cbcdc3f3515b49c108973a801/?ciid=f6ccb52bdb779110VgnVCM100000275d6e10RCRD#limits

7.2 Setup Limitations

7.2.1 No support for multiple HP 9000 Containers or other SRPs

HP 9000 Containers A.01.06 does not support creation of multiple HP 9000 Containers on the same HP-UX operating system instance. Also it is highly recommended that no

native SRPs be created on the same system. The OS image should be dedicated for the purpose of hosting and running a single HP 9000 container.

7.2.2 Host name limitation with some applications

Some server applications, which register RPC services, may fail to start inside the HP 9000 container with a virtual host name configured. With HP 9000 Containers A.01.06, the only workaround is to disable virtual host name configuration for those executables. Refer to Working around host name limitation under Troubleshooting section for more details.

7.2.3 Tunable base page size limitation

Applications running in an HP 9000 container on a HP-UX 11i v3 system where kernel tunable parameter `base_pagesize` is configured to a non-default value may experience correctness issues with symptoms such as application hangs and aborts. The recommendation is to reset the kernel tunable parameter `base_pagesize` to its default value.

7.3 Access Limitations

7.3.1 No support for **`telnet`** into the HP 9000 container

Using `telnet` to login to the HP 9000 container is not supported. Use `ssh` instead. If `telnet` is used the user login will be placed in the `INIT` compartment and will be unable to run applications. However `telnet` from the HP 9000 container to other servers (which are not HP 9000 Containers) is supported.

7.3.2 No support for **`remsh`**, **`rlogin`**, and **`rcp`** to the HP 9000 container

Using remote commands to access the HP 9000 container is not supported. Secure shell (`SSH`) based protocols (`ssh`, `slogin`, `scp`) may be used along with authorization keys to achieve similar functionality.

7.4 Patching Limitation

SD (Software Distributor) support through `swinstall` and related commands is not available in HP 9000 Containers A.01.06.

7.5 Commands Limitations

The following table lists limitations with commands with HP 9000 Containers A.01.06

Command	Limitation
`bdf, df`	Reports system wide data and not HP 9000 container specific data Errors will be displayed for loop back mounted directories
`date`	Should be used only to read date. not to modify it
`finger`	Reports system wide data and not HP 9000 container specific data
`hostname`	Should be used only to read host name, not to modify it
`ipcs`	Reports system wide data and not HP 9000 container specific data
`kmtune`	Should be used only to read kernel tunable(s), not to change them. Use native `kctune` to modify kernel tunable(s) from outside the HP 9000 container.
`Last, lastb`	Unsupported inside the HP 9000 container
`mount`	Should be used only to read information and not to perform mounts Reports system wide data and not HP 9000 container specific data
`netstat`	Reports system wide data and not HP 9000 container specific data
`uname`	Should not be used to change node name
`uptime`	Reports system uptime information, not HP 9000 container uptime
`who`	Reports system wide data and not HP 9000 container specific data

7.6 Unsupported Tasks

The HP 9000 container should not be used to perform system administration and related tasks. Hence most system administration commands are unsupported inside the HP 9000 container. In addition, there are a few other tasks that do not work inside the HP 9000 container A.01.06. The following list highlights the major tasks that are unavailable inside the HP 9000 container

- Assembly debugging
- Auditing
- Backup and recovery
- Cluster management
- Crash configuration
- DHCP configuration
- Device and driver management
- EFI
- Event monitoring Service
- File system management
- File system mount and umount
- Getty
- Global Instant Capacity Management
- Interrupt configuration
- IPFilter. IPSec configuration
- I/O commands
- Kernel debugging
- Kernel module administration
- Kernel registry services
- Kernel tunable management
- LIF
- Logical and physical volume management
- LORA
- Network tunable configuration
- NIC and other lan card administration
- NIS/LDAP/NFS server functionality

- NLIO
- NTP
- OLAR
- Packet tracing
- Partition management
- Portable file system
- PPP
- Printer management
- Process Resource Management (PRM)
- Processor set management
- RAID control
- Routing configuration. advertisement
- Reboot, shutdown, system init
- SAM, SMH
- SCSI control
- Serviceguard
- Software depot management and patching
- Special file creation
- Storage/Disk management
- STREAMS
- Support Tools Manager (STM)
- Swap space management
- System activity reporter
- System diagnostics and statistics
- System startup shutdown. Ignite, update
- Volume group management
- VxFS, VxVM, and Volume Replicator related tasks

8 HP 9000 Containers Troubleshooting

If failures are observed with applications running inside the HP 9000 container some or all of the following need to be performed

- Check HP 9000 container health
- Collect applications and system call logs
- Troubleshoot HP ARIES
- Troubleshoot HP-UX SRP
- Re-configure HP 9000 container

8.1 Checking HP 9000 container health

8.1.1 Checking SRP status

Login to the `INIT` compartment as `root` and run

```
$ srp -status <srp_name>
```

Verify that the compartment is "`STARTED`" and the interface is `UP`.

```
$ srp -list <srp_name>
```

Verify that the `list` shows `base`, `sshd` and `hp9000` templates

```
<srp_name>    base     admin, cmpt. init. Login, network
              sshd     cmpt, provision
              hp9000   cmpt, provision
```

Verify if connectivity to the HP 9000 container is working fine both from within the `INIT` compartment and from another system.

8.1.2 Checking HP 9000 loop back mounts

Login to the `INIT` compartment and run the command

```
$ mount | grep <hp9000_root>
```

Verify if all `lofs` mount points configured in `/var/hpsrp/<srp_nane>/etc/fstab` are active.

