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

Klaus Weidner <klaus@atsec.com>

November 22, 2005; v1.14

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 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 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.

1.3.1 Hardware requirements

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

- IBM xSeries systems based on the Intel Xeon EM64T processor (WS and AS)
- IBM eServer BladeCenter systems based on the Intel Xeon EM64T processor (WS and AS)
- IBM zSeries z800, z900, z890, z990 executing in a z/VM 5.1 virtual machine (AS only)
- IBM iSeries systems based on the POWER5 processor with iSeries LPAR and the OS/400 service partition (AS only)
- IBM pSeries systems based on the POWER5 processor with pSeries LPAR (AS only)
- IBM eServer systems based on the AMD Opteron processor (AS only)

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.

1.3.2 Software requirements

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).

1.3.3 Environmental requirements

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.

1.3.4 Operational requirements

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.

1.4 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.

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.

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.

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).

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. 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.

1.5 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.

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.
- 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.

1.6 Overview of the system's security functions

This section summarizes the security functions that were covered by the evaluation. Please refer to the appropriate sections for information on configuring, using and managing these functions.

1.6.1 Identification and authentication

Pluggable Authentication Module (PAM)

Sections §3.15 "Introduction to Pluggable Authentication Module (PAM) configuration", §3.16 "Required Pluggable Authentication Module (PAM) configuration" of this guide; and the documentation in */usr/share/doc/pam*/* and the *pam*(8) man page.

OpenSSH

Section §3.10 "Setting up SSH" of this guide; and the *sshd*(8), *ssh*(1), *sshd_config*(5) man pages.

vsftpd

Section §3.12 "Setting up FTP" of this guide; and the *vsftpd*(8), *vsftpd.conf*(5) man pages.

su

Sections §3.8 "Update permissions for su", §4.3 "Gaining superuser access" of this guide; and the *su*(8) man page.

1.6.2 Audit

Sections §3.14 "Setting up the audit subsystem" and §5.3 "Configuring the audit subsystem" of this guide whose "SEE ALSO" section points to the remaining audit related man pages.

1.6.3 Discretionary access control

Sections §6.4 "Access control for files and directories" and §4.9 "SYSV shared memory and IPC objects" of this guide.

1.6.4 Object reuse

See the RHEL High Level Design document, the kernel automatically ensures that new objects (disk files, memory, IPC) do not contain any traces of previous contents.

1.6.5 Security management and system protection

Chapters §4 "System operation" and §5 "Monitoring, Logging & Audit".

1.6.6 Secure communication

Section §4.10 "Configuring secure network connections with *stunnel*" of this guide; and the *stunnel*(1) man page.

Section §3.10 "Setting up SSH" of this guide; and the *sshd*(8), *ssh*(1), and *sshd_config*(5) man pages.

1.7 Overview of security relevant events

The audit subsystem is intended to be the central interface for collecting and viewing the record of security relevant events. The events being monitored by default in the evaluated configuration include:

- All authentication done through the PAM library, including the identity and location (where available) of the user and the success or failure result.
- Use of *su*(8) to change identity. All actions done as part of a *su* session are marked in the audit record with the original user's login user ID.
- Adding, changing, or deleting users or groups.
- Changes and change attempts to the contents of security critical files.
- Changes to the access permissions or ownership of any files or IPC objects.
- Binding network ports and accepting connections.

Please refer to section §5 "Monitoring, Logging & Audit" for more information.

2 Installation

The evaluation covers a fresh installation of RHEL AS or WS, Version 4 Update 1, on one of the supported hardware platforms as defined in section §1.3.1 "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.
- Any printers supported by the operating system.
- Operator console consisting of a keyboard, video monitor, and optionally mouse. Additionally, you MAY directly attach supported serial terminals (see section §4.8 "Using serial terminals" of this guide), but *not* modems, ISDN cards, or other remote access terminals.

Hot-pluggable hardware that depends on the dynamic loading of kernel modules is *not* supported. Examples of such unsupported hardware are USB and, IEEE1394/FireWire peripherals other than USB mouse and keyboard.

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.

1. 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, zSeries hosts are usually installed using NFS, because they do not have a CD drive). If you do use a network, you MUST ensure that this network is secure, for example by directly connecting the new system to a standalone NFS server with no other network connections.

