LSPP EAL4 Evaluated Configuration Guide for Red Hat Enterprise Linux on IBM hardware

Klaus Weidner <klaus@atsec.com>

May 23, 2007; v2.7

Contents

1 Introduction

1.1 Purpose of this document

The Red Hat Enterprise Linux (RHEL) distribution is designed to provide a secure and reliable operating system for a variety of purposes. Because security requirements obviously depend on the applications and environment, it is not possible to simply certify that the system is ”secure”, a more precise definition is needed.

The Common Criteria (CC) provides a widely recognized methodology for security certifications. A CC evaluation is fundamentally a two-step process, consisting of defining the ”security target” which describes the features that are to be evaluated, and then testing and verifying that the system actually implements these features with a sufficient level of assurance.

This document is a security guide that explains how to set up the evaluated configuration, and provides information to administrators and ordinary users to ensure secure operation of the system. It is intended to be self-contained in addressing the most important issues at a high level, and refers to other existing documentation where more details are needed.

The document primarily addresses administrators, but the section ”Security guidelines for users” is intended for ordinary users of the system as well as administrators.

Knowledge of the Common Criteria is not required for readers of this document.

1.2 How to use this document

The key words ”MUST”, ”MUST NOT”, ”REQUIRED”, ”SHALL”, ”SHALL NOT”, ”SHOULD”, ”SHOULD NOT”, ”RECOMMENDED”, ”MAY”, and ”OPTIONAL” in this document are to be interpreted as described in RFC 2119 (http://www.ietf.org/rfc/rfc2119.txt)

Note that this document avoids the terms ”SHOULD” and ”SHOULD NOT” that are defined in RFC 2119. Requirements are either absolute (and marked with MUST and equivalent terms), or entirely optional (in the sense of not affecting required security functions) and marked with RECOMMENDED, MAY or OPTIONAL.

If you follow the requirements in this document when setting up and using the system, your configuration will match the evaluated configuration. Certain configuration options are marked as OPTIONAL and you MAY modify them as needed, but you MUST NOT make other changes, because they will make the system fail to match the evaluated configuration.

Of course, you MUST always use common sense. This document is not a formal specification, and legitimate reasons can exist to modify the system setup in ways not described here if that is necessary for the system to fulfill its intended purpose. Specifically, applying security patches released by the vendor is strongly RECOMMENDED even though that will cause a deviation from the evaluated configuration.

In cases where the requirements and recommendations in this document conflict with those in other sources (such as the online documentation), the information in this Configuration Guide has higher precedence. You MUST follow the steps described here to reach the evaluated configuration, even if other documentation describes different methods.

The evaluated configuration may be set up in two separate ways:

- In **CAPP mode**, the system supports the usual discretionary access control features and a single ”root” administrative account.
- In **LSPP mode**, mandatory access control and role-based access control add restrictions to discretionary access control.

The information in this guide generally applies to both modes except where it specifically refers to ”LSPP mode” or ”CAPP mode”. All references to roles (other than ”root”) or multilevel security (MLS) always apply only to LSPP mode.

The usual convention is used in this guide when referring to manual pages that are included in the software distribution. For example, the notation *ls*(1) means that running the `man -S 1 ls` command will display the manual page for the *ls* command from section one of the installed documentation. In most cases, the `-S` flag and the section number can be omitted from the command, they are only needed if pages with the same name exist in different sections,

1.3 Requirements and assumptions

1.3.1 What is a CC compliant system?

A system can be considered to be ”CC compliant” if it matches an evaluated and certified configuration. This implies various requirements concerning hardware and software, as well as requirements concerning the operating environment, users, and the ongoing operating procedures.

Strictly speaking, an evaluation according to the CC represents the results of investigation of the security properties of the target system according to defined guidelines. It should not be considered as a guarantee for fitness for any specific purpose, but should provide help in deciding the suitability of the system considering how well the intended use fits the described capabilities. It is intended to provide a level of assurance about the security functions that have been examined by a neutral third party.

The software MUST match the evaluated configuration. In the case of an operating system, this also requires that the installed kernel, system, and application software are the same. The documentation (including this guide) will specify permitted variations, such as modifying certain configuration files and settings, and installing software that does not have the capability to affect the security of the system (typically those that do not require root privileges). Please refer to section §4.5 ”Installation of additional software” of this guide for more information.

Stated requirements concerning the operating environment MUST be met. Typical requirements include a secure location for the hardware (protected from physical access by unauthorized persons), as well as restrictions concerning permitted network connections.

The operation of the system MUST be in agreement with defined organizational security policies, to ensure that actions by administrators and users do not undermine the system’s security.

1.3.2 Hardware requirements

The hardware MUST be the one of the following IBM systems:

```
System x: x3550 (rack mount), HS20 and HS21 (blades)
Opteron (AMD): x3455 (rack mount), LS21 (blade)
System p: any POWER5 or POWER5+ system
System z: any z/Architecture compliant system or software
```

Running the certified software on other similar hardware might result in an equivalent security level, but the certification does not apply if the hardware is different from that used for the testing processes during the evaluation.

Please refer to section §2.1 ”Supported hardware” for more information about additional hardware supported for use with the evaluated configuration.

1.3.3 Requirements for the system’s environment

The security target covers one or more systems running RHEL, networked in a non-hostile network, with a well-managed and non-hostile user community. It is not intended to address the needs of an Internet-connected server, or the case where services are to be provided to potentially hostile users.

It is assumed that the value of the stored assets merits moderately intensive penetration or masquerading attacks.

You MUST set up the server (or servers) in a physically secure environment, where they are protected from theft and manipulation by unauthorized persons.

You MUST ensure that all connections to peripheral devices and all network connections are protected against tampering, tapping and other modifications. Using the secured protocols SSHv2 or SSLv3 is considered sufficient protection for network connections. All other connections must remain completely within the physically secure server environment.

When using labeled networking in LSPP mode, all network connections need to reside within the controlled access facilities because the secured protocols SSH and SSL do not protect the label information. Internal communication paths to access points such as terminals or other systems are assumed to be adequately protected.

1.3.4 Requirements for connectivity

All components in the network such as routers, switches, and hubs that are used for communication are assumed to pass the user data reliably and without modification. Translations on protocols elements (such as NAT) are allowed as long as those modifications do not lead to a situation where information is routed to somebody other than the intended recipient system.

Any other systems with which the system communicates MUST be under the same management control and operate under the same security policy constraints. When operating in LSPP mode, any data exported from the TOE to another system either with its sensitivity label or without the sensitivity label (over a single level connection) MUST be handled in accordance with its sensitivity label on any system that imports this data.

Be aware that information passed to another system leaves the control of the sending system, and the protection of this information against unauthorized access needs to be enforced by the receiving system. If an organization wants to implement a consistent security policy covering multiple systems on a network, organizational procedures MUST ensure that all those systems can be trusted and are configured with compatible security configurations enforcing an organization wide security policy. How to do this is beyond the scope of this Configuration Guide. If you set up a communication link to a system outside your control, please keep in mind that you will not be able to enforce any security policy for any information you pass to such a system over the communication link or in other ways (for example, by using removable storage media). In LSPP mode, the system supports labeled networking which can help ensure consistent handling of data labels across network connections. You MUST nevertheless ensure that all systems and networks involved are configured securely.

1.3.5 Requirements for procedures (LSPP mode only)

Procedures MUST exist for granting users authorization for access to specific security levels.

Procedures MUST exist for establishing the security level of all information imported into the system, for establishing the security level for all peripheral devices (e.g., printers, tape drives, disk drives) attached to the system, and marking a sensitivity label on all output generated.

1.3.6 Requirements for administrators

There MUST be one or more competent individuals who are assigned to manage the system and the security of the information it contains. These individuals will have sole responsibility for the following functions: (a) create and maintain roles (b) establish and maintain relationships among roles (c) Assignment and Revocation of users to roles. In addition these individuals (as owners of the entire corporate data), along with object owners will have the ability to assign and revoke object access rights to roles.

The system administrative personnel MUST NOT be careless, willfully negligent, or hostile, and MUST follow and abide by the instructions provided by the administrator documentation.

In CAPP mode, every person that has the ability to perform administrative actions by switching to root has full control over the system and could, either by accident or deliberately, undermine security features of the system and bring it into

an insecure state. In LSPP mode, the system can restrict actions of root users, but it is still REQUIRED that everyone with administrative access to the system must be a trusted administrator. This Configuration Guide provides the basic guidance how to set up and operate the system securely, but is not intended to be the sole information required for a system administrator to learn how to operate Linux securely.

It is assumed, within this Configuration Guide, that administrators who use this guide have a good knowledge and understanding of operating security principles in general and of Linux administrative commands and configuration options in particular. We strongly advise that an organization that wants to operate the system in the evaluated configuration nevertheless have their administrators trained in operating system security principles and RHEL security functions, properties, and configuration.

Every organization needs to trust their system administrators not to deliberately undermine the security of the system. Although the evaluated configuration includes audit functions that can be used to make users accountable for their actions, an administrator is able to stop the audit subsystem and reconfigure it such that his actions no longer get audited. Well trained and trustworthy administrators are a key element for the secure operation of the system. This Configuration Guide provides the additional information a system administrator should obey when installing, configuring and operating the system in compliance with the requirements defined in the Security Target for the Common Criteria evaluation.

1.3.7 Requirements for the system's users

The security target addresses the security needs of cooperating users in a benign environment, who will use the system responsibly to fulfill their tasks.

Authorized users possess the necessary authorization to access at least some of the information managed by the system and are expected to act in a cooperating manner in a benign environment.

Note that system availability is *not* addressed in this evaluation, and a malicious user could disable a server through resource exhaustion or similar methods.

The requirements for users specifically include:

- User accounts MUST be assigned only to those users with a need to access the data protected by the system, and who MUST be sufficiently trustworthy not to abuse those privileges. For example, the system cannot prevent data from being intentionally redistributed to unauthorized third parties by an authorized user.
- Rights for users to gain access and perform operations on information are based on their membership in one or more roles. These roles are granted to the users by the administrator. These roles MUST accurately reflect the users job function, responsibilities, qualifications, and/or competencies within the enterprise.
- A limited set of users is given the rights to create new data objects and they become owners for those data objects. The organization is the owner of the rest of the information under the control of system.
- Users are trusted to accomplish some task or group of tasks within a secure IT environment by exercising complete control over their data.
- All users of the system MUST be sufficiently skilled to understand the security implications of their actions, and MUST understand and follow the requirements listed in section §6 "Security guidelines for users" of this guide. Appropriate training MUST be available to ensure this.

It is part of your responsibility as a system administrator to verify that these requirements are met, and to be available to users if they need your help in maintaining the security of their data.

2 Installation

The evaluation covers a fresh installation of RHEL Version 5 Server or Client, on one of the supported hardware platforms as defined in section §1.3.2 ”Hardware requirements” of this guide.

On the platforms that support virtualization (VM) or secure logical partitioning (LPAR), other operating systems MAY be installed and active at the same time as the evaluated configuration. This is if (and only if) the VM or LPAR configuration ensures that the other operating systems cannot access data belonging to the evaluated configuration or otherwise interfere with its operation. Setting up this type of configuration is considered to be part of the operating environment and is not addressed in this guide.

On the other platforms, the evaluated configuration MUST be the only operating system installed on the server.

2.1 Supported hardware

You MAY attach the following peripherals without invalidating the evaluation results. Other hardware MUST NOT be installed in or attached to the system.

- Any storage devices and backup devices supported by the operating system (this includes hard disks, CD-ROM drives and tape drives).
- All Ethernet and Token Ring network adapters supported by the operating system. Modems, ISDN and other WAN adapters are not part of the evaluated environment.
- PCL 4 or PostScript level 1 compatible printers attached to the system using a parallel port or USB connection. In CAPP mode only, you MAY also use a network printer. Please refer to section §3.8.1 ”Setting up the Cups printing system” of this guide for more information about printing.
- Operator console consisting of a keyboard, video monitor, and optionally mouse. Additionally, you MAY directly attach supported serial terminals (see section §4.9 ”Using serial terminals” of this guide), but *not* modems, ISDN cards, or other remote access terminals.

USB keyboards and mice MAY be attached, as some of the supported hardware platforms would otherwise not have supported console input devices. If a USB keyboard or mouse is used, it MUST be connected before booting the operating system, and NOT added later to a running system. Other hot-pluggable hardware that depends on the dynamic loading of kernel modules MUST NOT be attached. Examples of such unsupported hardware are USB and IEEE1394/FireWire peripherals other than mice and keyboards.

2.2 Selection of install options and packages

This section describes the detailed steps to be performed when installing the RHEL operating system on the target server.

All settings listed here are REQUIRED unless specifically declared otherwise.

2.2.1 Prerequisites for installation

You will need the following components to install a system in the evaluated configuration as explained in the following sections. You will need:

- The target system that will be installed, refer to section §1.3.2 ”Hardware requirements” of this guide for the list of supported hardware. The target system REQUIRES at least one local hard drive that will be erased and repartitioned for use by the evaluated configuration.

- A static IP address if you are intending to attach the target system to a network; the evaluated configuration does not support DHCP. In addition, you will need to configure the netmask, gateway, and DNS server list manually.
- An Internet-connected system equipped with the *rpm* and *rpm2cpio* package management tools. This system does not need to be in the evaluated evaluated configuration, and no packages will be installed on it. It is used to download and verify the installation packages.
- A method to transfer the kickstart installation configuration and RPM packages to the target system. You can use any *one* of the following choices:
  - A CD-R containing the installation files.
  - A USB memory stick or USB external hard drive with a capacity of at least 32 MB, and formatted using either the *vfat* or *ext2* file system.
  - A network server configured to provide the installation files via the HTTP or NFS protocol.

  Note that a floppy disk drive is not suitable due to insufficient capacity.

2.2.2 Preparing for installation

You MUST download the distribution ISO images from the Red Hat Network on a separate Internet-connected computer, and either burn CD-Rs from them, or make the contents available on a file server via NFS or HTTP. The download location *https://rhn.redhat.com/rhn/software/downloads/AllISOs.do* contains links to the platform-specific images.

You MUST use **Red Hat Enterprise Linux 5**, either **Server** or **Client**. Make sure that you are using the appropriate version for your platform, refer to section §1.3.2 "Hardware requirements" of this guide for the list of supported hardware and the corresponding version needed.

You MUST verify that the MD5 checksums of the image files are correct. The checksums are shown on the RHN web page, please verify that the web page is encrypted (https:// URL) and has a valid certificate. Then run `md5sum *.iso` to view the checksums for the downloaded images, and compare them with those shown on the web page.

You MUST download several additional packages not included in the .iso images to set up the evaluated configuration. The packages are available at the following location:

```
ftp://ftp.redhat.com/pub/redhat/linux/eal/EAL4_RHEL5/IBM/
```

The installation script will prompt for the specific files and version numbers required. Alternatively, search for the variable RPMS_NEEDED in the kickstart file to see the full list of needed packages.

The files needed are the *lspp-eal4-config-ibm* RPM, the unpacked kickstart file (contained within the *lspp-eal4-config-ibm* RPM), and a specific set of RPM packages containing post-RHEL5 updates.

Download the RPMs using a separate Internet-connected computer. Do NOT install the downloaded packages yet.

You MUST have the Red Hat package signing key available to verify the integrity of the additional RPM packages. It is available at the following location:

```
https://www.redhat.com/security/db42a60e.txt
```

On the download system, run the following commands to verify the package integrity:

```
rpm --import db42a60e.txt
rpm --checksig lspp-eal4-config-ibm-*.rpm
```

This MUST display the status ”gpg OK”. If it does not, you MUST NOT proceed with the installation using that file.

The web page *https://www.redhat.com/security/team/key/* provides additional information about the usage of package signing keys.

Next, on the download system, unpack the contents of the *lspp-eal4-config-ibm* RPM into a temporary directory:

```
mkdir lspp-inst
cd lspp-inst
rpm2cpio ../lspp-eal4-config-ibm-*.rpm | cpio -id
```

This will create the following directory structure in the current working directory:

```
# this guide, and supporting documentation
./usr/share/doc/lspp-eal4-config-ibm-*/
        GPL.txt
        README-lspp.txt
        RHEL-LSPP-EAL4-IBM-Configuration-Guide.*

# the kickstart configuration used to automate the installation
./usr/share/capp-lspp/kickstart/
        ks-x86_64.cfg
        ks-ppc64.cfg
        ks-s390x.cfg

# the evaluated configuration reconfiguration script
./usr/sbin/
        capp-lspp-config

# configuration files used for the evaluated configurartion
./usr/share/capp-lspp/conf/
        auditd.conf
        [...]
        xinetd.conf
```

Depending on the installation method you choose, do *one* of the following steps:

- Burn a CD-R containing the kickstart files from ./usr/share/capp-lspp/kickstart/ and the downloaded RPM packages, with all files at the top directory level (no subdirectories).
- Copy the kickstart files from ./usr/share/capp-lspp/kickstart/ and the downloaded RPM packages onto a USB memory stick or USB external hard drive (with a capacity of at least 32 MB, and formatted using either the *vfat* or *ext2* file system). Put all files at the top directory level (no subdirectories).
- Configure a network server to provide the installation files via the HTTP or NFS protocol. Put all the downloaded RPM packages and the kickstart files from ./usr/share/capp-lspp/kickstart/ into a single directory with no subdirectories.

2.2.3 Customizing the installation

You MAY make changes to specific sections of the kickstart configuration. You MUST NOT change any settings not explicitly listed in this section.

keyboard

Default: `us`

You MAY select a different keyboard mapping.

langsupport

Default: `--default=en_US.UTF-8 en_US.UTF-8`

You MAY add additional language support, but MUST NOT change the default language or remove the `en_US` language support. (Users MAY configure individual language preferences to override the default.)

timezone

Default: `America/Chicago`

You MAY select a different time zone.

firewall

Default: `--disabled`

You MAY enable the firewall and modify the firewall settings. Please refer to section §4.18 "Firewall configuration" of this guide for more information.

selinux

Default: `--enforcing`

For LSPP mode, you MUST leave SELinux in enforcing mode. You MAY disable SELinux in CAPP mode.

default set of optional packages

You MAY delete packages from the optional packages list

gen_partitioning()

You MAY modify the default partitioning scheme in this function in the kickstart file, search for the following comment text:

```
## Required partitions, resize as appropriate
## Optional partitions, (de)activate and resize as appropriate
```

Note that you will have an opportunity to modify the partition settings during the install, please refer to section §2.2.6 "Partitioning" of this guide for more information. Alternatively, you MAY use the Logical Volume Manager (LVM) to resize and add partitions after the installation is complete as documented in the *lvm*(8) manual page.