8.1.3 Checking SRP startup logs

Check `/var/hpsrp/<srp_name>/etc/rc.log` to verify if the previous startup/ shutdown went fine. Search `/var/adm/syslog/syslog.log` for "`SRP`' to know the list of operations that have been applied to the compartment.

8.2 Triaging HP 9000 container access issues

Check `/etc/rc.config.d/netconf` and ensure that the IP address, gateway and subnet mask for the SRP is configured correctly. Refer to Modifying IP address configuration on how to change these values if needed.

Check if `sshd` is running inside the container

```
$ srp_ps <srp_name> -ef | grep sshd
```

Verify sanity of the sshd configuration file (by default /var/hpsrp/<srp_name>/opt/ssh/sshd_config). Towards the end of the file, the parameter ListenAddress should be set to the container IP address and the ChrootDirectory should be set to the root of the HP 9000 file system.

Ensure that all directories in the path of the ChrootDirectory (including / itself) are owned by root:sys or root:root and has 0755 permissions.

Try re-starting sshd for the container if it is not running

```
$ srp_su <srp_name> root "/opt/ssh/sbin/sshd -f \
  /var/hpsrp/<srp_name>/opt/ssh/sshd_config"
```

8.3 Collecting application and system call logs

- Check application logs and files where stdout and stderr have been re-directed,
- Install HP-UX system call tracer utility tusc for HP-UX 11i v3 on Integrity.
- Copy /usr/local/bin/tusc binary to the HP 9000 container root directory.
- Login to the HP 9000 container and run tusc on the failing application

```
$ /tusc -o <output file path> -lfpkaev    \
  -s \!sigprocmask,sigaction,sigsetreturn \
  <executable> <arguments>
```

Search the tusc log for clues like failing system calls. Check if any of the HP 9000 container limitations are encountered. For example, analyze execve() calls to see if any unsupported command is being invoked.

8.4 Working around host name limitation

There is a known limitation with virtual host name support in HP 9000 Containers A.01.06. With default configuration, some server applications may fail to start up and may throw errors such as "unable to register RPC service". For such applications, the only workaround available is to disable virtual host name in ARIES configuration files.

To disable virtual host name for all applications running inside an HP 9000 container

- Stop the HP 9000 container
  ```
  $ srp -stop <srp_name>
  ```

- Open <hp9000_root>/.ariesrc file for editing
- Remove (or comment out using #) the line
  ```
  / -cmpt_host_name <virtual host name>
  ```

- Do the same change to <hp9000_root>/.aries64rc
- Re-start the HP 9000 container
  ```
  $ srp -stop <srp_name>
  ```

It is also possible to disable virtual host name for the specific executable that is failing by configuring the host name of the HP-UX 11i v3 host system.

- Stop the application if it is running
- Identify if the executable is 32-bit or 64-bit
- If it is 32-bit, open <hp9000_root>/.ariesrc file for editing. Otherwise, open <hp9000_root/.aries64rc

- Add a line at the end of the configuration file
  `<executable full path> -cmpt_host_name <native HP-UX 11i v3 host name>`

8.5 Troubleshooting HP ARIES

If application complains about thread creation failure, refer to Tweaking the HP 9000 Container for resolution details. Otherwise, refer to the T*roubleshooting* section on HP ARIES web page http://www.hp.com/go/ARIES .

8.6 Troubleshooting HP-UX SRP

Refer to the *HP-UX Secure Resource Partitions (SRP) A.02.01 (or later) Administrator's Guide*. Known defects and workarounds are documented in the *HP-UX Secure Resource Partition (SRP) A.02.01 (or later) Release Notes.*

8.7 Re-configuring the HP 9000 Container

8.7.1 Switching to HP-UX 11i v3 HP 9000 libraries

Applications inside the HP 9000 container, by default, use system libraries which are brought over from the HP 9000 server. However it can be configured to use HP-UX 11i v3 HP 9000 libraries instead. This enables a newer set of libraries to be used in the HP 9000 container with potentially more defect fixes, HP-UX 11i v3 compatibility fixes and better performance. The HP 9000 container needs to be stopped before the libraries are switched. Login to the `INIT` compartment as root and run following commands

```
$ srp –stop <srp_name>
$ srp –add <srp_name> -t libv3 -b
```

The process may take about 5 minutes as the HP-UX 11i v3 libraries are copied into the HP 9000 container and any application libraries are merged in

To switch back to original libraries, use

```
$ srp –stop <srp_name>
$ srp –delete <srp_name> -t libv3
```

To update the set of HP-UX 11i v3 libraries that were copied into the HP 9000 container, use

```
$ srp –stop <srp_name>
$ srp –replace <srp_name> -t libv3
```

8.7.2 Re-doing HP 9000 container configuration

This is to be done only when absolutely necessary. This may cause changes made to the HP 9000 container post initial setup to be lost.

Login to the INIT compartment and run following commands

```
$ srp –stop <srp_name>
$ srp –delete <srp_name> -t hp9000
$ srp –add <srp_name> -t hp9000
```

For more information

- HP Integrity family
  http://www.hp.com/go/integrity
- HP-UX 11i v3
  http://www.hp.com/go/hpux11i
- HP OverEasy portfolio
  http://www.hp.com/go/overeasy
- HP 9000 Containers
  http://www.hp.com/go/hp9000-containers
- HP 9000 Containers Software Access
  http://software.hp.com
  » HP-UX 11i Software » HP-UX 11i general » HP 9000 Containers
- HP ARIES dynamic binary translator
  http://www.hp.com/go/aries
- HP-UX Secure Resource Partitions
  http://www.hp.com/go/srp
- HP ID-VSE for Integrity servers
  http://www.hp.com/go/vse
- HP Serviceguard for HP-UX 11i
  http://www.hp.com/go/serviceguard

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