2. You MUST download the ISO images from the RedHat Network on a separate Internet-connected computer, and either burn CD-Rs from them, or make the contents available on a NFS file server. The download location *https://rhn.redhat.com/network/software/download_isos_full.pxt* contains links to the platform-specific images.

   You MUST use **Red Hat Enterprise Linux 4 Update 1**, either **AS** (Advanced Server) or **WS** (Workstation). Make sure that you are using the appropriate version for your platform:

   ```
   xSeries                     x86_64     AS or WS
   eServer BladeCenter HS-20   x86_64     AS or WS
   eServer 326                 x86_64     AS
   pSeries                     ppc        AS
   iSeries                     ppc        AS
   zSeries                     s390x      AS
   ```

   You MUST verify that the MD5 checksums of the image files are correct. Run `md5sum *.iso` to view the checksums for the downloaded images, and compare them with those shown in this list:

   ```
   Red Hat Enterprise Linux 4 AS (X86_64) Update 1
   b3b089ec5453b2d3ff90d7273e484326  RHEL4-U1-x86_64-AS-disc1.iso
   21a1e08de685fb9623cfcfbe21e1f5c0  RHEL4-U1-x86_64-AS-disc2.iso
   f2da39b120eec0de840a42cb6fa42adc  RHEL4-U1-x86_64-AS-disc3.iso
   079458380012f0ee9fd550b4b3f0a36b  RHEL4-U1-x86_64-AS-disc4.iso
   9e1a20af9c82989981848a4e3b186d76  RHEL4-U1-x86_64-AS-disc5.iso

   Red Hat Enterprise Linux 4 WS (X86_64) Update 1
   4ea2c8fbd598eeb3dd06edd69005cb41  RHEL4-U1-x86_64-WS-disc1.iso
   [ the following disks are disk 2-5 of the AS version ]
   21a1e08de685fb9623cfcfbe21e1f5c0  RHEL4-U1-x86_64-AS-disc2.iso
   f2da39b120eec0de840a42cb6fa42adc  RHEL4-U1-x86_64-AS-disc3.iso
   079458380012f0ee9fd550b4b3f0a36b  RHEL4-U1-x86_64-AS-disc4.iso
   9e1a20af9c82989981848a4e3b186d76  RHEL4-U1-x86_64-AS-disc5.iso

   Red Hat Enterprise Linux 4 AS (ppc) Update 1
   75ecb5779c04ec6e0adb8f37990e5099  RHEL4-U1-ppc-AS-disc1.iso
   0a58f621fa5d3469c3266755d7904bfe  RHEL4-U1-ppc-AS-disc2.iso
   dd12a6f6f021e750d904d39ea907fb01  RHEL4-U1-ppc-AS-disc3.iso
   5405277fc84593c0854a3b04ddfcd943  RHEL4-U1-ppc-AS-disc4.iso
   e7158230927bc46beb71e29e996e3ef4  RHEL4-U1-ppc-AS-disc5.iso

   Red Hat Enterprise Linux 4 AS (s390x) Update 1
   1ef18ca6f7cef5a886bc3feb00430f30  RHEL4-U1-s390x-AS-disc1.iso
   f81f9700d27817b6229f8f5525b28df2  RHEL4-U1-s390x-AS-disc2.iso
   1cb29afe43769ef17679633ae1a515a0  RHEL4-U1-s390x-AS-disc3.iso
   3b48595995395ae042737a680d4e726f  RHEL4-U1-s390x-AS-disc4.iso
   ```

3. Launch the installer program contained on the CD-ROM. The details of how to do this depend on the hardware platform, please refer to the installation guide that is part of the printed manual accompanying the CD.

   For example:

   - xSeries, eServer 326 (Opteron), pSeries: Insert the first CD and boot from CD-ROM.
   - zSeries, iSeries: Details depend on the operation mode (VM, LPAR or native). The process generally involves copying the installer onto the server and launching the installer using the host's management interface.

4. You MAY choose text-mode installation instead of the default graphical installation by entering `linux text` at the boot prompt.