2.2.4 Kickstart

It is RECOMMENDED that you disconnect all network connections until the post-install system configuration is finished. You MAY use a network if required for the installation (for example when using a NFS or HTTP network server instead of CD-ROMs). If you do use a network, you MUST ensure that this network is secure.

Launch the installation boot program contained on the CD-ROM. The details of how to do this depend on the hardware platform, please refer to the hardware manuals and the *Red Hat Enterprise Linux Installation Guide*. Typically, insert the first CD and boot from CD-ROM.

At the boot loader prompt, you MUST initiate the preconfigured "kickstart" install using a configuration file specific for the evaluated configuration. The installer supports multiple methods to locate the kickstart information file.

You MAY use DHCP to temporarily configure the network during the installation process, but you MUST assign a static IP address for use in the evaluated configuration.

Please refer to the *Red Hat Enterprise Linux Installation Guide* for more information.

The first boot parameter is the name of the booted kernel image, this is always `linux` for installation.

You MUST use the `ks=` boot parameter that selects a kickstart based automated installation.

Choose the appropriate kickstart file for your architecture and distribution:

```
# System x (Xeon with EM64t 64-bit support, or Opteron)
ks-x86_64.cfg

# System p
ks-ppc64.cfg

# System z
ks-s390x.cfg
```

The installation process will prompt for all needed information, alternatively you MAY supply the following command line parameters to automate the installation:

method

Select one of the supported methods for accessing the distribution media:

```
method=cdrom:
method=nfs:server.example.com:/path/to/files/
method=http://server.example.com/path/to/files/
method=hd://sda1/path/to/files/
```

ksdevice

Use this network interface for the kickstart installation, default `eth0`.

ip, netmask, gateway, dns

Configure the network parameters for the installation. See also `ksdevice`.

hostname

Specify the fully qualified host name for the system, for example:

```
hostname=rhel5lspp.example.com
```

(This parameter is specific to the LSPP kickstart install and not generally available)

instdisk

Delete all data from the specified disk and partition it for the evaluated configuration. This will **DESTROY** the data on this disk without prompting, use with care. Example:

```
instdisk=sda
```

(This parameter is specific to the LSPP kickstart install and not generally available)

console

You MAY use a serial console to control the installation. Add the following parameter to activate a serial console attached to the first serial port (COM1):

```
console=ttyS0
```

You MAY use a computer using terminal emulation software and a null modem cable instead of a standalone serial terminal. You MUST ensure that the serial terminal is secure.

Examples:

```
# kickstart on USB storage device, install from CD
linux ks=hd:sda1:/ks-ppc64.cfg method=cdrom:

# interactive network install, get IP address via DHCP
linux ks=http://example.com/rhel5/ks-ppc64.cfg

# noninteractive network install (all on a single line)
linux ip=172.16.2.5 netmask=255.255.255.0 gateway=172.16.2.1
      dns=172.16.2.1
      ks=http://example.com/rhel5/ks-ppc64.cfg
      method=cdrom:
      hostname=rhel5lspp.example.com
      instdisk=sda
```

2.2.5 Pre-install configuration

The following transcript shows an example of the interactions during the pre-install phase of the configuration:

```
--------------------------------------------------------------------------------
*** Common Criteria configuration kickstart ***

Using volume group 'VolGroup01'.
(Answer '!' at any prompt to get an interactive shell)

Installation source [cdrom:] ?

Available destination disks:
sda 3067.09716797

Install on which disk(s), comma separated [sda] ?

Hostname (fully qualified) [rhel5.example.com] ?

Network interface [eth0] ?

IP address [] ? 172.16.2.5

Netmask [255.255.255.0] ?

Gateway [] ? 172.16.2.1

Nameserver list (comma separated) [] ?
```

```
Manually edit partitioning instructions (y/n) [n] ?

--- WARNING -----------------------------------------------
This is your last chance to stop the installation. Continuing
will erase the destination disk and install noninteractively.
Answer 'n' if you need to edit your settings.

Okay to proceed with install on sda (y/n) [n] ? y
-------------------------------------------------------------------------------
```

In case the installation does not show the pre-install configuration prompts, for example if you see a blank screen only, try using a different terminal emulator to control the installation.

2.2.6 Partitioning

You MAY manually edit the partitioning instructions during the kickstart process. This section describes the partitioning requirements.

Set up the REQUIRED / (root) and */var/log* partitions, and as many additional mounted partitions as appropriate. */var/log* REQUIRES at least 100 MB of space in order to be able to install and launch the audit system, but this does not include the additional space needed for saved audit logs. You MAY use a */var/log/audit/* partition separate from */var/log/* to ensure that audit data is stored separately from other system logs. Please refer to section §5.3 "Configuring the audit subsystem" of this guide for more information.

Some configurations (recognized automatically by the installation program) need a separate */boot* partition formatted as an **ext3** file system. If the installation program warns about the partitioning being invalid and that it may result in an unbootable system, add the */boot* partition.

It is RECOMMENDED to also use separate partitions for */var*, */var/log/audit/*, */home* and */tmp*. The following table shows a RECOMMENDED partitioning scheme together with minimum sizes for the partitions. Using more space is RECOMMENDED:

```
/boot           75 MB # if needed by installer
/             1200 MB
/tmp           200 MB
/home          100 MB
/var           384 MB
/var/log/audit 100 MB needed for install, >>1GB for use
```

All mounted partions MUST be of type **ext3** or **swap** and **formatted**.

In LSPP mode, the polyinstantiation mechanism changes the location that file data is stored. If you change the partitioning scheme, verify that the disk space is allocated to the correct mount point, for example */tmp-inst/* instead of */tmp/*. Please refer to section §3.12 "Configuring polyinstantiation" of this guide for more information.

Configuring a swap partition at least as large as the installed RAM is RECOMMENDED.

2.2.7 Post-install configuration

In the post-installation phase, you MUST select either `capp` or `lspp` mode for the system configuration when prompted.

The system will run the *capp-lspp-config* script to automatically configure the initial system settings, then prompt to reboot.

The following transcript shows an example of the interactions during the post-install phase of the configuration (the exact version numbers and package lists may differ in the final version):

```
--------------------------------------------------------------------------------
*** Common Criteria configuration kickstart ***

Protection profile (capp or lspp) [capp] ? lspp

Please verify the system time and date:
    Local time:           Wed Apr 25 00:28:16 CDT 2007
    Universal time (UTC): Wed Apr 25 05:28:16 UTC 2007

If the time or time zone is wrong, please correct it now using
tools such as 'date', 'hwclock', or 'tzselect' as appropriate.

Is the time correct (y/n) [y] ?
Bringing up loopback interface:  [  OK  ]
Bringing up interface eth0:  [  OK  ]

Need to install the certification RPM and updated RPM packages:

lspp-eal4-config-ibm-0.47-1.noarch.rpm
[...]
vixie-cron-4.1-68.el5.i386.rpm

Supply a web URL or a local (absolute) directory name.

If you need to mount a device containing the files,
enter '!' and RETURN to get a shell prompt.

Location [ftp://ftp.redhat.com/pub/redhat/linux/eal/EAL4_RHEL5/IBM/] ? !

Starting interactive shell, type 'exit' when done
sh-3.1# mount -o nolock 172.16.2.1:/home/export /mnt
sh-3.1# exit
exit

Location [ftp://ftp.redhat.com/pub/redhat/linux/eal/EAL4_RHEL5/IBM/] ? /mnt/rpms/
`/mnt/rpms/acl-2.2.39-2.1.el5.i386.rpm' -> `./acl-2.2.39-2.1.el5.i386.rpm'
[...]
`/mnt/rpms//vixie-cron-4.1-68.el5.i386.rpm' -> `./vixie-cron-4.1-68.el5.i386.rpm'

Preparing...                ########################################### [100%]
   1:audit-libs             ########################################### [  3%]
[...]
  31:vixie-cron             ########################################### [100%]

Switching SELinux to MLS mode...
Fixing file labels...
/sbin/setfiles:  labeling files under /
************************************************
```

```
Please enter the password for the root account.
Changing password for user root.
New UNIX password:
Retype new UNIX password:
passwd: all authentication tokens updated successfully.

Create an administrative user account.

Real name (First Last) [] ? John Doe

Userid [jdoe] ?
Changing password for user jdoe.
New UNIX password:
Retype new UNIX password:
passwd: all authentication tokens updated successfully.

Add more administrative users (y/n) [n] ?
 --- Wed Apr 25 00:34:47 CDT 2007 script running: /usr/sbin/capp-lspp-config args -a --
###  Configure mount options in /etc/fstab
[...]
### System reboot

Reconfiguration successful.
It is now necessary to reboot the system.
After the reboot, your system configuration will match the evaluated configuration
*** Reboot the system? (y/n) [y]: y
rebooting the system now. Sleeping for 10 seconds...
+sync
+sleep 10
Exiting.
--------------------------------------------------------------------------------
```

Warning messages indicating duplicate configuration files at this stage are harmless and can be ignored, for example:

```
warning: /etc/pam.d/system-auth created as /etc/pam.d/system-auth.rpmnew
```

The output of the *capp-lspp-config* script is stored in the */var/log/capp-lspp-config.log* file.

3 Secure initial system configuration

After the initial installation using the procedure described in the previous section, the operating system is in the evaluated configuration if you have selected a CAPP mode installation.

In LSPP mode, you MUST appropriately configure CIPSO or IPSEC labeled networking as described in section §4.17 ”Labeled networking (LSPP mode only)” of this guide, as there is no universally applicable default for this. Your system will be in the evaluated configuration once labeled networking is activated.

The system does not define audit rules as there is no universally applicable default for this. Please refer to section §5.3 ”Configuring the audit subsystem” of this guide for more information.

The steps described in this chapter were done automatically if the kickstart install has completed successfully. You MAY skip ahead to section §4 ”System operation” of this guide.

The information in this section provides background information about how this configuration was achieved, and mentions some changes you MAY make to the installed system while still remaining within the evaluated configuration. It is not intended to be a complete listing of the changes made to the system. Following the instructions in section §2 ”Installation” of this guide is the only supported method to set up the evaluated configuration.

After software upgrades or installation of additional packages, you MUST ensure that the configuration remains secure. Please refer to sections §1.2 ”How to use this document” and §4.5 ”Installation of additional software” of this guide for additional information. You MAY re-run the *capp-lspp-config* script, but this does not guarantee that you will be in the evaluated configuration if you have added, deleted, modified, or replaced system components.

3.1 Add and remove packages

The kickstart automated install uses a default package selection that contains all packages required for the evaluated configuration. It also installs several optional packages that you MAY remove once the installation is complete.

The following optional packages MAY be deleted from the system, or deleted from the kickstart file as indicated in the comments of the kickstart file:

```
audit-libs-devel
autoconf
automake
bison
cvs
cyrus-sasl-devel.@@native@@
elinks
expect
expect-devel
flex
gcc
gcc-c++
keyutils-libs
keyutils-libs-devel
libattr-devel
libcap-devel
libselinux-devel.@@native@@
libsemanage-devel.@@native@@
libsepol-devel.@@native@@
libuser-devel.@@native@@
make
openssl-devel.@@native@@
pam-devel.@@native@@
pciutils-devel
perl-Digest-HMAC
perl-Digest-SHA1
python-devel
readline-devel
rpm-build
strace
swig
tcl
texinfo
tk
zlib-devel
```

("@@native@@" refers to the default word size package for the platform as defined in section §4.5.1 "Supported software architectures" of this guide).

In addition to the preselected packages, certain additional software from the RHEL CDs MAY be installed without invalidating the evaluated configuration. The rules described in section §4.5 "Installation of additional software" of this guide MUST be followed to ensure that the security requirements are not violated.

3.2 Creating additional user accounts for administrators

The evaluated configuration disables direct root login over the network. All system administrators MUST log in using a non-root individual user ID, then use the *su*(8) command to gain superuser privileges for administrative tasks. This requires membership in the 'wheel' group of trusted users.

You MUST define at least one non-root user account with the *useradd*(8) command, and add this user account to the 'wheel' group. Note that the enhanced password quality checking mechanisms and the password expiry settings of the evaluated configuration are not active yet. You must manually set the password properties in accordance with the password policy.

Please refer to section §4.8.6 "Defining administrative accounts" of this guide for more information about creating administrative accounts. The administrative accounts created during the initial install (§2.2.7 "Post-install configuration") are *staff_u* users as described in that section.

Please refer to sections §4.8 "Managing user accounts" and §6.3 "Password policy" of this guide for more information on creating user accounts.

3.3 Installing required updates

Several packages shipped on the installation media MUST be replaced with more recent versions to fix bugs or add additional features required for the evaluated configuration.

The kickstart script automatically installs the required updates in the postinstall section.

3.4 Automated configuration of the system

The kickstart script installs the `lspp-eal4-config-ibm` RPM package and runs the *capp-lspp-config* script contained within that RPM package noninteractively.

You MAY run the *capp-lspp-config* script interactively after installation is complete to verify and reset configuration settings to appropriate values for the evaluated configuration.

The *lspp-eal4-config-ibm* package contains configuration files and the script *capp-lspp-config* that sets up the evaluated configuration.

Run the following command to view a summary of the supported options:

```
capp-lspp-config -h
```

You MAY use the `-a` flag to automate the install and have it run without prompting. This is intended for people who are familiar with the process; if running it for the first time you SHOULD let it run interactively and verify the actions as described in this guide.

You MUST answer all questions asked by the script that are not marked as "optional" with `y` to achieve the evaluated configuration.

WARNING: The *capp-lspp-config* script will reboot the system as the final step in the process, as described in the manual instructions in section §3.14 "Reboot and initial network connection" of this guide. Remember to remove any CD-ROM from the drive and/or configure the system to boot from hard disk only.

3.5 Disable services

Note: The system runlevel as specified in the 'initdefault' entry in */etc/inittab* MUST remain at the default setting of '3' for these steps to be valid.

The following services are REQUIRED for runlevel 3:

```
auditd          # the audit daemon
crond           # vixie-cron
irqbalance      # configures SMP IRQ balancing
                # (not available on System z/s390x)
kudzu           # new device discovery
network         # network interface configuration
syslog          # system logging
mcstrans        # MLS/MCS label translation service
capp-lspp       # Kill udevd after boot is complete
```

The following services are OPTIONAL for runlevel 3:

```
cups            # print subsystem
mdmonitor       # software raid monitoring
postfix         # SMTP MTA (CAPP mode only)
rawdevices      # Raw partition management (eg. for Oracle)
sshd            # Secure Shell
vsftpd          # FTP server
xinetd          # Internet Services (required by sshd in LSPP mode)
```

You MUST ensure that all REQUIRED services are active. You MAY enable or disable services from the OPTIONAL list as suitable for your configuration. All other services MUST be deactivated.

Use *chkconfig SERVICENAME off* to disable a service, and *chkconfig SERVICENAME on* to enable it. The following command lists the active services:

```
chkconfig --list | grep "3:on" | sort
```

Make sure that the audit subsystem is activated. If `auditd` is not running, all logins are automatically disabled in the evaluated configuration as required by CAPP and LSPP.

3.5.1 Configure shell prompt

You MAY define a shell alias to remind users of their current role and level in their shell prompt. The *capp-lspp-config* script has created the */etc/profile.d/selinux-prompt.sh* file with the following content:

```
#!/bin/bash

if [ ! -z "$PS1" ]
then
    SEROLE=`secon -rP 2>/dev/null`
    SEMLS=`secon -lP 2>/dev/null`

    PS1="[\u/$SEROLE/$SEMLS@\h \W]\\$ "

    export PS1
fi
```

You MAY delete the */etc/profile.d/selinux-prompt.sh* file to disable the additional prompt information.

3.6 Setting up xinetd

3.6.1 xinetd in LSPP mode

In LSPP mode, the *xinetd* super server is used in the evaluated configuration to integrate *sshd* and labeled networking.

Please refer to sections §4.17 ”Labeled networking (LSPP mode only)” and §6.4.2 ”Multilevel mandatory access control (LSPP mode only)” of this guide for more information about using *ssh* in MLS mode.

3.6.2 xinetd in CAPP mode

In CAPP mode, *xinetd* is not used in the evaluated configuration, but MAY be used to start non-root network processes. The file */etc/xinetd.conf* contains default settings, these can be overridden by service-specific entry files stored in the directory */etc/xinetd.d/*.

3.7 Setting up FTP

The evaluated configuration OPTIONALLY includes FTP services. Note that FTP does not provide support for encryption, so this is only RECOMMENDED for anonymous access to non-confidential files. If you do not specifically need FTP, it is RECOMMENDED that you disable the *vsftpd*(8) service.

Use the *chkconfig*(8) command to control the FTP service:

```
# Activate FTP service
chkconfig vsftpd on

# Disable FTP service
chkconfig vsftpd off
```

The *vsftpd* service uses several additional configuration files. In */etc/vsftpd/vsftpd.conf* the configuration of the ftp daemon is specified. In addition, the file */etc/vsftpd.ftpusers* is used for access control. Users listed in that file can NOT log in via FTP. This file initially contains all system IDs and the root user. It can be augmented with other IDs according to the local needs, but the *root* entry MUST NOT be removed. The *ftpusers* file is not checked by the ftp daemon itself but by a PAM module. Please see section §3.10 ”Required Pluggable Authentication Module (PAM) configuration” of this guide for details.

The setup of */etc/vsftpd/vsftpd.conf* depends on the local needs. Please refer to *vsftpd.conf*(5) for details.

You MUST add the following line to the */etc/vsftpd/vsftpd.conf* file to enable PAM session handling support:

```
session_support=YES
```

The default configuration uses the following settings in the */etc/vsftpd/vsftpd.conf* file:

```
anonymous_enable=YES
local_enable=YES
```

The default configuration permits anonymous FTP. This setting is only suitable for distribution of public files for which no read access control is needed.

It is RECOMMENDED disabling anonymous FTP if you do not need this functionality with the following */etc/vsftpd/vsftpd.conf* setting:

```
anonymous_enable=NO
```

It is RECOMMENDED disabling FTP authentication for local user accounts if you do not need that functionality. The corresponding setting in */etc/vsftpd/vsftpd.conf* is:

```
local_enable=NO
```

It is RECOMMENDED to use the more secure alternatives *sftp*(1) or *scp*(1) to copy files among users, and to use FTP only for legacy applications that do not support this alternative.

3.8 Setting up additional services

3.8.1 Setting up the Cups printing system

Use of the Cups printing system is OPTIONAL, if the service is active you MUST configure the settings described in this section.

You MAY attach a PCL 4 or PostScript level 1 compatible printer to the system using a parallel port or USB connection.

In CAPP mode only, you MAY also use a network printer. Network printers MUST NOT be used in LSPP mode since they cannot meet the requirements for data export.

Verify that the printer daemon is able to access your printer devices with the configured permissions. You MAY need to reconfigure the printer device access rights to match, for example by setting the device owner for the */dev/lp** devices to the *lp* user in the */etc/udev/permissions.d/50-udev.permissions* file.

In LSPP mode, you MUST use the *chcon -l* command to assign appropriate MLS levels to the printer device. This MUST be done while the printer queue is disabled. For example:

```
cupsdisable
chcon -t printer_device_t -l SystemLow-SystemHigh /dev/lp1
cupsenable
```

In LSPP mode, you MUST ensure that the printer cannot be accessed directly by nonadministrative users who try to bypass the operating system print queue. For parallel port and USB connections, the DAC restrictions on the printer device will restrict access to administrators which is sufficient protection.

In LSPP mode, note that the printer name is visible for all users, even for users who do not have sufficient clearance to use the printer. The human readable printer name MUST NOT in itself contain sensitive information.

Please refer to the *cupsd.conf*(5), *cupsdisable*(8), *cupsenable*(8), *chcon*(8) and *cupsd*(8) man pages for more information.

3.8.2 Setting up Postfix (CAPP mode only)

Postfix is NOT supported in LSPP mode. You do not need to specifically disable it but it is unlikely to work as expected since it does not contain any support for multilevel security or polyinstantiation.

Use of the Postfix mail transport is OPTIONAL, if the service is active you MUST configure the settings described in this section.

An alias MUST be set up for root in */etc/aliases*, as postfix will not deliver mail while running with UID 0. Specify one or more user names of administrators to whom mail addressed to root will be forwarded, for example with this entry in the */etc/aliases* file:

```
root: jdoe, jsmith
```

You MUST disable the execution of programs in the *$HOME/.forward* files of individual users. Add the following line to the */etc/postfix/main.cf* file:

```
allow_mail_to_commands = alias
```

Please see *postfix*(1), *master*(8), *local*(8), and the documentation in */usr/share/doc/postfix*/* for details.

3.8.3 Setting up Cron (LSPP mode only)

In LSPP mode, Cron MUST be configured to disable sending mail. Edit the */etc/sysconfig/crond* file to use the following setting:

```
CRONDARGS=-m /bin/true
```

All output from commands run via the cron system will be silently discarded.

Please refer to section §4.6 "Scheduling processes using cron" of this guide for more information.

3.9 Introduction to Pluggable Authentication Module (PAM) configuration

The PAM subsystem is responsible for maintaining passwords and other authentication data. Because this is a security-critical system, understanding how it works is very important. In addition to the *pam*(8) manual page, full documentation is available in */usr/share/doc/pam-*/txts/* and includes *"The Linux-PAM System Administrator's Guide"* (*pam.txt*) as well as information for writing PAM applications and modules. Detailed information about modules is available in */usr/share/doc/pam-*/txts/README.pam_** as well as manual pages for individual modules, such as *pam_stack*(8).

The PAM configuration is stored in the */etc/pam.d/* directory. Note that the documentation refers to a file */etc/pam.conf* that is not used by RHEL (PAM was compiled to ignore this file if the */etc/pam.d/* directory exists).

Each service (application) that uses PAM for authentication uses a *service-name* to determine its configuration. stored in the */etc/pam.d/SERVICE_NAME* file. The special *service-name* `OTHER` (case insensitive) is used for default settings if there are no specific settings.

The configuration file for the service contains one entry for each module, in the format:

```
module-type   control-flag   module-path   args
```

Comments MAY be used extending from '#' to the end of the line, and entries MAY be split over multiple lines using a backslash at the end of a line as a continuation character.

The *module-type* defines the type of action being done. This can be one of four types:

auth

Authenticates users (determines that they are who they claim to be). It can also assign credentials, for example additional group memberships beyond those specified through */etc/passwd* and */etc/groups*. This additional functionality MUST NOT be used.

account

Account management not related to authentication, it can also restrict access based on time of day, available system resources or the location of the user (network address or system console).

session

Manages resources associated with a service by running specified code at the start and end of the session. Typical usage includes logging and accounting, and initialization such as auto mounting a home directory.

password

Used for updating the password (or other authentication token), for example when using the *passwd*(1) utility to change it.

The *control-flag* specifies the action that will be taken based on the success or failure of an individual module. The modules are stacked (executed in sequence), and the *control-flags* determine which final result (success or failure) will be returned, thereby specifying the relative importance of the modules.

Stacked modules are executed in the order specified in the configuration file.

The *control-flag* can be specified as either a single keyword, or alternatively with a more elaborate syntax that allows greater control. RHEL uses only the single keyword syntax by default.

The following keywords control how a module affects the result of the authentication attempt:

required

If this module returns a failure code, the entire stack will return failure. The failure will be reported to the application or user only after all other modules in the stack have been run, to prevent leakage of information (for example, ask for a password even if the entered username is not valid).

requisite

Same as **required**, but return failure immediately not executing the other modules in the stack. Can be used to prevent a user from entering a password over an insecure connection.

sufficient

Return success immediately if no previous **required** modules in the stack have returned failure. Do not execute succeeding modules.

optional

The return code of this module is ignored, except if all other modules in the stack return an indeterminate result (PAM_IGNORE).

The *module-path* specifies the filename of the module to be run (relative to the directory */lib/security/*, and the optional *args* are passed to the module - refer to the module's documentation for supported options.

3.10 Required Pluggable Authentication Module (PAM) configuration

You MUST restrict authentication to services that are explicitly specified. The 'other' fallback MUST be disabled by specifying the *pam_deny.so* module for each *module-type* in the 'other' configuration. This ensures that access decisions within the PAM system are handled only by the service specific PAM configuration.

Note that RHEL uses the *pam_stack*(8) module to unify commonly used configuration options within single files, rather than having redundant information in multiple files. You MUST verify that the shared settings are applicable to services that use *pam_stack*, and keep in mind that a change to the shared file will affect several services.

You MUST add the *pam_wheel.so* module to the 'auth' *module_type* configuration for the 'su' service to restrict use of *su*(1) to members of the 'wheel' group.

You MUST add the *pam_tally2.so* module to the `auth` and `account` *module_type* configurations of *login*, *sshd* and *vsftpd*. This ensures that accounts are disabled after several failed login attempts.The *pam_tally2.so* module is used in the `auth` stack to increment a counter in the file */var/log/tallylog*, and in the `account` stack to either deny login after

too many failed attempts, or to reset the counter to zero after successful authentication. The evaluated configuration uses a lockout after multipe failed attempts, corresponding to the `deny=` setting. You MAY decrease the number for stricter enforcement. Be aware that this can be used in denial-of-service attacks to lock out legitimate users. Please refer to section §4.8 "Managing user accounts" of this guide for more information.

You MUST use the *pam_passwdqc.so* password quality checking module to ensure that users will not use easily-guessable passwords.

You MUST use the *pam_loginuid.so* module for all authentication paths where human users are identified and authenticated, and add the *require_auditd* option for all cases where the authentication method is accessible to non-administrative users. This module sets the persistent login user ID and prevents login in case the audit system is inoperable for fail-secure operation.

In LSPP mode, you MUST use the *pam_selinux.so* module for interactive shell sessions as shown below in the sample config files.

In LSPP mode, you MUST use the *pam_namespace.so* module for all login mechanisms available for non-administrative users. The module ensures that user sessions running at multiple MLS levels each have their private copy of the home directory and temporary directories. Please refer to section §3.12 "Configuring polyinstantiation" for more information.

The system supports many other PAM modules apart from the ones shown here. In general, you MAY add PAM modules that add additional restrictions. You MUST NOT weaken the restrictions through configuration changes of the modules shown here or via additional modules. Also, you MUST NOT add PAM modules that provide additional privileges to users (such as the *pam_console.so* module).

You MUST NOT run the *authconfig*(8) tool to modify the authentication configuration.

Following are the pam configuration files:

3.10.1 /etc/pam.d/system-auth

This file contains common settings that are shared by multiple services using authentication. The *pam_passwdqc.so* module is configured to enforce the minimum password length of 8 characters. Note that the *pam_passwdqc.so* module is not part of a default installation, it was added previously as described in section §3.1 "Add and remove packages" of this guide.

The *remember* option to *pam_unix.so* prevents users from reusing old passwords. Hashes of old passwords are stored in the file */etc/security/opasswd*. Note that this file MUST exist, otherwise users cannot change passwords. Use the following commands to create it:

```
touch /etc/security/opasswd
chmod 600 /etc/security/opasswd
restorecon /etc/security/opasswd
```

The file */etc/pam.d/system-auth* MUST be set up with the following content:

```
auth        required      pam_env.so
auth        required      pam_unix.so nullok try_first_pass

account     required      pam_unix.so

password    required      pam_passwdqc.so min=disabled,disabled,16,12,8 \
                          random=42
password    required      pam_unix.so nullok use_authtok md5 \
                          shadow remember=7

session     required      pam_limits.so
session     required      pam_unix.so
```

3.10.2 /etc/pam.d/login

This file configures the behavior of the *login* program. It allows root login only for terminals configured in */etc/securetty*. If the file */etc/nologin* is present, then only root can log in.

The recommended login configuration does NOT specify the *require_auditd* option for the *pam_loginuid.so* module. This assumes that all terminals available for login are in physically secure locations and accessible only for authorized administrators. This permits administrators to log in on the console even if the audit subsystem is not available.

The *select_context* option to the *pam_selinux.so* module is OPTIONAL, it supports selecting an SELinux role and level at login time. Users MAY use the *newrole*(1) program instead to change roles and levels on console devices.

If any serial terminals are attached and available for arbitrary users, you MUST add the *require_auditd* option to the *pam_loginuid.so* module to ensure the LSPP-compliant fail-secure operating mode that disables login if audit is not working. Please refer to section §4.9 "Using serial terminals" of this guide for more information.

The *pam_tally2* module MUST be used to block the user after 5 failed login attempts.

In LSPP mode, you MUST use the *pam_namespace.so* module. It is optional in CAPP mode.

This is the content in CAPP mode:

```
auth       required     pam_securetty.so
auth       include      system-auth
auth       required     pam_tally2.so deny=5 onerr=fail

account    required     pam_nologin.so
account    include      system-auth
account    required     pam_tally2.so

password   include      system-auth

# pam_selinux.so close should be the first session rule
session    required     pam_selinux.so close
session    include      system-auth
session    required     pam_loginuid.so
session    optional     pam_console.so
# pam_selinux.so open should only be followed by sessions to be
# executed in the user context
session    required     pam_selinux.so open
```

This is the content in LSPP mode:

```
auth       required     pam_securetty.so
auth       include      system-auth
auth       required     pam_tally2.so deny=5 onerr=fail

account    required     pam_nologin.so
account    include      system-auth
account    required     pam_tally2.so

password   include      system-auth
```

```
# pam_selinux.so close should be the first session rule
session    required     pam_selinux.so close
session    include      system-auth
session    required     pam_loginuid.so
session    optional     pam_console.so
# pam_selinux.so open should only be followed by sessions to be
# executed in the user context
session    required     pam_selinux.so open select_context
session    required     pam_namespace.so
```

3.10.3 /etc/pam.d/other

This configuration applies for all PAM usage for which no explicit service is configured. It will log and block any attempts.

```
auth     required       pam_warn.so
auth     required       pam_deny.so

account  required       pam_warn.so
account  required       pam_deny.so

password required       pam_warn.so
password required       pam_deny.so

session  required       pam_warn.so
session  required       pam_deny.so
```

3.10.4 /etc/pam.d/sshd

This file configures the PAM usage for SSH. This is similar to the *login* configuration. The *securetty* entry is not applicable to network logins, and the *pam_loginuid.so* module MUST be configured to prevent network login if the audit system is not available. Note that *pam_loginuid.so* MUST run in the *session* stack, it does not work in the *account* or *auth* stacks due to the OpenSSH privilege separation mechanism. You MUST NOT use the *pam_selinux.so* module with the `open` option.

The *pam_tally2* module MUST be used to block the user after 5 failed login attempts.

In LSPP mode, you MUST use the *pam_namespace.so* module. It is optional in CAPP mode.

This is the content in CAPP mode:

```
auth       include      system-auth
auth       required     pam_tally2.so deny=5 onerr=fail

account    required     pam_nologin.so
account    include      system-auth
account    required     pam_tally2.so

password   include      system-auth

session    required     pam_selinux.so close
session    include      system-auth
session    required     pam_loginuid.so require_auditd
```

This is the content in LSPP mode:

```
auth       include      system-auth
auth       required     pam_tally2.so deny=5 onerr=fail

account    required     pam_nologin.so
account    include      system-auth
account    required     pam_tally2.so

password   include      system-auth

session    required     pam_selinux.so close
session    include      system-auth
session    required     pam_loginuid.so require_auditd
session    required     pam_namespace.so
```

3.10.5 /etc/pam.d/su

This file configures the behavior of the *su* command. Only users in the trusted 'wheel' group can use it to become root, as configured with the *pam_wheel* module.

```
auth            sufficient      pam_rootok.so
auth            required        pam_wheel.so use_uid
auth            include         system-auth

account         include         system-auth

password        required        pam_deny.so

session         include         system-auth
session         optional        pam_xauth.so
```

The *password* branch is disabled because forcing the root user to change the root password is not desired for this program,

3.10.6 /etc/pam.d/vsftpd

This file configures the authentication for the FTP daemon. With the listfile module, users listed in */etc/vsftpd.ftpusers* are denied FTP access to the system. Note that the setting is relevant only for authentication of incoming connections, and does not prevent local users from using the *ftp*(1) client to access other machines on the network.

You do not need the *pam_selinux.so* module since the FTP protocol does not involve execution of an interactive shell.

The *pam_tally2* module MUST be used to block the user after 5 failed login attempts.

```
auth       required     pam_listfile.so item=user sense=deny \
                        file=/etc/vsftpd/ftpusers onerr=succeed
auth       required     pam_shells.so
auth       include      system-auth
auth       required     pam_tally2.so deny=5 onerr=fail
```

```
account    include      system-auth
account    required     pam_tally2.so

password   required     pam_deny.so

session    include      system-auth
session    required     pam_loginuid.so require_auditd
```

pam_deny.so is used in the `password` stack because the FTP protocol has no provisions for changing passwords.

3.11 Configuring default account properties

The file */etc/login.defs* defines settings that will be used by user management tools such as *useradd*(8). The file is not used during the authentication process itself.

The password aging settings defined in this file are used when creating users and when changing passwords, and stored in the user's */etc/shadow* entry. Note that only the */etc/shadow* entries are considered during authentication, so changes in */etc/login.defs* will not retroactively change the settings for existing users.

The `PASS_MIN_LEN` setting has no effect in the evaluated configuration, the relevant settings are instead configured using the `min=` parameter to *pam_passwdqc.so* in the */etc/pam.d/system-auth* file.

```
### /etc/login.defs
# Global user account settings for the Common Criteria CAPP/LSPP configuration.
#
# *REQUIRED*
#   Directory where mailboxes reside, _or_ name of file, relative to the
#   home directory.  If you _do_ define both, MAIL_DIR takes precedence.
#   QMAIL_DIR is for Qmail
#
#   The setting is used only when creating or deleting users, and has
#   no effect on the mail delivery system. MAY be changed as required.
#
#QMAIL_DIR      Maildir
MAIL_DIR        /var/spool/mail
#MAIL_FILE      .mail
#
# Password aging controls:
#
#   PASS_MAX_DAYS    Maximum number of days a password may be used.
#   PASS_MIN_DAYS    Minimum number of days allowed between password changes.
#   PASS_MIN_LEN     Minimum acceptable password length.
#   PASS_WARN_AGE    Number of days warning given before a password expires.
#
PASS_MAX_DAYS    60   # MAY be changed, must be <= 60
PASS_MIN_DAYS    1    # MAY be changed, 0 < PASS_MIN_DAYS < PASS_MAX_DAYS
PASS_MIN_LEN     5    # no effect in the evaluated configuration
PASS_WARN_AGE    7    # MAY be changed
#
# Min/max values for automatic uid selection in useradd
#
# MAY be changed, 100 < UID_MIN < UID_MAX < 65535
#
```

```
UID_MIN                  500
UID_MAX                60000
#
# Min/max values for automatic gid selection in groupadd
#
# MAY be changed, 100 < GID_MIN < GID_MAX < 65535
#
GID_MIN                  500
GID_MAX                60000
#
# If defined, this command is run when removing a user.
# It should remove any at/cron/print jobs etc. owned by
# the user to be removed (passed as the first argument).
#
# MAY be activated as described in the "Managing user accounts"
# section of the ECG.
#
#USERDEL_CMD     /usr/sbin/userdel_local
#
# If useradd should create home directories for users by default
# On RH systems, we do. This option is overridden with the -m flag on
# useradd command line.
#
# MAY be changed.
#
CREATE_HOME      yes
#
# The permission mask is initialized to this value. If not specified,
# the permission mask will be initialized to 022.
#
# MAY be changed.
#
UMASK           077
```

3.12 Configuring polyinstantiation

The *pam_namespace.so* module ensures that user sessions running at multiple MLS levels each have their private copy of the home directory and temporary directories. The module is configured using the */etc/security/namespace.conf* file with the following content in the evaluated configuration:

```
# /etc/security/namespace.conf
#
# Polyinstantiation setup for the LSPP evaluated configuration
#
# See /usr/share/doc/pam-*/txts/README.pam_namespace for more information.
#
# Uncommenting the following three lines will polyinstantiate
# /tmp, /var/tmp and user's home directories. /tmp and /var/tmp will
# be polyinstantiated based on both security context as well as user
# name, whereas home directory will be polyinstantiated based on
# security context only. Polyinstantion will not be performed for
# user root and adm for directories /tmp and /var/tmp, whereas home
# directories will be polyinstantiated for all users. The user name
```

```
# and/or context is appended to the instance prefix.
#
# Note that instance directories do not have to reside inside the
# polyinstantiated directory. In the examples below, instances of /tmp
# will be created in /tmp-inst directory, where as instances of /var/tmp
# and users home directories will reside within the directories that
# are being polyinstantiated.
#
# Instance parent directories must exist for the polyinstantiation
# mechanism to work. By default, they should be created with the mode
# of 000. pam_namespace module will enforce this mode unless it
# is explicitly called with an argument to ignore the mode of the
# instance parent. System administrators should use this argument with
# caution, as it will reduce security and isolation achieved by
# polyinstantiation.
#
/tmp     /tmp-inst/             both      root,adm
/var/tmp /var/tmp-inst/         both      root,adm
$HOME    /home/home.inst/       both      root,adm
```

You MAY modify the polyinstantiation parent directories (second column) or add additional lines as appropriate. Please refer to the *pam_namespace*(8) and *namespace.conf*(5) man pages for more information.