   You MAY also use a serial console to do a text-mode installation. To do so, connect a serial terminal (or a computer with terminal emulator software; such a computer MUST be appropriately secure) to the server's serial port, and boot from the RHEL CD. When the boot prompt is shown on the serial console, enter `linux text console=ttyS0` (use the appropriate name of the serial device if not using ttyS0) and press `ENTER` to start the installation.

5. Running the CD **media test** for all installation CDs is RECOMMENDED.

6. **Welcome screen:** press **Next**.

7. **Language Selection:** choose **English (English)** to ensure that the messages shown during the installation match those described in this guide.

8. **Keyboard Configuration:** You MAY change the **U.S. English** setting to match your keyboard.

9. **Mouse Configuration:** (This screen is platform dependent and is skipped where not appropriate). You MAY change the **Mouse Selection** if the autodetected values are not appropriate, including choosing "No mouse" and using the keyboard only.

10. **Upgrade Examine:** This screen appears if you have a previously installed system on your machine. Choose **Install Red Hat Enterprise Linux**, upgrading is NOT supported for the evaluated configuration.

11. **Disk Partitioning Setup:** Use **Manual partition with Disk Druid** to set up the partitions. For CAPP-compliant auditing, it is RECOMMENDED to set up a separate partition for the directory */var/log/*.

    - You MAY use the Logical Volume Manager (LVM) or a Redundant Array of Independent disks (RAID) array to configure the disk space available.

      Set up the REQUIRED */* (root) and RECOMMENDED */var/log* and */var/log/audit/* partitions, and as many additional mounted partitions as appropriate. */var/log/audit/* 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. A separate partition dedicated to audit is strongly RECOMMENDED to ensure that disk space related actions work reliably. Please refer to section §5.3 "Configuring the audit subsystem" of this guide for more information.

      It is RECOMMENDED to also use separate partitions for */var*, */home* and */tmp*. Some configurations need a separate */boot* partition. This is usually recognized automatically by the installation program. For pSeries machines, you MUST create a partition of type 41 and at least 2MB in size for boot information, and you do not need a separate *boot* partition.

      The following table shows a RECOMMENDED partitioning scheme together with minimum sizes for the partitions. Using more space is RECOMMENDED:

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

- All mounted partions MUST be of type **ext3** and **formatted**.
- Configuring a swap partition at least as large as the installed RAM is RECOMMENDED.

12. Boot Loader Configuration: Setting a **boot loader password** is RECOMMENDED. You MUST NOT add other operating systems to the configuration.

13. **Network Configuration:** Configure all installed network cards (zero or more) as appropriate for the platform. In the case of virtual network cards on zSeries or iSeries, these options are not available. The following options MUST be used for non-virtual network cards:

    - Use the **Edit** button to either assign a static IP address by unchecking the **Configure using DHCP** box and entering the **IP Address** and **Netmask**; or alternatively disable the card by unchecking the **Activate on boot** box.
    - You MUST NOT use DHCP for any active network card.
    - Enter a valid **hostname** (which is RECOMMENDED to be unique within your network) consisting of one or more alphanumeric components, separated by '.', and each matching the regular expression `[a-zA-Z][-a-zA-Z0-9]*`
    - OPTIONAL: assign a **Gateway** address and **DNS** servers.
    - Modems and ISDN adapters MUST NOT be present.

14. **Firewall Configuration:** RECOMMENDED to select **No firewall** for the evaluated configuration, it is not needed on a hardened minimal installation and can cause conflicts with the use of *stunnel*(8) for secure connections. You MAY enable the firewall and choose a list of permitted ports.

    Security Enhanced Linux (SELinux): You MAY choose any one of the settings *Active*, *Warn*, or *Disabled*. Please refer to section §4.13 "SELinux configuration" for more information about the use of SELinux in the evaluated configuration. Note that the CAPP/EAL4+ evaluation did not test SELinux features and does not provide any assurance related to SELinux functionality.

15. **Additional Language Support:** RECOMMENDED to leave the **default language** set as **English (USA)** to ensure that system messages match those described in the documentation. (Note that users can individually override this setting.) You MAY add additional language support.

16. **Time Zone Selection:** RECOMMENDED to set the **Location** or **UTC Offset** as appropriate for the server's location, and RECOMMENDED to activate **System clock uses UTC**.

17. **Set Root Password:** Choose a **Root Password** according to the password policy (§6.3), and **Confirm** it.

18. **Package Installation Defaults:** Select **Customize the set of packages to be installed**. When using the graphical installer, put a check mark on the **Minimal** set of packages (last item, in the **Miscellaneous** group), this will deselect all the other package selections. If using the text-mode installer or if the installer does not offer **minimal** as a selection on your platform, you MUST manually deselect all package selection groups by removing all check marks in the **Package Group Selection** dialog. Note that the configuration script will remove any extra packages found on the system.

19. **About to Install:** This is the final confirmation to start the installation. Press **Next** to start the automated partitioning, formatting, and installation process. Confirm the informational dialog showing the list of CD-ROMs needed if it appears. Insert additional disks if prompted to do so.

20. When the automated install is complete and the **Congratulations** screen appears, pressing **Reboot Exit** will reboot the system. It is RECOMMENDED that you now reconfigure the system BIOS or firmware to boot from the newly installed system only (typically the first hard disk) and disable all other boot methods such as CD-ROM, network boot (PXE) or floppy disk. If you choose not to do that, you MUST remove the installation CD-ROM from the drive before rebooting.

21. Wait for the freshly installed system to start, and verify that the issue message printed above the login prompt matches the installed system type and version. Then log in as root and proceed with the next section.

3 Secure initial system configuration

After the initial installation, the operating system is not yet in the evaluated configuration. The instructions in this section explain how to achieve that configuration.

After software upgrades or installation of additional packages, these steps MUST be re-done or at least re-checked to ensure that the configuration remains secure.

Log in as user root on the system console for these steps.

3.1 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.

Here is an example of creating an additional user account:

```
useradd -m -c "John Doe" -G wheel jdoe
passwd jdoe
chage -m 1 -M 60 -W 7 jdoe
```

Please refer to sections §4.7 "Managing user accounts" and §6.3 "Password policy" of this guide for more information on creating user accounts.

3.2 Installing required updates

You need to download several additional packages not included in Update 1 to set up the evaluated configuration. The packages are available at the following location:

```
ftp://partners.redhat.com/EAL4_RHEL4/IBM/
```

Download the RPMs using an Internet-connected computer, and transfer the RPMs to the system being installed.

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

xSeries (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.

iSeries or pSeries (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 both iSeries and pSeries (the separate "ppc64iseries.rpm" kernel is for older hardware). 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.

zSeries (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.

The active kernel MUST be one of the listed *kernel* or *kernel-smp* packages. The installation procedure has chosen an appropriate kernel type for your machine and it is RECOMMENDED that you continue using the same type of kernel, but you MAY also run an SMP kernel on a uniprocessor machine or vice versa. It is RECOMMENDED that you uninstall unused kernel packages, such as the uniprocessor kernel on a SMP machine.