3.13 Configuring the boot loader

You MUST set up the server in a secure location where it is protected from unauthorized access. Even though that is sufficient to protect the boot process, it is RECOMMENDED to configure the following additional protection mechanisms:

- Ensure that the installed system boots exclusively from the disk partition containing RHEL, and not from floppy disks, USB drives, CD-ROMs, network adapters, or other devices.
- Ensure that this setting cannot be modified, for example by using a BootProm/BIOS password to protect access to the configuration.

3.13.1 GRUB boot loader configuration

The GRUB boot loader is used on the System x and eServer 326 (Opteron) platforms. It is highly configurable, and permits flexible modifications at boot time through a special-purpose command line interface. Please refer to the *grub*(8) man page or run `info grub` for more information.

- Use the `password` command in */boot/grub/menu.lst* to prevent unauthorized use of the boot loader interface. Using md5 encoded passwords is RECOMMENDED, run the command *grub-md5-crypt* to generate the encoded version of a password.
- Protect all menu entries other than the default RHEL boot with the `lock` option, so that the boot loader will prompt for a password when the user attempts to boot from other media (such as a floppy) or sets other non-default options for the boot process. To implement this, add a line containing just the keyword `lock` after the `title` entry in the */boot/grub/menu.lst* file.
- Remove group and world read permissions from the grub configuration file if it contains a password by running the following command:

```
chmod 600 /boot/grub/menu.lst
```

All changes to the configuration take effect automatically on the next boot, there is no need to re-run an activation program.

The following example of the */boot/grub/menu.lst* configuration file shows RECOMMENDED settings:

```
default=0
timeout=5
splashimage=(hd0,0)/grub/splash.xpm.gz
password --md5 $1$O471l/$H/JW2MYeugX6Y1h3v.1Iz0
hiddenmenu
title Red Hat Enterprise Linux Server (2.6.18-6.el5.lspp.64)
        root (hd0,0)
        kernel /vmlinuz-2.6.18-6.el5.lspp.64 ro root=/dev/VolGroup00/LvRoot
        initrd /initrd-2.6.18-6.el5.lspp.64.img
```

Note that the configuration shown here might not be exactly the configuration used on the installed system, depending on the kernel options needed for the hardware.

3.13.2 Yaboot boot loader configuration

Yaboot is used on the System p machines, it is an OpenFirmware-based boot loader, and can be reconfigured at boot time from a specialized command line.

Yaboot and GRUB are very similar, both support MD5-encrypted passwords specified in the configuration file.

You need to re-run the *ybin*(8) tool when you have modified the configuration file, this is however not necessary if you replace a kernel and keep all path names unchanged.

Please refer to the *yaboot.conf*(5) and *ybin*(8) manual pages and the yaboot HOWTO for more information:

```
http://penguinppc.org/bootloaders/yaboot/doc/yaboot-howto.shtml/
```

3.13.3 ZIPL boot loader configuration

The ZIPL boot loader is used on the System z mainframe when the system is set up using the VM virtualization layer. In this context, ”booting” refers to the initial program load (IPL) done from the CP command prompt, which affects only a single specific Linux instance (a.k.a. ”partition”, which refers to the running system and not the disk partition in this context).

Configuration of the VM system is beyond the scope of this document. You MUST ensure that the configuration settings and virtual devices used are only accessible to the authorized administrators. Do NOT use unencrypted 3270 sessions for console access on insecure networks.

ZIPL writes a boot record on the virtual disk (DASD) used by this Linux instance, this boot record then proceeds to load and run the Linux kernel itself. The `zipl` command must be re-run after any kernel or boot argument modifications. Please refer to the *zipl*(8) man page for more information.

The following example shows a typical */etc/zipl.conf* file:

```
[defaultboot]
default=ipl
```

```
[ipl]
target=/boot/zipl
image=/boot/kernel/image
ramdisk=/boot/initrd
parameters="dasd=0200 root=/dev/dasda1"
```

3.14 Reboot and initial network connection

After all the changes described in this chapter have been done, you MUST reboot the system to ensure that all unwanted tasks are stopped, and that the running kernel, modules and applications all correspond to the evaluated configuration.

Please make sure that the boot loader is configured correctly for your platform. On System z, remember to run the *zipl*(8) tool to write the boot record.

The system will then match the evaluated configuration. The server MAY then be connected to a secure network as described above.

4 System operation

To ensure that the systems remains in a secure state, special care MUST be taken during system operation.

4.1 System startup, shutdown and crash recovery

Use the *shutdown*(8), *halt*(8) or *reboot*(8) programs as needed to shut down or reboot the system.

When powered on (or on initial program load of the logical partition on a host system), the system will boot into the RHEL operating system. If necessary (for example after a crash), a filesystem check will be performed automatically. In rare cases manual intervention is necessary, please refer to the *e2fsck*(8) and *debugfs*(8) documentation for details in this case.

In case a nonstandard boot process is needed (such as booting from floppy disk or CD-ROM to replace a defective hard drive), interaction with the boot loader and/or the host's management system can be used to modify the boot procedure for recovery.

For example, on System x you can use the following grub commands to launch a shell directly from the kernel, bypassing the normal init/login mechanism:

```
# view the current grub configuration
grub> cat (hd0,1)/boot/grub/menu.lst

# manually enter the modified settings
grub> kernel (hd0,1)/boot/vmlinuz root=/dev/sda1 init=/bin/sh
grub> initrd (hd0,1)/boot/initrd
grub> boot
```

Please refer to the relevant documentation of the boot loader, as well as the RHEL administrator guide, for more information.

4.2 Backup and restore

Whenever you make changes to security-critical files, you MAY need to be able to track the changes made and revert to previous versions, but this is not required for compliance with the evaluated configuration.

The *star*(1) archiver is RECOMMENDED for backups of complete directory contents, please refer to section §6.5 ”Data import / export” of this guide. Regular backups of the following files and directories (on removable media such as tapes or CD-R, or on a separate host) are RECOMMENDED:

```
/etc/
/var/spool/cron/
```

You MUST use the `-xattr` option for *star* if you intend to save or restore security relevant extended attributes, such as ACLs or MLS labels. You MAY omit the `-xattr` option if you only intend to save or restore file contents without security metadata.

Depending on your site’s audit requirements, also include the contents of */var/log/* in the backup plan. In that case, the automatic daily log file rotation needs to be disabled or synchronized with the backup mechanism, refer to sections §5.2 ”System logging and accounting” and §5.3 ”Configuring the audit subsystem” of this guide for more information.

You MUST protect the backup media from unauthorized access, because the copied data does not have the access control mechanisms of the original file system. Among other critical data, it contains the secret keys used by the *SSH* and *stunnel* servers, as well as the */etc/shadow* password database. Store the backup media at least as securely as the server itself.

A RECOMMENDED method to track changes is to use a version control system. RCS is easy to set up because it does not require setting up a central repository for the changes, and you can use shell scripting to automate the change tracking. RCS is not included in the evaluated configuration, see *rcsintro*(1) in the rcs RPM package for more information. Alternatively, you can create manually create backup copies of the files and/or copy them to other servers using *scp*(1).

4.3 Gaining administrative access

System administration tasks require superuser (root) privileges. In CAPP mode, superuser rights are also sufficient for administrative actions. In LSPP mode, superuser rights are a prerequisite for administrative rights, but in addition you need to select an administrative role with appropriate privileges.

Directly logging on over the network as user root is disabled. To gain superuser rights, you MUST first authenticate using an unprivileged user ID, and then use the `su` command to switch identities. Note that you MUST NOT use the root rights for anything other than those administrative tasks that require these privileges, all other tasks MUST be done using your normal (non-root) user ID.

You MUST use exactly the following *su*(1) command line to gain superuser access:

```
/bin/su -
```

This ensures that the correct binary is executed irrespective of PATH settings or shell aliases, and that the root shell starts with a clean environment not contaminated with the starting user’s settings. This is necessary because the *.profile* shell configuration and other similar files are writable for the unprivileged ID, which would allow an attacker to easily elevate privileges to root if able to subvert these settings.

Administrators MUST NOT add any directory to the root user’s PATH that are writable for anyone other than root, and similarly MUST NOT use or execute any scripts, binaries or configuration files that are writable for anyone other than root, or where any containing directory is writable for a user other than root.

In LSPP mode, the system supports several administrative roles:

system

The operating system supports multiple roles for noninteractive system processes such as daemons. All non-interactive roles are considered to be subdivisions of a conceptual ”system” role. The additional restrictions enforced on system services are beyond the scope of this document. The definition of system roles allows separating those from users.

sysadm

This is a role defined for general system administration tasks, including setting or modifying security contexts, and changing the sensitivity label of a subject or object.

auditadm

This is a role for the management of the audit configuration and evaluation of the audit records.

In addition, the system provides the following non-administrative roles by default:

staff

This is a role for users that are allowed use the newrole command to transition to administrative roles.

user

This is a generic role for all users other than ”staff”.

In LSPP mode, you MUST select one of the administrative roles after running ”su” to perform administrative actions, for example:

```
/bin/su -
newrole -r sysadm_r
newrole -r auditadm_r
```

You MUST use the *SystemLow* level for system administration. This is necessary to avoid accidentally upgrading system files to inappropriately high MLS levels, which would make them unreadable for processes running at lower levels.

Please refer to the *newrole*(1) man page and section §6.4.3 ”Role-based access control (LSPP mode only)” of this guide for more information.

In LSPP mode, you MAY also select a MLS level for administrative actions, usually one of *SystemLow* or *SystemHigh*. Please refer to section §6.4.2 ”Multilevel mandatory access control (LSPP mode only)” of this guide for more information.

4.4 Editing configuration files

It is RECOMMENDED to use the `rnano` editor to edit system configuration files. It is documented in the *nano*(8) man page.

It is RECOMMENDED to set the `EDITOR` environment variable in the */etc/profile* file to ensure that this editor is used by default by tools such as *crontab*(1):

```
if [ `id -u` -eq 0 ]; then
        EDITOR=rnano
        export EDITOR
fi
```

Other editors can read and execute commands specified in run control files or in the edited files themselves or have other complex dependencies on the execution environment. That is a security risk and inappropriate for an editor used for system administration tasks. The *rnano* editor was tested and examined as part of the evaluation to ensure that it works as expected and is secure, this was not done for any of the other editors shipped with the system.

4.5 Installation of additional software

Additional software packages MAY be installed as needed, provided that they do not conflict with the security requirements.

4.5.1 Supported software architectures

You MUST use the default kernel (which is SMP capable even on uniprocessor systems) from the package *kernel-2.6.*.rpm* on all systems. You MUST NOT use a different kernel flavor such as the PAE kernel.

You MUST select the appropriate RPM packages for your architecture. The 64bit architectures support execution of both 64bit and 32bit binaries.

System x (Intel EM64T/x86_64) and eSeries 326 (AMD Opteron/x86_64)

These systems use a 64bit kernel and 64bit userspace programs and also supports running 32bit programs. Use the ***.x86_64.rpm** or ***.noarch.rpm** variants of packages. You can OPTIONALLY install the ***.i386.rpm** or ***.i686.rpm** variants of libraries (package names containing *-libs* or *-devel*) in addition to the 64bit versions.

System p (ppc/ppc64)

These systems use a 64bit kernel, but the installed userspace programs are the 32bit variants. They support running 64bit programs as well. Use the ***.ppc64.rpm** kernel for System p. Use the ***.ppc.rpm** or ***.noarch.rpm** packages for all packages other than the kernel. You can OPTIONALLY install the ***.ppc64.rpm** variants of libraries (package names containing *-libs* or *-devel*) in addition to the 32bit versions.

System z (s390x)

The evaluated configuration uses a 64bit kernel running 64bit userspace programs. Use the ***.s390x.rpm** or ***.noarch.rpm** variants of packages. You can OPTIONALLY install the 32bit ***.s390.rpm** variants of libraries (package names containing *-libs* or *-devel*) in addition to the 64bit versions.

4.5.2 Security requirements for additional software

Any additional software added is not intended to be used with superuser privileges. The administrator MUST use only those programs that are part of the original evaluated configuration for administration tasks, except if the administrator has independently ensured that use of the additional software is not a security risk.

Administrators MAY add scripts to automate tasks as long as those only depend on and run programs that are part of the evaluated configuration.

The security requirements for additional software are:

- Kernel modules other than those provided as part of the evaluated configuration MUST NOT be installed or loaded. You MUST NOT load the *tux* kernel module (the in-kernel web server is not supported). You MUST NOT add support for non-ELF binary formats or foreign binary format emulation that circumvents system call auditing. You MUST NOT activate knfsd or export NFS file systems.
- Device special nodes MUST NOT be added to the system.
- SUID root or SGID root programs MUST NOT be added to the system. Programs which use the SUID or SGID bits to run with identities other than root MAY be added if the numerical SUID and SGID values are not less than 100. This restriction is necessary to avoid conflict with system user and group IDs such as the ”disk” group.
- The content, permissions, and ownership of all existing filesystem objects (including directories and device nodes) that are part of the evaluated configuration MUST NOT be modified. Files and directories MAY be added to existing directories provided that this does not violate any other requirement.

- Programs automatically launched with root privileges MUST NOT be added to the system. Exception: processes that *immediately* and *permanently* switch to a non-privileged identity on launch are permitted, for example by using `su USERID -c LAUNCH_COMMAND` in the startup file, or alternatively by using the *setgroups*(2), *setgid*(2) and *setuid*(2) system calls in a binary. (*seteuid*(2) etc. are insufficient.)

  Automatic launch mechanisms are:

  - Entries in */etc/inittab*
  - Executable files or links in */etc/rc.d/init.d/* and its subdirectories
  - Entries in */etc/xinetd.conf*
  - Scheduled jobs using `cron` (including entries in */etc/cron** files)

Examples of programs that usually do not conflict with these requirements and MAY be installed are compilers, interpreters, network services running with non-root rights, and similar programs. The requirements listed above MUST be verified in each specific case.

Some system programs are configured to automatically change their SELinux context when executed. This uses the type transitioning facilities of the SELinux policy, and can add or remove privileges from programs. Type transitioning programs can be recognized by the file context (as shown with the `ls -Z` command) containing the *exec_t* suffix, for example */bin/passwd* with the *passwd_exec_t* type. You MUST NOT assign type transitions with predefined system types to additional programs. Automatic type transitions are not safe for use with script files, and MUST NOT be used for adding privileges to scripts, only for voluntarily removing them.

4.6 Scheduling processes using cron

The *cron* facility is available for scheduling processes. The legacy *at* service is not supported in the evaluated configuration.

The *cron*(8) program schedules programs for execution at regular intervals. Entries can be modified using the *crontab*(1) program - the file format is documented in the *crontab*(5) manual page.

In LSPP mode, users MAY use the MLS_LEVEL environment variable to select an MLS level for the job to execute. This is documented in the *crontab*(5) manual page.

In LSPP mode, cron will NOT send mail containing job output to users. You MAY use output redirection in crontab entries to save output in files at the appropriate MLS level.

You MUST follow the rules specified for installation of additional programs for all entries that will be executed by the root user. Use non-root crontab entries in all cases where root privileges are not absolutely necessary.

Errors in the non interactive jobs executed by `cron` are reported in the system log files in */var/log/*, and, in CAPP mode, additionally via e-mail to the user who scheduled it.

Permission for users to schedule jobs with `cron` through the following *allow* and *deny* files:

```
/etc/cron.allow
/etc/cron.deny
```

The *allow* file has precedence if it exists, then only those users whose usernames are listed in it are permitted to use the service. If it does not exist, the *deny* file is used instead and all users who are *not* listed in that file can use the service. Note that the contents of these files are only relevant when the scheduling commands are executed, and changes have no effect on already scheduled commands.

In the RHEL distribution, the *allow* files do not exist, and *deny* files are used to prevent system-internal IDs and/or guest users from using these services. By default, the evaluated configuration permits everybody to use *cron*.

It is RECOMMENDED to restrict the use of *cron* to human users and disallow system accounts from using these mechanisms. For example, the following commands add all system accounts other than root to the *deny* files:

```
awk -F: '{if ($3>0 && $3<100) print $1}' /etc/passwd >/etc/cron.deny
chmod 600 /etc/cron.deny
```

Administrators MAY schedule jobs that will be run with the privileges of a specified user by editing the file */etc/crontab* with an appropriate username in the sixth field. Entries in */etc/crontab* are not restricted by the contents of the *allow* and *deny* files.

You MAY create a */etc/cron.allow* file to explicitly list users who are permitted to use this service. If you do create this file, it MUST be owned by the user root and have file permissions 0600 (no access for group or others).

4.7 Mounting filesystems

If any filesystems need to be mounted in addition to those set up at installation time, appropriate mount options MUST be used to ensure that mounting the filesystem does not introduce capabilities that could violate the security policy.

The special-purpose *proc*, *sysfs*, *devpts*, *selinuxfs*, *binfmt_misc*, and *tmpfs* filesystems are part of the evaluated configuration. These are virtual filesystems with no underlying physical storage, and represent data structures in kernel memory. Access to contents in these special filesystems is protected by the normal discretionary access control policy and additional permission checks.

Note that changing ownership or permissions of virtual files and directories is generally NOT supported for the *proc* and *sysfs* filesystems (corresponding to directories */proc/* and */sys/*), and attempts to do so will be ignored or result in error messages.

Note that use of the *usbfs* filesystem type is NOT permitted (and not needed) in the evaluated configuration.

A new file system can be integrated as part of the evaluated configuration, for example by installing an additional hard disk, under the following conditions:

- The device is protected against theft or manipulation in the same way as the server itself, for example by being installed inside the server.
- One or more new, empty, file systems in ext3 format are created on it.
- The file systems are mounted using the `acl` option, for example with the following setting in the */etc/fstab* file:

  ```
  /dev/sdc1 /home2 ext3 acl 1 2
  ```

  Existing files and directories MAY then be moved onto the new file systems.
- If a device containing a file system is ever removed from the system, the device MUST be stored within the secure server facility, or alternatively MUST be destroyed in a way that the data on it is reliably erased.

Alternatively, media MAY be accessed without integrating them into the evaluated configuration, for example CD-ROMs or DVDs.

CD/DVD devices MUST be accessed using the *iso9660* filesystem type. Using an automounter is NOT permitted in the evaluated configuration.

The following mount options MUST be used if the filesystems contain data that is not part of the evaluated configuration:

```
nodev,nosuid
```

Adding the *noexec* mount option to avoid accidental execution of files or scripts on additional mounted filesystems is RECOMMENDED.