The development libraries (**-devel**) and additional non-default word size libraries as explained above are OPTIONAL. All other packages listed here are REQUIRED. You MUST verify the MD5 sums against the following list:

```
### xSeries and eServer 326

8edeaaf20178f2a422993e1bde6e2608  amtu-1.0.2-2.EL4.x86_64.rpm
73d53576dc8bfee307a8dbbad9ed6355  at-3.1.8-78_EL4.x86_64.rpm
72f15a4185a09051165702a7022bded0  audit-1.0.3-5.EL4.x86_64.rpm
d92c7c3474347c67349b59b16be7b0b8  audit-libs-1.0.3-5.EL4.x86_64.rpm
18eda03fc15b13ac4a0e49943efc1134  audit-libs-devel-1.0.3-5.EL4.x86_64.rpm
cf93016c70e25089caa0948d6e4846c2  coreutils-5.2.1-31.2.x86_64.rpm
9777c65d6950a7f0b1525a131174c390  dbus-0.22-12.EL.5.x86_64.rpm
3ec143b17887c9a6fa524c3ae27b5535  dbus-glib-0.22-12.EL.5.x86_64.rpm
6a6ef21d961d63525c3bc40b00a3990e  dbus-python-0.22-12.EL.5.x86_64.rpm
2a3f8ff55a3f273802f338dbcfb69276  glibc-2.3.4-2.9.audit.i386.rpm
6009820e7380da2cdacbb318766e436f  glibc-2.3.4-2.9.audit.x86_64.rpm
4c6c0c994198e4a57e9bc8efc8a595a5  glibc-common-2.3.4-2.9.audit.x86_64.rpm
0872a8d51bd53b3a865188b762f677cd  glibc-devel-2.3.4-2.9.audit.i386.rpm
13204d79b1672e91e51dc9c55c1c1270  glibc-devel-2.3.4-2.9.audit.x86_64.rpm
4850691e21318695f2edff5956d522cf  glibc-headers-2.3.4-2.9.audit.x86_64.rpm
1b45293457836378b9f721761d897487  glibc-kernheaders-2.4-9.1.96.EL.x86_64.rpm
db342f01b120f905615e9485298835d3  kernel-2.6.9-11.EL.audit.90.x86_64.rpm
3939d08772183a2573a8dd5dbbced213  kernel-smp-2.6.9-11.EL.audit.90.x86_64.rpm
e285ebfa87ab0cd8b595df5d0d2d1186  nscd-2.3.4-2.9.audit.x86_64.rpm
5650c6a385cbe91ab27347cbf1a824f5  openssh-3.9p1-8.RHEL4.7.x86_64.rpm
8f081cd02b84ca529ce9cfd83c9fd764  openssh-clients-3.9p1-8.RHEL4.7.x86_64.rpm
a9aa344649992af7d13675a2d0136486  openssh-server-3.9p1-8.RHEL4.7.x86_64.rpm
7a876126f0ea9907f621c921e00a2f09  openssl-0.9.7a-43.3.x86_64.rpm
094567c211fa20a4838bee3371bf46c6  openssl-devel-0.9.7a-43.3.x86_64.rpm
4c6fb66a512f83582a33e5265c4190a4  pam-0.77-66.10.x86_64.rpm
b7b2e1d107db0617b018e6372c9d38bc  pam-devel-0.77-66.10.x86_64.rpm
4d9469ae308d1d5451112fc60e0c0be3  passwd-0.68-10.1.x86_64.rpm
c84561a91c933097fcf379c2072c3ea0  shadow-utils-4.0.3-50.RHEL4.x86_64.rpm
31e859f7c5d99e50824d4f8a3247b396  util-linux-2.12a-16.EL4.10.x86_64.rpm
deaae58b3ea70035554eeee549c5602f  vixie-cron-4.1-EL4.34.x86_64.rpm
83412212bda39d4201ff3a3d37f200d6  vsftpd-2.0.1-5.EL4.3.x86_64.rpm

### iSeries and pSeries
4989990c1360c98dbc053378b4f602d9  amtu-1.0.2-2.EL4.ppc.rpm
2e162dc42e71cbc07ff4fd70984b66b7  at-3.1.8-78_EL4.ppc.rpm
634d1afcf74ce6927bfaaaa77fcdc32a  audit-1.0.3-5.EL4.ppc.rpm
f464cdfa3309882b94ec8d1f8d9e76d3  audit-libs-1.0.3-5.EL4.ppc.rpm
```

```
582747b803136b442ef2e3f9e521db9f  audit-libs-devel-1.0.3-5.EL4.ppc.rpm