In LSPP mode, be aware that *iso9660* filesystems do not support MLS labels on individual objects. You MAY use the `context=` mount option to specify an SELinux context including MLS level for the entire filesystem. It is RECOMMENDED that you use *iso9660* filesystems only for world readable data that does not need read protection.

Be aware that data written to removable media is not reliably protected by the DAC permission mechanism, and should be considered accessible to anyone with physical access to the media. It is RECOMMENDED to add the *ro* option to mount the file system read-only.

Note that these settings do not completely protect against malicious code and data, you MUST also verify that the data originates from a trustworthy source and does not compromise the server's security. Specifically, be aware of the following issues:

- Even unprivileged programs and scripts can contain malicious code that uses the calling user's rights in unintended ways, such as corrupting the user's data, introducing trojan horses in the system, attacking other machines on the network, revealing confidential documents, or sending unsolicited commercial e-mail ("spam").
- Data on the additional filesystem MUST have appropriate access rights to prevent disclosure to or modification by unauthorized users. Be aware that imported data could have been created using user names and permissions that do not match your system's security policies.
- You MUST NOT write data on removable file systems such as floppy disks, since it cannot be adequately protected by the system's access control mechanisms after being removed from the system. Please refer to section §4.2 "Backup and restore" of this guide for more information regarding non-filesystem-based backup.

Each new file system MUST be mounted on an empty directory that is not used for any other purpose. It is RECOMMENDED using subdirectories of */mnt* for temporary disk and removeable storage media mounts.

For example:

```
# mount /dev/cdrom /mnt/cdrom -t iso9660 -o ro,nodev,nosuid,noexec
```

You MAY also add an equivalent configuration to */etc/fstab*, for example:

```
/dev/cdrom /mnt/cdrom iso9660 ro,noauto,nodev,nosuid,noexec 0 0
```

You MUST NOT include the *user* flag, ordinary users are not permitted to mount filesystems. This is also enforced by the deletion of the SUID bit on the *mount* command.

4.8 Managing user accounts

4.8.1 Creating users

Use the *useradd*(8) command to create new user accounts, then use the *passwd*(1) command to assign an initial password for the user. Alteratively, if the user is present when the account is created, permit them to choose their own password. Refer to the manual pages for *useradd*(8) and *passwd*(1) for more information.

If you assign an initial password for a new user, you MUST transfer this initial password in a secure way to the user, ensuring that no third party gets the information. For example, you can tell the password to a user personally known to you. If this is not possible, you MAY send the password in written form in a sealed letter. This applies also when you set a new password for a user in case the user has forgotten the password or it has expired. You need to advise the user that he MUST change this initial password when he first logs into the system and select his own password in accordance with the rules defined in section §6.3 "Password policy" of this guide.

You MUST NOT use the `-p` option to *useradd*(8), specifying a password in that way would bypass the password quality checking mechanism.

The temporary password set by the administrator MUST be changed by the user as soon as possible. Use the *chage*(8) command with the `-d` option to set the last password change date to a value where the user will be reminded to change the password. The RECOMMENDED value is based on the settings in */etc/login.defs* and is equivalent to today's date plus PASS_WARN_AGE minus PASS_MAX_DAYS.

Example:

```
useradd -m -c "John Doe" jdoe
passwd jdoe
chage -d $(date +%F -d "53 days ago") jdoe
```

The `-m` option to *useradd*(8) creates a home directory for the user based on a copy of the contents of the */etc/skel/* directory. Note that you MAY modify some default configuration settings for users, such as the default *umask*(2) setting or time zone, by editing the corresponding global configuration files:

```
/etc/profile
/etc/bashrc
/etc/csh.cshrc
```

4.8.2 Changing user passwords

If necessary, you MAY reset the user's password to a known value using `passwd` *`USER`*, and entering the new password. You cannot recover the previously used password, since the hash function used is not reversible.

4.8.3 Changing user properties

You MAY use the *usermod*(8) command to change a user's properties.

4.8.4 Locking and unlocking user accounts

Users MAY be locked out (disabled) using `passwd -l` *`USER`*, and re-enabled using `passwd -u` *`USER`*.

The *pam_tally2.so* PAM module enforces automatic lockout after excessive failed authentication attempts, as described in section §3.10 "Required Pluggable Authentication Module (PAM) configuration" of this guide. Use the program *pam_tally2* to view and reset the counter if necessary, as documented in the file */usr/share/doc/pam-*/txts/README.pam_tally2*. Note that the *pam_tally2* mechanism does not *prevent* password guessing attacks, it only prevents *use* of the account after such an attack has been detected. Therefore, you MUST assign a new password for the user before reactivating an account. For example:

```
# view the current counter value
pam_tally2 --user jdoe

# set new password, and reset the counter
passwd jdoe
pam_tally2 --user jdoe --reset
```

The *chage*(1) utility MAY be used to view and modify the expiry settings for user accounts. Unprivileged users are able to view but not modify their own expiry settings.

4.8.5 Removing users

The *userdel*(8) utility removes the user account from the system, but does not remove files outside the home directory (and the mail spool file), or kill processes belonging to this user. Use `kill` (or reboot the system) and `find` to do so manually if necessary, for example:

```
# Which user to delete?
U=jdoe

# Lock user account, but don't remove it yet
passwd -l $U

# Kill all user processes, repeat if needed (or reboot)
kill -9 `ps -la --User $U|awk '{print $4}'`

# Recursively remove all files and directories belonging to user
# (Careful - this may delete files belonging to others if they
# are stored in a directory owned by this user.)
find / -depth \( ! -fstype ext3 -prune -false \) \
        -o -user $U -exec rm -rf {} \;

# Remove cron jobs
crontab -u $U -r

# Now delete the account
userdel $U
```

If you need to create additional groups or modify or delete existing groups, use the *groupadd*(8), *groupmod*(8) and *groupdel*(8) commands.

You MAY assign group passwords and allow use of the *newgrp*(8) program to change groups. Note that the *gpasswd*(1) program will only work when run at *SystemLow* level.

4.8.6 Defining administrative accounts

Administrative users MUST be member of the *wheel* group. Specify the `-G wheel` option for the *useradd*(8) command when creating administrative users.

You MAY also use the *usermod*(8) command to change group membership. For example, if you want to add the user 'jdoe' to the *wheel* group, you could use the following:

```
# List the groups the user is currently a member of:
groups jdoe

# Add the additional group
usermod -G $(su jdoe -c groups | sed 's/ /,/g'),wheel jdoe
```

In LSPP mode, administrative users MUST also be assigned to the *staff_u* user class, and MUST be assigned to one or more administrative roles. The *staff_u* user class gives permission to use the *sysadm_r*, *secadm_r*, and *auditadm_r* roles in addition to the default *staff_r* role. Use the following steps to define an administrative user in LSPP mode:

```
useradd -m -c "John Doe" -G wheel jdoe
passwd jdoe
chage -m 1 -M 60 -W 7 jdoe
semanage login -a -s staff_u -r SystemLow-SystemHigh jdoe
restorecon -r /home/jdoe
```

4.8.7 Defining user roles and MLS levels (LSPP mode only)

In LSPP mode, use the *semanage*(8) program to assign SELinux user classes, roles, and MLS levels to users.

Here is an example of creating a nonadministrative user class with permission to access a range of MLS levels, then creating two users and assigning different clearances within that range to these users:

```
semanage user -a -R user_r -r s0-s4:c100.c299 -P user op_u

useradd -m op1
useradd -m op2
passwd op1
passwd op2
chage -m 1 -M 60 -W 7 op1
chage -m 1 -M 60 -W 7 op2

semanage login -a -s op_u -r s0-s2:c150.c159 op1
semanage login -a -s op_u -r s0-s3:c130.c249 op2
```

Please refer to the *semanage*(8) man page for more information about this program.

Section §4.16.3 ”Creating a custom role (LSPP mode only)” of this guide contains a more detailed example which includes defining a custom role and associated rights.

4.9 Using serial terminals

You MAY attach serial terminals to the System x, System p, and eServer 326 (Opteron) systems that are accessible to non-administrative users. Serial terminals on System z MUST be accessible by trusted administrators only.

Serial terminals are activated by adding an entry in the file */etc/inittab* for each serial terminal that causes *init*(8) to launch an *agetty*(8) process to monitor the serial line. *agetty* runs *login*(1) to handle user authentication and set up the user’s session.

If you use serial terminals and require the LSPP-compliant fail-safe audit mode, you MUST ensure that the file */etc/pam.d/login* is configured to use the *require_auditd* option for the *pam_loginuid.so* module in the `session` stack. Please refer to section §3.10.2 ”/etc/pam.d/login” of this guide for more information about the needed PAM configuration.

For example, adding the following line to */etc/inittab* activates a VT102-compatible serial terminal on serial port /dev/ttyS1, communicating at 19200 bits/s:

```
S1:3:respawn:/sbin/agetty 19200 ttyS1 vt102
```

The first field MUST be an unique identifier for the entry (typically the last characters of the device name). Please refer to the *agetty*(8) and *inittab*(5) man pages for further information about the format of entries.

You MUST reinitialize the *init* daemon after any changes to */etc/inittab* by running the following command:

```
init q
```

4.10 Managing data objects

4.10.1 Revoking access

As with most operating systems, access rights are checked only once, when the object is first accessed by the process. If the initial permission check was successful, read and/or write operations are permitted indefinitely without further checking, even if the access rights to the object are changed or revoked.

If this delayed revocation is not acceptable to you and you need to definitely ensure that no user processes are accessing an object after you have changed the access rights to that object, you MUST reboot the system. This ensures that no processes have open descriptors which could permit continued access.

4.10.2 SYSV shared memory and IPC objects

The system supports SYSV-compatible shared memory, IPC objects, and message queues. If programs fail to release resources they have used (for example, due to a crash), the administrator MAY use the *ipcs*(8) utility to list information about them, and *ipcrm*(8) to force deletion of unneeded objects. Note that these resources are also released when the system is rebooted.

For additional information, please refer to the *msgctl*(2), *msgget*(2), *msgrcv*(2), *msgsnd*(2), *semctl*(2), *semget*(2), *semop*(2), *shmat*(2), *shmctl*(2), *shmdt*(2), *shmget*(2) and *ftok*(3) manual pages.

4.10.3 Posix Message Queues

POSIX message queues are supported as an alternative to SYSV message queues. Users and administrators MAY use the system calls and corresponding library functions documented in the *mq_overview*(7) man page, such as *mq_open*(2) and *mq_unlink*(2).

The message queue file system (type *mqueue*) is NOT supported in the evaluated configuration. Administrators MUST reboot the system in the unlikely case that they need to explicitly destroy POSIX message queue objects.

4.11 Configuring object access rights

Administrators MAY use the *chown*(1), *chgrp*(1), and *chmod*(1) tools to configure DAC access rights in CAPP and LSPP mode. You MUST NOT grant additional access to objects that are part of the evaluated configuration.

In LSPP mode, administrators MAY use the *chcon*(1) tool to change the MLS level and SELinux type of objects. You MUST NOT grant additional access to objects that are part of the evaluated configuration. The *chcat*(1) tool is unsuitable for MLS mode and MUST NOT be used.

Please refer to the respective man pages for more information about these tools.

4.12 Configuring secure network connections with *stunnel*

4.12.1 Introduction to stunnel

The *stunnel* program is a flexible and secure solution for setting up encrypted network connections, enabling the use of strong encryption even for applications that are not able to use encryption natively. *stunnel* uses the OpenSSL library for its encryption functions, and the corresponding *openssl*(1) command line tool for key management.

Stunnel has three main operating modes:

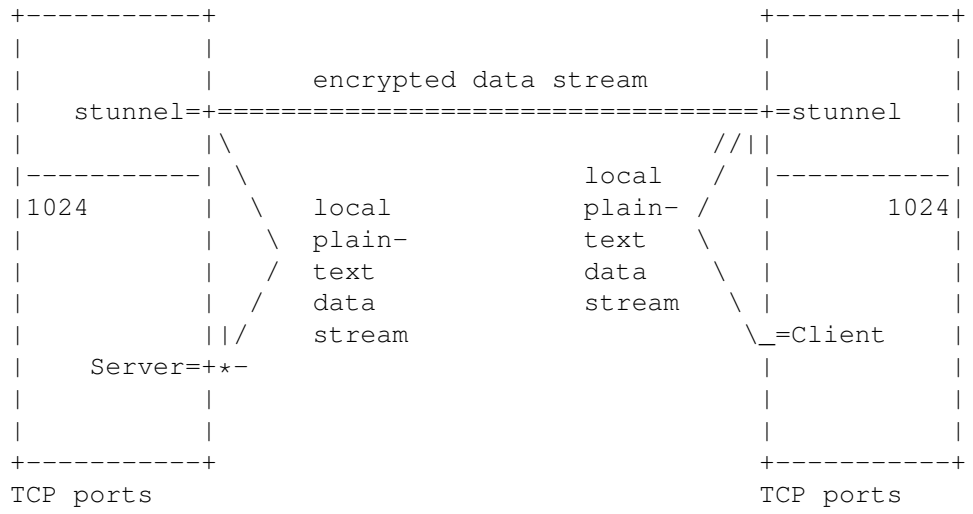
- Accept incoming SSL-encrypted TCP connections, and run a specific program to handle the request.

  This is similar to how *xinetd* launches programs, and any program compatible with *xinetd* can also be used for this purpose. It must read and write the communication data on the *stdin* and *stdout* file descriptors and stay in the foreground. *stunnel* also supports switching user and group IDs before launching the program.

- Open a SSL connection to a remote SSL-capable TCP server, and copy data to and from *stdin* and *stdout*.

- Bind a TCP port to accept incoming unencrypted connections, and forward data using SSL to a prespecified remote server.

The following diagram shows a sample usage scenario:



In this scenario, neither the client nor the server have administrator privileges, they are running as normal user processes. Also, the client and server do not support encryption directly.

stunnel makes a secure communication channel available for the client and server. On the client, *stunnel* is accepting connections on TCP port 82. The client connects to this port on the local machine using normal unencrypted TCP, *stunnel* accepts the connection, and opens a new TCP connection to the *stunnel* server running on the remote machine. The *stunnel* instances use cryptographic certificates to ensure that the data stream has not been intercepted or tampered with, and then the remote *stunnel* opens a third TCP connection to the server, which is again a local unencrypted connection.

Any data sent by either the client or server is accepted by the corresponding *stunnel* instance, encrypted, sent to the other *stunnel*, decrypted and finally forwarded to the receiving program. This way, no modifications are required to the client and server.

To set up a secure connection compliant with the evaluated configuration, you MUST start the *stunnel* server(s) with administrator rights, and you MUST use a TCP port in the administrator-reserved range 1-1023 to accept incoming connections. A corresponding client which connects to the server MAY be started by any user, not just administrators.

stunnel MAY also be used by non-administratorive users to receive encrypted connections on ports in the range 1024-65536. This is permitted, but it is outside of the scope of the evaluated configuration and not considered to be a trusted connection.

Any network servers and clients other than the trusted programs described in this guide (*stunnel*, *sshd*, *vsftpd*, *postfix* and *cupsd*) MUST be run using non-administrator normal user identities. Programs run from *stunnel* MUST be switched to a non-root user ID by using the *setuid* and *setgid* parameters in the */etc/stunnel/*.conf* configuration files.

It is RECOMMENDED configuring any such servers to accept connections only from machine-local clients, either by binding only the *localhost* IP address 127.0.0.1, or by software filtering inside the application. This ensures that the only encrypted connections are possible over the network. Details on how to do this depend on the software being used and are beyond the scope of this guide.

Please refer to the *stunnel*(8) and *openssl*(1) man pages for more information.

4.12.2 Creating an externally signed certificate

It is strongly RECOMMENDED that you have your server's certificate signed by an established Certificate Authority (CA), which acts as a trusted third party to vouch for the certificate's authenticity for clients. Please refer to the *openssl*(1) and *req*(1) man pages for instructions on how to generate and use a certificate signing request.

Create the server's private key and a certificate signing request (CSR) with the following commands:

```
touch /etc/stunnel/stunnel.pem

chmod 400 /etc/stunnel/stunnel.pem

openssl req -newkey rsa:1024 -nodes \
  -keyout /etc/stunnel/stunnel.pem -out /etc/stunnel/stunnel.csr
```

You will be prompted for the information that will be contained in the certificate. Most important is the "Common Name", because the connecting clients will check if the hostname in the certificate matches the server they were trying to connect to. If they do not match, the connection will be refused, to prevent a 'man-in-the-middle' attack.

Here is a sample interaction:

```
Generating a 1024 bit RSA private key
..........++++++
.......++++++
writing new private key to '/etc/stunnel/stunnel.pem'
-----
You are about to be asked to enter information that will be incorporated
into your certificate request.
What you are about to enter is what is called a Distinguished Name or a DN.
There are quite a few fields but you can leave some blank
For some fields there will be a default value,
If you enter '.', the field will be left blank.
-----
Country Name (2 letter code) [PL]:US
State or Province Name (full name) [Some-State]:TX
Locality Name (eg, city) []:Austin
Organization Name (eg, company) [Stunnel Developers Ltd]:Example Inc.
Organizational Unit Name (eg, section) []:
Common Name (FQDN of your server) []:www.example.com
Common Name (default) []:localhost
```

The file */etc/stunnel/stunnel.pem* will contain both the certificate (public key) and also the secret key needed by the server. The secret key will be used by non-interactive server processes, and cannot be protected with a passphrase. You MUST protect the secret key from being read by unauthorized users, to ensure that you are protected against someone impersonating your server.

Next, send the generated CSR file */etc/stunnel/stunnel.csr* (*not* the private key) to the CA along with whatever authenticating information they require to verify your identity and your server's identity. The CA will then generate a signed certificate from the CSR, using a process analogous to `openssl req -x509 -in stunnel.csr -key CA-key.pem -out stunnel.cert`.

When you receive the signed certificate back from the CA, append it to the file */etc/stunnel/stunnel.pem* containing the private key using the following command:

```
echo >> /etc/stunnel/stunnel.pem
cat stunnel.cert >> /etc/stunnel/stunnel.pem
```

Make sure that the resulting file contains no extra whitespace or other text in addition to the key and certificate, with one blank line separating the private key and certificate:

```
-----BEGIN RSA PRIVATE KEY-----
MIICXQIBAAKBgQCzF3ezbZFLjgv1YHNXnBnI8jmeQ5MmkvdNw9XkLnA2ONKQmvPQ
[...]
4tjzwTFxPKYvAW3DnXxRAkAvaf1mbc+GTMoAiepXPVfqSpW2Qy5r/wa04d9phD5T
oUNbDU+ezu0Pana7mmmvg3Mi+BuqwlQ/iU+G/qrG6VGj
-----END RSA PRIVATE KEY-----

-----BEGIN CERTIFICATE-----
MIIC1jCCAj+gAwIBAgIBADANBgkqhkiG9w0BAQQFADBXMQswCQYDVQQGEwJQTDET
[...]
bIbYKL6Q1kE/vhGmRXcXQrZzkfu8sgJv7JsDpoTpAdUnmvssUY0bchqFo4Hhzkvs
U/whL2/8RFv5jw==
-----END CERTIFICATE-----
```

You MAY distribute the original signed certificate (*stunnel.cert* in this example) to clients, it does not contain any confidential information. *Never* distribute the file containing the private key, that is for use by the `stunnel` server only.

When using externally signed certificates, you MUST use the option *CApath* in *stunnel* client configuration files along with the setting *verify=2* or *verify=3* to enable the clients to verify the certificate.

4.12.3 Creating a self-signed certificate

Alternatively, you MAY use a self-signed certificate instead of one signed by an external CA. This saves some time and effort when first setting up the server, but each connecting client will need to manually verify the certificate's validity. Experience shows that most users will not do the required checking and simply click "OK" for whatever warning dialogs that are shown, resulting in significantly reduced security. Self-signed certificates can be appropriate for controlled environments with a small number of users, but are not recommended for general production use.

Create a self-signed host certificate with the following commands:

```
# create secret key and self-signed certificate
openssl req -newkey rsa:1024 -nodes \
  -keyout /etc/stunnel/stunnel.pem \
  -new -x509 -sha1 -days 365 \
  -out /etc/stunnel/stunnel.cert

# set appropriate file permissions
chmod 400 /etc/stunnel/*.pem
chmod 444 /etc/stunnel/*.cert
```

```
# append copy of certificate to private key
echo >> /etc/stunnel/stunnel.pem
cat /etc/stunnel/stunnel.cert >> /etc/stunnel/stunnel.pem
```

The secret key contained in the */etc/stunnel/stunnel.pem* file MUST be kept secret. The key files contain human-readable headers and footers along with the ASCII-encoded key, and the secret key is marked with the header "BEGIN RSA PRIVATE KEY".

You MAY distribute the public certificate stored in the */etc/stunnel/stunnel.cert* file to clients, it is marked with the header "BEGIN CERTIFICATE". Make sure you do not accidentally distribute the secret key instead.

The client has no independent way to verify the validity of a self-signed certificate, each client MUST manually verify and confirm the validity of the certificate.

One method is to give a copy of the self-signed certificate to the client (using a secure transport mechanism, not e-mail), and import it into the client directly. The `stunnel` client uses the *CAfile* option for this purpose.

Alternatively, many client programs (not `stunnel`) can interactively import the certificate when connecting to the server. The client will display information about the server's certificate including an MD5 key fingerprint. You need to compare this fingerprint with the original fingerprint of the server's certificate.

Run the following command on the server to display the original certificate's fingerprint:

```
openssl x509 -fingerprint -in /etc/stunnel/stunnel.cert
```

Most clients will store the certificate for future reference, and will not need to do this verification step on further invocations.

4.12.4 Activating the tunnel

In the evaluated configuration, you MUST use one of the following cipher suites as defined in the SSL v3 protocol:

```
# Cipher Proto Key    Authen- Encryption   Message
#              exchg  tication            auth code
#
RC4-SHA  SSLv3 Kx=RSA Au=RSA  Enc=RC4(128) Mac=SHA
DES-CBC3-SHA SSLv3 Kx=RSA Au=RSA Enc=3DES(168) Mac=SHA1
AES128-SHA   SSLv3 Kx=RSA Au=RSA Enc=AES(128) Mac=SHA1
AES256-SHA   SSLv3 Kx=RSA Au=RSA Enc=AES(256) Mac=SHA1
```

You MUST specify the cipher list and protocol in all *stunnel* client and server configuration files:

```
ciphers = RC4-SHA:DES-CBC3-SHA:AES128-SHA:AES256-SHA
options = NO_TLSv1
options = NO_SSLv2
```

For a service or tunnel that will only be used temporarily, simply launch the `stunnel` program from the command line and specify an appropriate configuration file. The tunnel will be available for multiple clients, but will not be started automatically after a reboot. To shut down the tunnel, search for the command line in the `ps ax` process listing, and use the *kill*(1) command with the PID shown for the *stunnel* process.

The RECOMMENDED method is to use two separate configuration files, one for server definitions (incoming connections use SSL), and one for client definitions (outgoing connections use SSL). More complex configurations will require additional configuration files containing individual service-specific settings. You MUST use the REQUIRED settings in all *stunnel* configuration files.

Use the following content for the file */etc/stunnel/stunnel-server.conf*:

```
### /etc/stunnel/stunnel-server.conf
#
# The following settings are REQUIRED for LSPP compliance when used
# as a server, see ECG. File names MAY be changed as needed.
cert = /etc/stunnel/stunnel.pem
ciphers = RC4-SHA:DES-CBC3-SHA:AES128-SHA:AES256-SHA
options = NO_TLSv1
options = NO_SSLv2
#
# User and group ID MUST NOT be "root", but MAY be changed as needed.
setuid = nobody
setgid = nobody
#
# The following settings are RECOMMENDED
debug = 6
output = /var/log/stunnel-server.log
pid =
foreground = yes
#
# Individual service definitions follow
```

Use the following content for the file */etc/stunnel/stunnel-client.conf*:

```
### /etc/stunnel/stunnel-client.conf
#
# The following settings are REQUIRED for LSPP compliance when used
# as a client, see ECG. File names MAY be changed as needed. You
# MAY use CApath instead of CAfile for externally signed certificates.
CAfile = /etc/stunnel/stunnel.cert
ciphers = RC4-SHA:DES-CBC3-SHA:AES128-SHA:AES256-SHA
options = NO_TLSv1
options = NO_SSLv2
client = yes
verify = 2
#
# User and group ID MUST NOT be "root", but MAY be changed as needed.
setuid = nobody
setgid = nobody
#
# The following settings are RECOMMENDED
debug = 6
output = /var/log/stunnel-client.log
pid =
foreground = yes
#
# Individual service definitions follow
```

The RECOMMENDED launch method for *stunnel*(8) is via the *init*(8) process. This requires adding new entries to */etc/inittab*, the tunnels will be re-launched automatically whenever they are terminated, as well as after a reboot. The following are the RECOMMENDED */etc/inittab* entries:

```
ts:3:respawn:/usr/sbin/stunnel /etc/stunnel/stunnel-server.conf
tc:3:respawn:/usr/sbin/stunnel /etc/stunnel/stunnel-client.conf
```

Make sure you use the option `foreground = yes` in the configuration file when running from init (otherwise `init` will misinterpret the backgrounded server as having died and will try to restart it immediately, causing a loop), and use the `output` option to redirect the output to a log file.

4.12.5 Using the tunnel

If the client program supports SSL encryption, it will be able to communicate with the *stunnel* service directly. You will need to verify and accept the server's certificate if the client cannot recognize it as valid according to its known certification authorities.

If the client program does not support SSL directly, you can use `stunnel` as a client, or indirectly by setting up a proxy that allows the client to connect to an unencrypted local TCP port.

WARNING: The `stunnel` client does *not* verify the server's certificate by default. You MUST specify either `verify = 2` or `verify = 3` in the client configuration file to switch on certificate verification.

You MAY also activate client certificate verification in the server's configuration file, so that the server can verify the client's identity as well.

As described in the previous section, you MUST specify

```
ciphers = RC4-SHA:DES-CBC3-SHA:AES128-SHA:AES256-SHA
options = NO_TLSv1
options = NO_SSLv2
```

in the configuration file to ensure that the cipher selection supported in the evaluated configuration will be used.

4.12.6 Example 1: Secure SMTP delivery

Normal SMTP e-mail delivery is not encrypted, but most mail clients support the enhanced SMTPS protocol that uses SSL encryption. The protocol itself is unchanged other than being encrypted.

`stunnel` can easily be used as a proxy to receive SMTPS connections on the standard port expected by clients (465/tcp), and then forward the data to the mail server listening on the SMTP port (25/tcp). The mail server configuration does not need to be modified to support encryption of incoming mail.

To implement SSL support for incoming mail, add the following service definition to the */etc/stunnel/stunnel-server.conf* configuration:

```
[inbound_mail]
accept = 465
connect = 127.0.0.1:25
```

4.12.7 Example 2: Simple web server

The following shell script acts as a simple web server, reading requests from standard input and writing HTTP/HTML to standard output:

```
cat > /usr/local/sbin/webserver_test <<-__EOF__
#!/bin/sh
# Simple web server, can be run via stunnel or xinetd
#
# read and discard client data
dd bs=65536 count=1 >/dev/null 2>&1
```

```
#
# Send HTTP header
echo -e "HTTP/1.0 200\r"
echo -e "Content-type: text/html\r"
echo -e "\r"
#
# Send HTML output
echo "<html>"
echo "<h1>Test Page</h1>"
date
echo "<h2>Memory usage</h2>"
echo "<pre>"
free
echo "</pre>"
echo "</html>"
__EOF__

chmod +x /usr/local/sbin/webserver_test
```

Add the following entry to the */etc/stunnel/stunnel-server.conf* configuration to make this service available using the encrypted HTTPS protocol:

```
[webserver_test]
accept = 443
exec = /usr/local/sbin/webserver_test
TIMEOUTclose = 0
```

Then, use a SSL-capable web browser to connect to port 443:

```
elinks https://localhost/
```

4.12.8 Example 3: system status view

This example shows how to combine *stunnel* client and server definitions to implement an encrypted tunnel for applications that do not themselves support encryption.

First, on the server machine, set up a *stunnel* server definition that accepts SSL connections on TCP port 444, and reports memory usage statistics for the server to connecting clients. Add the following service definition to the */etc/stunnel/stunnel-server.conf* configuration:

```
[free]
accept = 444
exec = /usr/bin/free
execargs = free
```

Then, on the client machine, add the following entry to the */etc/stunnel/stunnel-client.conf* configuration, using the server's IP address instead of "127.0.0.1":

```
[free]
accept  = 81
connect = 127.0.0.1:444
```

On the client machine, connect to the local *stunnel* proxy by running the following command as a normal user:

```
telnet localhost 81
```

This will open an unencrypted TCP connection to the client's local port 81, then *stunnel* builds an encrypted tunnel to the server's port 444 and transfers the decrypted data (in this case, the "free" output) back to the client. All unencrypted connections are machine local, and the data transferred over the network is encrypted.

4.13 The Abstract Machine Testing Utility (AMTU)

The security of the operating system depends on correctly functioning hardware. For example, the memory subsystem uses hardware support to ensure that the memory spaces used by different processes are protected from each other.

The Abstract Machine Testing Utility (AMTU) is distributed as an RPM, and was installed previously as described in section §3.1 "Add and remove packages" of this guide.

To run all supported tests, simply execute the `amtu` program:

```
amtu
```

A successful run is indicated by the following output:

```
Executing Memory Test...
Memory Test SUCCESS!
Executing Memory Separation Test...
Memory Separation Test SUCCESS!
Executing Network I/O Tests...
Network I/O Controller Test SUCCESS!
Executing I/O Controller - Disk Test...
I/O Controller - Disk Test SUCCESS!
Executing Supervisor Mode Instructions Test...
Privileged Instruction Test SUCCESS!
```

The program will return a nonzero exit code on failure, which MAY be used to automatically detect failures of the tested systems and take appropriate action.

Please refer to the *amtu*(8) man page for more details.

4.14 The Self-Test Utility (LSPP mode only)

The self test utility *rbac-self-test*(1) lets the administrator verify some aspects of the security state of the system, and MAY configure this tool to automatically switch the system to single user mode in case a failure is detected. Administrators MAY run this tool manually or automatically as they choose.

The self test tool includes the following functionality:

- verify that critical security functions work correctly
- verify the integrity of critical system data files
- verify the integrity of critical system program files

Please refer to the documentation in the *rbac-self-test*(1) man page for more information.

4.15 Setting the system time and date

You MUST verify periodically that the system clock is sufficiently accurate, otherwise log and audit files will contain misleading information. When starting the system, the time and date are copied from the computer's hardware clock to the kernel's software clock, and written back to the hardware clock on system shutdown.

All internal dates and times used by the kernel, such as file modification stamps, use universal time (UTC), and do not depend on the current time zone settings. Userspace utilities usually adjust these values to the currently active time zone for display. Note that text log files will contain ASCII time and date representations in local time, often without explicitly specifying the time zone.

The *date*(1) command displays the current time and date, and can be used by administrators to set the software clock, using the argument *mmddHHMMyyyy* to specify the numeric month, day, hour, minute and year respectively. For example, the following command sets the clock to May 1st 2004, 1pm in the local time zone:

```
date 050113002004
```

The *hwclock*(8) can query and modify the hardware clock on supported platforms, but is not available in virtual environments such as z/VM or LPAR. The typical use is to copy the current value of the software clock to the hardware clock. Note that the hardware clock MAY be running in either local time or universal time, as indicated by the *UTC* setting in the */etc/sysconfig/clock* file. The following command sets the hardware clock to the current time using UTC:

```
hwclock -u -w
```

Use the command *tzselect*(8) to change the default time zone for the entire system. Note that users MAY individually configure a different time zone by setting the *TZ* environment variable appropriately in their shell profile, such as the *$HOME/.bashrc* file.

4.16 SELinux configuration

4.16.1 General SELinux configuration

In LSPP mode, SELinux MUST be enabled and in enforcing mode, and MUST use the "mls" policy. The */etc/selinux/config* file MUST have the following content:

```
SELINUX=enforcing
SELINUXTYPE=mls
```

In CAPP mode, the evaluated configuration keeps the SELinux system enabled in a static configuration, but does not depend on SELinux for any security features. You MAY modify the SELinux configuration, for example to add additional restrictions.

In CAPP mode, the */etc/selinux/config* file has the following content by default:

```
SELINUX=enforcing
SELINUXTYPE=targeted
```

In CAPP mode, you MAY disable SELinux by using one of the settings `SELINUX=disabled` or `SELINUX=permissive` instead, or configure a different policy, but any additional restrictions added by SELinux are beyond the scope of the CAPP configuration. (Note that reconfiguring the SELinux policy is likely to affect your support contract status. This is also beyond the scope of this document.)

4.16.2 LSPP mode specific policy module

The *lspp_policy* SELinux policy module adds permissions necessary for correct system operation in LSPP mode. You MAY customize some of the settings in the */usr/share/selinux/devel/lspp_policy.te* file as indicated in the file comments:

```
## Customized SELinux policy for LSPP evaluated configuration

policy_module(lspp_policy,1.0)

########################################################################
### Additional audit
########################################################################

gen_require(`
        attribute domain;
')

# Audit setting of security relevant process attributes
# These settings are OPTIONAL
auditallow domain self:process setcurrent;
auditallow domain self:process setexec;
auditallow domain self:process setfscreate;
auditallow domain self:process setsockcreate;
```

After any changes to this file, use the following steps to reload the module:

```
cd /usr/share/selinux/devel/

# as role "sysadm_r":
make lspp_policy.pp

# as role "secadm"r"
semodule -i lspp_policy.pp
```

4.16.3 Creating a custom role (LSPP mode only)

This example shows how to create a ”backup admin” role with the privilege to read all files on the system, but no special write privileges. This role could be used to perform system backups, but without the risk of overwriting or modifying any system files.

The role created in this example is an administrative role. The people assigned to this role are required to follow the same operational rules as all administrators, and are also assumed to be fully trusted not to undermine system security. The root password is needed to use the role, but the actions available to the backup admin are limited while using the role. For example, changing roles to ”sysadm_r” is denied when using an interactive ssh session. However, if the backup admin has direct console access, the root password would permit a login as ”root” directly with unlimited administrative actions.

As a first step, define a SELinux policy module defining the role and its privileges. Do the following steps as role ”sysadm_r”:

```
## role "sysadm_r"
```

```
# change to the local policy directory
cd /usr/share/selinux/devel

# create the new policy module source
cat <<-'_EOF'_ > backupadm.te
        policy_module(backupadm,1.0)

        gen_require(`
                role staff_r;
                type staff_t, staff_devpts_t, staff_tty_device_t;
        ')

        # Define the role and domain
        userdom_unpriv_user_template(backupadm)
        role backupadm_r types backupadm_t;

        # Allow members of staff_r to transition to this role
        userdom_role_change_template(staff, backupadm)

        # grant DAC read override capability
        allow backupadm_t self:capability dac_read_search;

        # grant MLS read override capability
        mls_file_read_up(backupadm_t)

        # grant RBAC file read override capability
        files_read_all_files(backupadm_t)
_EOF_

# build binary policy module
make backupadm.pp

# Assign the default domain for the role
echo "backupadm_r:backupadm_t" >>/etc/selinux/mls/contexts/default_type
```

If necessary, as ”sysadm_r”, create an administrative user account for the user who will be using this role:

```
## role "sysadm_r"
useradd -G wheel jdoe
passwd jdoe
```

As role ”secadm_r”, insert the new policy module into the active policy:

```
## role "secadm_r"
semodule -i backupadm.pp
```

Now create a new SELinux user class with the right to use the new role (but not any other administrative roles), and assign the user(s) to this user class to give them the right to use the role:

```
## role "secadm_r"
semanage user -a -R "staff_r backupadm_r" -P backupadm backup_u
semanage login -a -s backup_u -r SystemLow jdoe
```

To test the new role, log in as this user, "su" to root, and enter the new role:

```
ssh jdoe@localhost
        /bin/su -
        newrole -r backupadm_r
```

Verify that you can read all files, but not modify any system files:

```
## user "jdoe", role "backupadm_r"
cat /etc/shadow     # succeeds
touch /etc/shadow   # fails
```

To delete the new role, first ensure that no users are mapped to this role (the system will refuse to remove the module from the policy if the role is in use), and remove the module:

```
## role "secadm_r"
semanage login -d jdoe
semanage user -d backup_u
semodule -r backupadm
```

4.16.4 Defining hierarchical roles (LSPP mode only)

Hierarchical roles MAY be defined using the *dominates* operator.

This example defines a *root_r* role that combines the rights of *sysadm_r*, *secadm_r*, and *auditadm_r*:

```
# as role "sysadm_r"

cd /usr/share/selinux/devel

### set up the new policy module
cat <<'_EOF_' > root_role.te
        policy_module(root_role,1.0)

        gen_require(`
                role sysadm_r, secadm_r, auditadm_r;
        ')

        # Define the role and domain
        userdom_admin_user_template(rootuser)

        # Allow members of staff_r to transition to this role
        userdom_role_change_template(staff, rootuser)
```

```
        # define new role in terms of existing roles
        dominance { role rootuser_r {
             role sysadm_r;
             role secadm_r;
             role auditadm_r;
        } }
_EOF_
```

If necessary, as ”sysadm_r”, create an administrative user account for the user who will be using this role:

```
## role "sysadm_r"
useradd -G wheel jdoe
passwd jdoe
```

As role ”secadm_r”, insert the new policy module into the active policy:

```
## role "secadm_r"
semodule -i root_role.pp
```

Now create a new SELinux user class with the right to use the new role (but not any other administrative roles), and assign the user(s) to this user class to give them the right to use the role:

Now assign the new role to a user:

```
# as role "secadm_r"
semanage user -a -R "staff_r rootuser_r" -P staff rootuser_u
semanage login -a -s rootuser_u jdoe
```

The new administrative user may then switch freely among the subsidiary roles without having to list these roles separately in the login mapping:

```
# as user in "root_u" class:
newrole -r auditadm_r
```

Changes to the *root_r* role definition, such as adding new subsidiary roles, will automatically change the rights of all users in this class.

4.17 Labeled networking (LSPP mode only)

In LSPP mode, you MUST use one of the two available labeled networking mechanisms to ensure that the data flow restrictions are properly enforced when using networking related system call interfaces.

4.17.1 IPSec labeled networking

Setting up IPSec is described in the *racoon*(8), *racoon.conf*(5), and *setkey*(8) man pages.

The encryption and authentication properties of IPSec are beyond the scope of this guide and evaluation. It is concerned only with the use of IPSec to transport MLS labels.

Be aware that the labeled IPSec configuration may result in being unable to access the system using the network. It is RECOMMENDED to do this when logged in at the local system console.

You MUST define a pre-shared key for each system that will communicate using labeled IPSec, and distribute the */etc/racoon/psk.txt* file containing all keys to all the systems.

You MUST define a security policy database (SPD) definition for each set of communicating systems using the *setkey*(8) program, and specify the `-ctx` option to the *spdadd* entries to activate labeled networking.

Finally, you MUST restart the *racoon* daemon to activate the changes.

The following example describes how to set up labeled IPSec between two machines with IP addresses 172.16.2.55 and 172.16.2.66.

On both systems, create the file */etc/racoon/psk.txt* containing pre-shared secret keys, for example:

```
172.16.2.55 flibbertigibbet
172.16.2.66 flibbertigibbet
```

On each system, create a file containing the security policy database (SPD) definitions for use with the *setkey*(8) program.

On system 172.16.2.55, create a file with the following content and load it using the this file using the `setkey -f` *`FILE`* command:

```
spdadd 172.16.2.55 172.16.2.66 any
-ctx 1 1 "system_u:object_r:ipsec_spd_t:s0-s15:c0.c1023"
 -P out ipsec
esp/transport//require;

spdadd 172.16.2.66 172.16.2.55 any
-ctx 1 1 "system_u:object_r:ipsec_spd_t:s0-s15:c0.c1023"
 -P in ipsec
esp/transport//require;
```

On system 172.16.2.66, create a file with the following content and load it using the this file using the `setkey -f` *`FILE`* command:

```
spdadd 172.16.2.66 172.16.2.55 any
-ctx 1 1 "system_u:object_r:ipsec_spd_t:s0-s15:c0.c1023"
 -P out ipsec
esp/transport//require;

spdadd 172.16.2.55 172.16.2.66 any
-ctx 1 1 "system_u:object_r:ipsec_spd_t:s0-s15:c0.c1023"
 -P in ipsec
esp/transport//require;
```

Then (re-)start the *racoon* daemon:

```
killall racoon; sleep 1; racoon
```

To disable labeled networking and resume unlabeled networking operations, use the following command to unload the SPD configuration:

```
setkey -F -FP
```

4.17.2 CIPSO labeled networking

Use the following commands to activate CIPSO labeled networking:

```
netlabelctl cipsov4 add pass doi:1 tags:1
netlabelctl map del default
netlabelctl map add default protocol:cipsov4,1
netlabelctl unlbl accept off
```

Be aware that the `unlbl accept off` configuration may result in being unable to access the system using the network. It is RECOMMENDED to do this when logged in at the local system console.

You MAY define other DOI settings as defined in the *netlabelctl*(8) man page.

Use the following commands to disable CIPSO labeled networking:

```
netlabelctl unlbl accept on
netlabelctl map del default
netlabelctl map add default protocol:unlbl
```

4.17.3 xinetd configuration for labeled networking

When labeled networking is enabled (using either CIPSO or labeled IPSEC), you MUST disable *sshd* on the default port 22 by issuing the following command:

```
chkconfig sshd off
```

SSH sessions established by users will automatically run at the level corresponding to the label of the network data. By default, the label aware *sshd* instance runs on TCP port 222, you MAY change the port number by editing the */etc/xinetd.d/sshd-mls* file, for example by setting `port=22` to replace the disabled non-label-aware *sshd*. You MUST register the port number using the following command (using the appropriate port number instead of "222"):

```
semanage port -a -t ssh_port_t -p tcp 222
```

The *sshd* server will enforce that the requested level is within the permitted range for that user, but cannot control any information flow happening within the *ssh* client itself. You MUST activate labeled networking to help ensure proper labeling of information across the system boundary.

4.18 Firewall configuration

You MAY enable, reconfigure, or disable the builtin network firewall as required. The network firewall and its security properties are beyond the scope of this guide and were not part of the evaluation.

Useful commands include:

```
# Disable firewall
lokkit --disabled -q
chkconfig --level=3 iptables off
```

```
# Enable firewall
lokkit  --enabled \
        --port=22:tcp \
        --port=222:tcp \
        --port=80:tcp \
        --port=21:tcp \
        --port=25:tcp \
        --port=500:udp \
        --port=:esp \
        --port=:ah \
        -q

chkconfig --level=3 iptables on
```

Please refer to the *lokkit* help information (available by running `lokkit --help`) and the *iptables*(8) man page for more information.

5 Monitoring, Logging & Audit

5.1 Reviewing the system configuration

It is RECOMMENDED that you review the system's configuration at regular intervals to verify if it still agrees with the evaluated configuration. This primarily concerns those processes that run with root privileges.

The permissions of the device files */dev/** MUST NOT be modified.

In particular, review settings in the following files and directories to ensure that the contents and permissions have not been modified:

```
/etc/aide.conf
/etc/audit/audit.rules
/etc/audit/auditd.conf
/etc/cron.{ weekly hourly daily monthly}
/etc/cron.allow
/etc/cron.d/*
/etc/cron.deny
/etc/crontab
/etc/group
/etc/gshadow
/etc/hosts
/etc/inittab
/etc/ld.so.conf
/etc/localtime
/etc/login.defs
/etc/modprobe.conf
/etc/netlabel.rules
/etc/pam.d/*
/etc/passwd
/etc/racoon/racoon.conf
/etc/rc.d/init.d/*
/etc/rc.d/init.d/auditd
/etc/securetty
```

```
/etc/security/opasswd
/etc/security/rbac-self-test.conf
/etc/selinux/config
/etc/selinux/mls/contexts/
/etc/selinux/mls/modules/
/etc/selinux/mls/policy/
/etc/selinux/mls/setrans.conf
/etc/selinux/mls/seusers
/etc/selinux/semanage.conf
/etc/shadow
/etc/ssh/sshd_config
/etc/stunnel/stunnel.conf
/etc/stunnel/stunnel.pem
/etc/sysconfig/*
/etc/sysctl.conf
/etc/vsftpd/ftpusers
/etc/vsftpd/vsftpd.conf
/etc/xinetd.conf
/etc/xinetd.d/*
/var/lib/aide/aide.db.gz
/var/lib/aide/aide.db.new.gz
/var/log/lastlog
/var/log/tallylog
/var/spool/cron/root
```

Use the command `lastlog` to detect unusual patterns of logins.

Also verify the output of the following commands (run as root):

```
crontab -l
find / \( -perm -4000 -o -perm -2000 \) -ls
find / \( -type f -o -type d -o -type b \) -perm -0002 -ls

find /bin /boot /etc /lib /sbin /usr \
        ! -type l \( ! -uid 0 -o -perm +022 \)
```

5.2 System logging and accounting

System log messages are stored in the */var/log/* directory tree in plain text format, most are logged through the *syslogd*(8) and *klogd*(8) programs, which MAY be configured via the */etc/syslog.conf* file.

The *logrotate*(8) utility, launched from */etc/cron.daily/logrotate*, starts a fresh log file every week or when they reach a maximum size and automatically removes or archives old log files. You MAY change the configuration files */etc/logrotate.conf* and */etc/logrotate.d/** as required.

In addition to the *syslog* messages, various other log files and status files are generated in */var/log* by other programs:

```
File           Source
-------------+-------------------------------------------------------------
audit          Default audit log file
boot.msg       Messages from system startup
lastlog        Last successful log in  (see lastlog(8))
vsftpd.log     Transaction log of the VSFTP daemon
localmessages  Written by syslog
```

```
mail            Written by syslog, contains messages from the MTA (postfix)
messages        Written by syslog, contains messages from su and ssh
news/           syslog news entries (not used in the evaluated configuration)
secure          Security related messages (for example from PAM)
warn            Written by syslog
wtmp            Written by the PAM susbystem, see who(1)
```

Administrators MAY use process accounting as documented in the *acct*(2), *acct*(5), and *sa*(8) man pages, but this is beyond the scope of the CC evaluation. Administrators MUST NOT use the *acct*(2) system call to access any files not specifically intended as accounting log files.

Please see *syslog*(3), *syslog.conf*(5) and *syslogd*(8) man pages for details on syslog configuration.

The *ps*(1) command can be used to monitor the currently running processes. Using `ps faux` will show all currently running processes and threads.

5.3 Configuring the audit subsystem

The audit subsystem implements a central monitoring solution to keep track of security relevant events, such as changes and change attempts to security critical files.

This is accomplished through two separate mechanisms. All system calls are intercepted, and the kernel writes the parameters and return value to the audit log for those calls that are marked as security relevant in the filter configuration. In addition, some trusted programs contain audit-specific code to write audit trails of the actions they are requested to perform.

Please refer to the *auditd*(8), *auditd.conf*(8), and *auditctl*(8) man pages for more information.

5.3.1 Intended usage of the audit subsystem

CAPP and LSPP specify the auditing capabilities that a compliant system must support. The evaluated configuration described here is based on these requirements.

WARNING: Some of the protection profile requirements can conflict with your specific requirements for the system. For example, a LSPP-compliant system MUST disable logins if the audit subsystem is not working. Please ensure that you are aware of the consequences if you enable auditing.

CAPP and LSPP are designed for a multiuser system, with multiple unique users who maintain both shared and private resources. The auditing features are intended to support this mode of operation with a reliable trail of security-relevant operations. It is less useful for a pure application server with no interactive users.

Please be aware that the auditing subsystem will, when activated, cause some slowdown for applications on the server. The impact depends on what the application is doing and how the audit subsystem is configured. As a rule of thumb, applications that open a large number of separate files are most affected, and CPU-bound programs should not be measurably affected. You will need to balance the performance requirements against your security needs when deciding if and how you want to use auditing.

5.3.2 Selecting the events to be audited

You MAY make changes to the set of system calls and events that are to be audited. CAPP and LSPP require that the system has the *capability* to audit security relevant events, but it is up to you to choose how you want to use these capabilities. It is acceptable to turn off system call auditing completely even in an evaluated configuration, for example on a pure application server with no interactive users on the system.

The audit package provides several suggested audit configuration files, for example the */usr/share/doc/audit-*/capp.rules* file for CAPP systems, and the *lspp.rules* file (in the same location) for LSPP

systems. They contains a suggested setup for a typical multiuser system, all access to security relevant files is audited, along with other security relevant events such as system reconfiguration. You MAY copy one of the sample rules files to */etc/audit.rules* and modify the configuration according to your local requirements, including the option of using an empty audit rules file to disable auditing if not required.

When using CUPS in LSPP mode, you MUST configure an audit rule to monitor changes to the printer device MLS level, for example:

```
-w /dev/lp1 -k Printdevice
-a exit,possible -S setxattr
```

You MAY selectively disable and enable auditing for specific events or users as required by modifying the *audit.rules* file. For example, you can include and exclude specific users from auditing by adding filters based on the loginuid, such as the following entry:

```
-a exit,always -F auid!=trusteduser -S chown
```

The following examples filter by subject role and MLS level (LSPP mode only):

```
-a exit,always -F subj_role=staff_r -S unlink
-a exit,always -F subj_sen>=s2 -S open
```

The audit system also supports filtering on success or failure of system call operations:

```
-F success=1   # for successful syscalls
-F success!=1  # for unsuccessful syscalls
```

You MAY configure filesystem watches using the `-w` option. Note that filesystem watches are order sensitive if you create multiple watches for the same inode, for example if creating separate watches for multiple hard links to a single file. You can filter filesystem watches, for example to exclude a user ID from being audited:

```
-w /etc/shadow -k Secret
-a watch,never -F auid=trusteduser
-a exit,possible -S open
```

It is RECOMMENDED that you monitor use of the *semodule*(8) tool to keep track of administrative changes to optional security policy modules:

```
-w /usr/sbin/semodule
```

This will generate audit records similar to the following when that command is used:

```
type=EXECVE msg=audit(1160941525.448:6789):
            a0="semodule" a1="-i" a2="root_role.pp"
```

It is RECOMMENDED that you always reconfigure the audit system by modifying the */etc/audit.rules* file and then running the following command to reload the audit rules:

```
# as role "auditadm_r"
auditctl -R /etc/audit.rules
```

This procedure ensures that the state of the audit system always matches the content of the */etc/audit.rules* file. You SHOULD NOT manually add and remove audit rules and watches on the command line as those changes are not persistent.

Note that reloading audit rules involves initially deleting all audit rules, and for a short time the system will be operating with no or only a partial set of audit rules. It is RECOMMENDED to make changes to the audit rules when no users are logged in on the system, for example by using single user mode or a reboot to activate the changes.

Note that listing the current audit rules using the `auditctl -l` command can occasionally fail on SMP systems due to a known bug in version 1.0.3 of the audit utilities. This does not affect the operation of the audit system itself, the rules and watches are active even if not shown.

Please refer to the *auditctl*(8) man page for more details.

Setting SELinux contexts through library functions such as *setexeccon*(3), or equivalently by writing information to the */proc/self/attr/*{*current,exec,fscreate,sockcreate*} files, will generate audit records when enabled in the SELinux policy by *auditallow* rules. Please refer to section §4.16.2 "LSPP mode specific policy module" of this guide for more information about configuring this policy. Note that the audit records will always report success when the open/write operation to the pseudofile was successful, even if the context that was written there is invalid. In the case of an invalid context, the following operation (such as an *exec*(2) system call in the case of *setexeccon*) will fail, and will generate its own audit record if configured to do so for that operation.

5.3.3 Reading and searching the audit records

Use the *ausearch*(8) tool to retrieve information from the audit logs. The information available for retrieval depends on the active filter configuration. If you modify the filter configuration, it is RECOMMENDED keeping a datestamped copy of the applicable configuration with the log files for future reference.

For example:

```
# search for events with a specific login UID
ausearch -ul jdoe

# search for events by process ID
ausearch -p 4690
```

Please refer to the *ausearch*(8) man page for more details.

For some system calls on some platforms, the system call arguments in the audit record can be slightly different than you may expect from the program source code due to modifications to the arguments in the C library or in kernel wrapper functions. For example, the *mq_open*(3) glibc library function strips the leading '/' character from the path argument before passing it to the *mq_open*(2) system call, leading to a one character difference in the audit record data. Similarily, some system calls such as *semctl*(2), *getxattr*(2), and *mknodat*(2) can have additional internal flags automatically added to the flag argument. These minor modifications do not change the security relevant information in the audit record.

Of course, you can use other tools such as plain *grep*(1) or scripting languages such as *awk*(1), *python*(1) or *perl*(1) to further analyze the text audit log file or output generated by the low-level *ausearch* tool.

5.3.4 Starting and stopping the audit subsystem

If the audit daemon is terminated, no audit events are saved until it is restarted. To avoid lost audit records when you have modified the filter configuration, you MUST use the command `/etc/init.d/audit reload` to re-load the filters.

You MUST NOT use the *KILL* signal (-9) to stop the audit daemon, doing so would prevent it from cleanly shutting down.

It is RECOMMENDED that you add the kernel parameter `audit=1` to your boot loader configuration file to ensure that all processes, including those launched before the *auditd* service, are properly attached to the audit subsystem. Please refer to the documentation of your boot loader and section §3.13 "Configuring the boot loader" of this document for more details.

5.3.5 Storage of audit records

The default audit configuration stores audit records in the */var/log/audit/audit.log* file. This is configured in the */etc/audit/auditd.conf* file. You MAY change the *auditd.conf* file to suit your local requirements.

It is RECOMMENDED that you configure the audit daemon settings appropriately for your local requirements, for example by changing the log file retention policy to never delete old audit logs with the following setting in the */etc/audit/auditd.conf* file:

```
max_log_file_action = KEEP_LOGS
```

The most important settings concern handling situations where the audit system is at risk of losing audit information, such as due to lack of disk space or other error conditions. You MAY choose actions appropriate for your environment, such as switching to single user mode (action `single`) or shutting down the system (action `halt`) to prevent auditable actions when the audit records cannot be stored.

Warning: Switching to single user mode does not automatically kill all user processes when using the system default procedure. You MAY make the following change to the */etc/rc.d/init.d/single* script to help ensure user processes are terminated. Add the lines marked with a "+" sign at the start of the line to the file at the indicated location, but do not include the "+" sign itself. You do not need to include the comment.

```
--- /etc/rc.d/init.d/single.orig        2006-06-15 17:45:37.000000000 -0400
+++ /etc/rc.d/init.d/single     2006-06-15 18:25:03.000000000 -0400
@@ -40,6 +40,20 @@
         $i start
 done

+echo "Killing everything... "
+
+# Tell kernel to kill all processes except init and current process
+# (see kill(2) man page). The kernel locks the task list while
+# killing processes which prevents new processes being created
+# during the operation, and does not permit forking processes that
+# have a kill signal pending, so this should be reliable. Send
+# multiple signals for extra paranoia anyway.
+#
+# See also the "Robin Hood and Friar Tuck" hack description:
+#     http://catb.org/jargon/html/meaning-of-hack.html
+#
+kill -KILL -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
+
 # Now go to the single user level.
 echo $"Telling INIT to go to single user mode."
 exec init -t1 S
```

Halting the system is RECOMMENDED and most certain way to ensure all user processes are stopped. The following settings are RECOMMENDED in the */etc/auditd.conf* file if a fail-secure audit system is required:

```
admin_space_left_action = SINGLE
disk_full_action = HALT
disk_error_action = HALT
```

It is RECOMMENDED that you configure appropriate disk space thresholds and notification methods to receive an advance warning when the space for audit records is running low.

It is RECOMMENDED that you use a dedicated partition for the */var/log/audit/* directory to ensure that *auditd* has full control over the disk space usage with no other processes interfering.

Please refer to the *auditd.conf*(5) man page for more information about the storage and handling of audit records.

5.3.6 Reliability of audit data

You MAY choose an appropriate balance between availability of the system and secure failure mode in case of audit system malfunctions based on your local requirements.

You MAY configure the system to cease all processing immediately in case of critical errors in the audit system. When such an error is detected, the system will then immediately enter ”panic” mode and will need to be manually rebooted. To use this mode, add the following line to the */etc/audit/audit.rules* file:

```
-f 2
```

Please refer to the *auditctl*(8) man page for more information about the failure handling modes.

You MAY edit the */etc/libaudit.conf* file to configure the desired action for applications that cannot communicate with the audit system. Please refer to the *get_auditfail_action*(3) man page for more information.

auditd writes audit records using the normal Linux filesystem buffering, which means that information can be lost in a crash because it has not been written to the physical disk yet. Configuration options control how *auditd* handles disk writes and allow the administrator to choose an appropriate balance between performance and reliability.

Any applications that read the records while the system is running will always get the most current data out of the buffer cache, even if it has not yet been committed to disk, so the buffering settings do not affect normal operation.

The default setting is `flush = DATA`, ensuring that record data is written to disk, but metadata such as the last file time might be inconsistent.

The highest performance mode is `flush = none`, but be aware that this can cause loss of audit records in the event of a system crash.

If you want to ensure that auditd always forces a disk write for each record, you MAY set the `flush = SYNC` option in */etc/audit/auditd.conf*, but be aware that this will result in significantly reduced performance and high strain on the disk.

A compromise between crash reliability and performance is to ensure a disk sync after writing a specific number of records to provide an upper limit for the number of records lost in a crash. For this, use a combination of `flush = INCREMENTAL` and a numeric setting for the `freq` parameter, for example:

```
flush = INCREMENTAL
freq = 100
```

The audit record files are *not* protected against a malicious administrator, and are not intended for an environment where the administrators are not trustworthy.

5.4 System configuration variables in */etc/sysconfig*

The system uses various files in */etc/sysconfig* to configure the system. Most files in this directory tree contain variable definitions in the form of shell variables that are either read by the rc scripts at system boot time or are evaluated by other commands at runtime. Note that changes will not take effect until the affected service is restarted or the system is rebooted.

6 Security guidelines for users

6.1 System Documentation

The system provides a large amount of online documentation, usually in text format. Use the `man` program to read entries in the online manual, for example:

```
man ls
man man
```

to read information about the `ls` and `man` commands respectively. You can search for keywords in the online manual with the *apropos*(1) utility, for example:

```
apropos password
```

When this guide refers to manual pages, it uses the syntax ENTRY(SECTION), for example *ls*(1). Usually you do not need to provide the section number, but if there are several entries in different sections, you can use the optional `-S` switch and pick a specific one.

Some programs provide additional information GNU 'texinfo' format, use the `info` program to read it, for example:

```
info diff
```

Additional information, sorted by software package, can be found in the */usr/share/doc/*/* directories. Use the *less*(1) pager to read it, for example:

```
/usr/share/doc/bash*/FAQ
```

Many programs also support a `--help`, `-?` or `-h` switch you can use to get a usage summary of supported command-line parameters.

A collection of How-To documents in HTML format can be found under */usr/share/doc/howto/en/html* if the optional *howtoenh* package is installed.

Please see */usr/share/doc/howto/en/html/Security-HOWTO* for security information. The HTML files can be read with the *elinks* browser.

The RHEL server documentation is also available in electronic form in the directories */usr/share/doc/rhel**.

Note that this Configuration Guide has precedence over other documents in case of conflicting recommendations.

6.2 Authentication

You MUST authenticate (prove your identity) before being permitted to use the system. When the administrator created your user account, he or she will have assigned a user name and default password, and provided that information for you along with instructions how to access the system.

Logging in to the system will usually be done using the Secure Shell (SSH) protocol, alternatively a serial terminal can be used. Use the `ssh` command to connect to the system unless instructed otherwise by the administrator, for example:

```
ssh jdoe@172.16.0.1
```

In case the system administrator has assigned multiple roles for your use, you can select the desired role by appending it to the username separated with a slash, for example:

```
ssh jdoe/user_r@172.16.0.1
```

The *ssh*(1) manual page provides more information on available options. If you need to transfer files between systems, use the *scp*(1) or *sftp*(1) tools.

If this is the first time you are connecting to the target system, you will be prompted if you want to accept the host key. If the administrator has provided a key fingerprint for comparison, verify that they match, otherwise type `yes` to continue. You MUST immediately change your initially assigned password with the *passwd*(1) utility.

You MUST NOT under any circumstances attempt to log in from an insecure device, such as a public terminal or a computer belonging to a friend. Even if the *person* owning the computer is trustworthy, the *computer* might not be due to having been infected with malicious code. Always remember that the device you are typing your password into has the ability to save and re-use your authentication information, so you are in effect giving the computer you are using the right to do any and all actions in your name. Insecure handling of authentication information is the leading cause for exploits of otherwise secure systems, and SSH can only protect the information during transit, and offers no protection at all against an insecure end point.

When you log out from the system and leave the device you have used for access (such as a terminal or a workstation with terminal emulation), you MUST ensure that you have not left information on the screen or within an internal buffer that should not be accessible to another user. You should be aware that some terminals also store information not displayed on the terminal (such as passwords, or the contents of a scrollback buffer). Nevertheless this information can be extracted by the next user unless the terminal buffer has been cleared. Safe options include completely shutting down the client software used for access, powering down a hardware terminal, or clearing the scrollback buffer by switching among virtual terminals in addition to clearing the visible screen area.

If you ever forget your password, contact your administrator who will be able to assign a new password.

You MAY use the *chsh*(1) and *chfn*(1) programs to update your login shell and personal information if necessary. Not all settings can be changed this way, contact your administrator if you need to change settings that require additional privileges.

6.3 Password policy

All users, including the administrators, MUST ensure that their authentication passwords are strong (hard to guess) and handled with appropriate security precautions. The password policy described here is designed to satisfy the requirements of the evaluated configuration. If your organization already has a password policy defined, your administrator MAY refer you to that policy if it is equivalently strong.

You MUST change the initial password set by the administrator when you first log into the system. You MUST select your own password in accordance with the rules defined here. You MUST also change the password if the administrator

has set a new password, for example if you have forgotten your password and requested the administrator to reset the password.

Use the *passwd*(1) program to change passwords. It will first prompt you for your old password to confirm your identity, then for the new password. You need to enter the new password twice, to catch mistyped passwords.

The *passwd*(1) program will automatically perform some checks on your new password to help ensure that it is not easily guessable, but you MUST nevertheless follow the requirements in this chapter.

Note that the administrators MUST also ensure that their own passwords comply with this password policy, even in cases where the automatic checking is not being done, such as when first installing the system.

- Your password MUST be a minimum of 8 characters in length. More than 8 characters MAY be used (it is RECOMMENDED to use more than 8, best is to use passphrases), and all characters are significant.
- Combine characters from different character classes to construct a sufficiently strong password, using either 8 total characters containing at least one character from each class, or alternatively 12 total characters chosen from any three of the classes. The character classes are defined as follows:

```
Lowercase letters: abcdefghijklmnopqrstuvwxyz
Uppercase letters: ABCDEFGHIJKLMNOPQRSTUVWXYZ
Digits:            0123456789
Punctuation:       !"#$%&'()*+,-./:;<=>?[\]^_`{|}~
```

- You MUST NOT base the password on a dictionary word, your real name, login name, or other personal details (such as dates, names of relatives or pets), or names of real people or fictional characters.
- Instead of a password, you MAY use a passphrase consisting of multiple unrelated words (at least three) joined with random punctuation characters. Such a passphrase MUST have a length of at least 16 characters. (This corresponds to automatically generated pass phrases constructed by choosing 3 words from a 4096 word dictionary and adding two punctuation characters from a set of 8, equivalent to 42 bits of entropy.)
- You MUST NOT use a simple alphabetic string, palindrome or combinations of adjacent keyboard keys.
- When you choose a new password, it MUST NOT be a simple variation or permutation of a previously used one.
- You MUST NOT write the password on paper or store it on electronic devices in unprotected form. Storage in a secure location (such as an envelope in a safety deposit box, or encrypted storage on an electronic device) MAY be acceptable, contact your administrator first to ensure that the protection is strong enough to make password recovery infeasible for the types of attackers the system is intended to protect against.
- The password is for you and you only. A password is like a toothbrush - you do not want to share it with anybody, even your best friend. You MUST NOT disclose your password to anybody else, or permit anybody else to use the system using your identity.

  Note that administrators will never ask you for your password, since they do not need it even if they are required to modify settings affecting your user account.
- You MUST NOT use the same password for access to any systems under external administration, including Internet sites. You MAY however use the same password for accounts on multiple machines within one administrative unit, as long as they are all of an equivalent security level and under the control of the same administrators.
- You MUST inform the administrator and select a new password if you have reason to believe that your password was accidentally disclosed to a third party.
- If the system notifies you that your password will expire soon or has expired, choose a new one as instructed. Contact your administrator in case of difficulty.

A RECOMMENDED method of generating passwords that fits these criteria while still being easy to memorize is to base it on letters of words in a sentence (NOT a famous quotation), including capitalization and punctuation and one or two variations. Example:

```
"Ask not for whom the bell tolls."
=> An4wtbt.

"Password 'P'9tw;ciSd' too weak; contained in RHEL documentation"
=> P'9tw;ciRd
```

6.4 Access control for files and directories

Linux is a multiuser operating system, and it is essential that the system can enforce confidentiality and integrity of user data. For this purpose, the operating system implements access control policies that provide rules for reading and writing data.

Note that the administrators (root) are able to override these permissions and access all files on the system. Use of encryption is RECOMMENDED for additional protection of sensitive data.

6.4.1 Discretionary Access Control

You can control which other users will be able to read or modify your files by setting the Unix permission bits and user/group IDs, or (if more precise control is needed) by using POSIX-style access control lists (ACLs). This is referred to as discretionary access control (DAC).

The 'umask' setting controls the permissions of newly created files and directories and specifies the access bits that will be *removed* from new objects. Ensure that the setting is appropriate, and never grant write access to others by default. The umask MUST include at least the 002 bit (no write access for others), and the RECOMMENDED setting is 027 (read-only and execute access for the group, no access at all for others).

Do not set up world-writable areas in the filesystem - if you want to share files in a controlled manner with a fixed group of other users (such as a project group), please contact your administrator and request the creation of a user group for that purpose.

Programs can be configured to run with the access rights of the program file's owner and/or group instead of the rights of the calling user. This is the SUID/SGID mechanism, which utilities such as *passwd*(1) use to be able to access security-critical files. You could also create your own SUID/SGID programs via *chmod*(1), but DO NOT do that unless you fully understand the security implications - you would be giving away *your* access privileges to whoever launches the SUID program. Please refer to the "Secure Programming HOWTO" in the unlikely case that you need to create such a program, there you will find explanations of the many aspects that must be considered, such as the risk of unintended shell escapes, buffer overflows, resource exhaustion attacks and many other factors. Note that SUID root programs MUST NOT be added to the evaluated configuration, the only permitted use of the SUID bit is for setting non-root user IDs.

6.4.2 Multilevel mandatory access control (LSPP mode only)

The system can enforce additional restrictions on operations. When the system is in LSPP mode, it enforces mandatory access control (MAC) to ensure that all data and user processes are labeled and that information flow is possible only according to rules based on these labels. The rules are "mandatory" since you cannot voluntarily give read access to other users for data if that would violate the information flow rules.

Users can be cleared to operate at multiple different MLS levels, but each interactive session has a single effective level. A MLS level consists of a hierarchical component (for example "s0" or "s4") and zero or more categories separated

by commas. Contiguous categories can be abbreviated with the first and last category separated by a period (”.”). A sample MLS level specification is ”s2:c2,c5.c7,c9”, equivalent to ”s2:c2,c5,c6,c7,c9”.

You MAY use the following methods to select an MLS level and categories for your interactive session:

- At a login prompt (for example on a serial terminal), you will be prompted interactively for the desired role and MLS level.
- Run `newrole -l` to launch a new shell running at a different level from within the current session, for example:

  ```
  newrole -l s2:c1,c3.c5
  ```

  This functionality is restricted to secure terminal types listed in the */etc/selinux/mls/contexts/securetty_types* file, and is not supported for pseudoterminals as used in *ssh* sessions.
- When labeled networking is active, you MUST specify the correct port number for the label aware sshd instance when this number is different from 22, for example:

  ```
  ssh -p 222 user@rhel5.example.com
  ```

  When labeled networking is disabled, *ssh* supports selecting a role and level when logging in, using the *user/role/mlslevel@host* syntax, for example:

  ```
  ssh jdoe/staff_r/s2:c0,c1@rhel5.example.com
  ```

Administrators MAY use the *chcon -l*(1) command to change the MLS labels for objects, this is NOT permitted for regular users. Please contact an administrator if you believe that data objects are incorrectly labeled.

The *chcat*(1) program is NOT supported in the evaluated configuration and is disabled. It is intended for use with the Multi-Category System (MCS) security policy which is distinct from the MLS policy. The MCS policy is beyond the scope of this guide and evaluation.

6.4.3 Role-based access control (LSPP mode only)

In addition, in LSPP mode, the system supports role-based access control (RBAC) to further restrict access according to administrator-defined rules. Permissions are based on roles assigned to users, and you may have the option of choosing from several roles when logging in to the system, or by using the *newrole -r ROLE* command. You are only able to choose a role from the set of roles that the system administrator has assigned for your use, and you will use a default role when you do not select one explicitly. Please contact your system administrator for further information about which roles are available and what the corresponding access rights and restrictions are.

Roles are defined via types and access to types. A ”type” is a security attribute given to an object or a process. The type of a process is commonly called a ”domain”. Policy rules define how domains may interact with objects and with other domains.

Permissions to perform actions are delegated to specific roles. In addition the system supports types that can be associated with objects and domains that can be associated with processes. Roles are defined by the domains they have access to. A predefined policy file, which is part of the system configuration, defines the rules between domains and types.

You MAY use the *chcon -t* command to change the SELinux type of objects which can grant permission to specific roles to access the object. You are limited to selecting from a small number of allowed types for this purpose, the tool will reject attempts to change to restricted types. Your system administrator will explain the types available for this purpose. For example, in the default configuration, you MAY switch between the *user_home_t* and *user_home_ssh_t* types:

```
chcon -t user_home_t FILE
chcon -t user_home_ssh_t FILE
```

(This example is not useful since the default configuration does not define user roles with granular permissions. Additional types will be available when your system administrator has defined additional roles and the corresponding types.)

6.4.4 General access control

Access is permitted only if all policies (DAC, MAC, and RBAC) agree in permitting the access.

Always remember that **you** are responsible for the security of the data you create and use. Choose permissions that match the protection goals appropriate for the content, and that correspond to your organization's security policy. Access to confidential data MUST be on a need-to-know basis, do not make data world-readable unless the information is intended to be public.

Whenever you start a program or script, it will execute with your access rights. This implies that a malicious program would be able to read and modify all files that you have access to. Never execute any code that you have received from untrustworthy sources, and do not run commands that you do not understand. Be aware that manipulations to the environment a program is run in can also cause security flaws, such as leaking sensitive information. Do not use the shell variables LD_LIBRARY_PATH or LD_PRELOAD that modify the shared library configuration used by dynamically linked programs unless the specific settings are approved by the administrator or your organizational policies.

Please refer to the *chmod*(1), *umask*(2), *chown*(1), *chgrp*(1), *acl*(5), *getfacl*(1), and *setfacl*(1) manual pages for information, or any of the many available books covering Linux security (cf. Appendix 'Literature'), or ask your system administrator for advice.

6.5 Data import / export

The system comes with various tools to archive data (*tar*, *star*, *cpio*). If ACLs or file labels are used, then only *star* MUST be used to handle the files and directories as the other commands do not support ACLs. The options *-H=exustar -acl* must be used with *star*.

Please see the *star*(1) man page for more information.

7 Appendix

7.1 Online Documentation

If there are conflicting recommendations in this guide and in one of the sources listed here, the Configuration Guide has precedence concerning the evaluated configuration.

RHEL5 Installation Guide: *http://www.redhat.com/docs/manuals/enterprise/RHEL-5-manual/Installation_Guide-en-US/index.html*

RHEL5 Deployment Guide: *http://www.redhat.com/docs/manuals/enterprise/RHEL-5-manual/Deployment_Guide-en-US/index.html*

David A. Wheeler, "Secure Programming for Linux and Unix HOWTO", */usr/share/doc/howto/en/html_single/Secure-Programs-HOWTO.html*, *http://tldp.org/HOWTO/Secure-Programs-HOWTO/*

Kevin Fenzi, Dave Wreski, "Linux Security HOWTO", */usr/share/doc/howto/en/html_single/Security-HOWTO.html*, *http://www.linuxsecurity.com/docs/LDP/Security-HOWTO/*

7.2 Literature

Frank Mayer, Karl MacMillan, David Caplan, ”SELinux by Example: Using Security Enhanced Linux”, Prentice Hall 2006, ISBN 0131963694

Ellen Siever, Stephen Spainhour, Stephen Figgins, & Jessica P. Hekman, ”Linux in a Nutshell, 3rd Edition”, O’Reilly 2000, ISBN 0596000251

Simson Garfinkel, Gene Spafford, Alan Schwartz, ”Practical Unix & Internet Security, 3rd Edition”, O’Reilly 2003, ISBN 0596003234

Aeleen Frisch, ”Essential System Administration, 3rd Edition”, O’Reilly 2002, ISBN 0596003439

Daniel J. Barrett, Richard Silverman, ”SSH, The Secure Shell: The Definitive Guide”, O’Reilly 2001, ISBN 0596000111

David N. Blank-Edelman, ”Perl for System Administration”, O’Reilly 2000, ISBN 1565926099

Shelley Powers, Jerry Peek, Tim O’Reilly, Mike Loukides, ”Unix Power Tools, 3rd Edition”, O’Reilly 2002, ISBN 0596003307

W. Richard Stevens, ”Advanced Programming in the UNIX(R) Environment”, Addison-Wesley 1992, ISBN 0201563177

Linda Mui, ”When You Can’t Find Your UNIX System Administrator”, O’Reilly 1995, ISBN 1565921046