59e3727c9a383cb0e93ce12ddaf7dda7  coreutils-5.2.1-31.2.ppc.rpm
be81f84cf01b4c825b1d4d3e4a237792  dbus-0.22-12.EL.5.ppc.rpm
debec0e8386dc9ca77898dd6d722d059  dbus-glib-0.22-12.EL.5.ppc.rpm
50595447992aaa325ac42eba2e04a671  dbus-python-0.22-12.EL.5.ppc.rpm
9597d21b612eb890905b0af603e3807b  glibc-2.3.4-2.9.audit.ppc.rpm
a871b4b1ca87396d9429fd071707b559  glibc-2.3.4-2.9.audit.ppc64.rpm
d0a01d8fca7d00c6751222126b1975d6  glibc-common-2.3.4-2.9.audit.ppc.rpm
63d7f34f1a3040a62d4471f986bdd601  glibc-devel-2.3.4-2.9.audit.ppc.rpm
868c8e7cba090357a3cd2c3a68653ce5  glibc-devel-2.3.4-2.9.audit.ppc64.rpm
def883c46530e55156306c403259b49f  glibc-headers-2.3.4-2.9.audit.ppc.rpm
4555f0ff82e468a3f00a68e67de87f61  glibc-kernheaders-2.4-9.1.96.EL.ppc.rpm
99a0067a56f7f7302f2758e463c71b7b  kernel-2.6.9-11.EL.audit.90.ppc64.rpm
9197df1350b8cec6c31a41782edb081d  nscd-2.3.4-2.9.audit.ppc.rpm
cf720d4d25c3dcbf6b392fd735530870  openssh-3.9p1-8.RHEL4.7.ppc.rpm
cdb238f6740f91181f3d9ead5128affc  openssh-clients-3.9p1-8.RHEL4.7.ppc.rpm
f51f0a56ac77c77f216be6e78af4d396  openssh-server-3.9p1-8.RHEL4.7.ppc.rpm
78d8b26178399ecad054434a51e09d9c  openssl-0.9.7a-43.3.ppc.rpm
70451b7359ac13da86d818c585cc03f3  openssl-devel-0.9.7a-43.3.ppc.rpm
8bf8e360c8f01e86ce2dd33ed897c8e7  pam-0.77-66.10.ppc.rpm
0a36f5e916e53eaea84321e8f40e38f8  pam-devel-0.77-66.10.ppc.rpm
b52c622b5756b5c824cb40241143a704  passwd-0.68-10.1.ppc.rpm
9ba29a000e3a29a5e3f7913f87cad3ef  shadow-utils-4.0.3-50.RHEL4.ppc.rpm
943d85de3fb88b69931a6ccfd3c2569b  util-linux-2.12a-16.EL4.10.ppc.rpm
867936b2a2b75dd4401f8713258fef7f  vixie-cron-4.1-EL4.34.ppc.rpm
e3480e6f6402212dd363a3c6267d3816  vsftpd-2.0.1-5.EL4.3.ppc.rpm

### zSeries
0970af6af4775c6475d621fbae4aa1e7  amtu-1.0.2-2.EL4.s390x.rpm
3aa0eefaea2d6ad02d14f99f11f223d2  at-3.1.8-78_EL4.s390x.rpm
094fc8ecbcd90a5c4a41d35f3ef1db6f  audit-1.0.3-5.EL4.s390x.rpm
36f9efb53bf921b594c5d570304b6ed9  audit-libs-1.0.3-5.EL4.s390x.rpm
659cebb2b5e6f62a686604807a1f7632  audit-libs-devel-1.0.3-5.EL4.s390x.rpm
871b29a4319a9260c387a108421ef2b5  coreutils-5.2.1-31.2.s390x.rpm
0d3200cdd21a54a8bc05f1c995dd2b08  dbus-0.22-12.EL.5.s390x.rpm
30359f07afcbf198bfc708fb8aba7735  dbus-glib-0.22-12.EL.5.s390x.rpm
bac3d9daa675d065468aa02a3b1561f8  dbus-python-0.22-12.EL.5.s390x.rpm
92b6da6b22a9a5461cce3a6e04fb260d  glibc-2.3.4-2.9.audit.s390.rpm
e2c157dd2d71948fa2df990548ce04c8  glibc-2.3.4-2.9.audit.s390x.rpm
df6f08a5f5ee7af1e362012b81289a33  glibc-common-2.3.4-2.9.audit.s390x.rpm
863c0947fec77025b095f06f4c5dba23  glibc-devel-2.3.4-2.9.audit.s390.rpm
de2c06aa29314b6359c6969b94af4f8f  glibc-devel-2.3.4-2.9.audit.s390x.rpm
1e26008002bc0b04160fc5990f7d6b2d  glibc-headers-2.3.4-2.9.audit.s390x.rpm
f5e2e3c4dde7d7334ada10cdb1c50507  glibc-kernheaders-2.4-9.1.96.EL.s390x.rpm
b1eb68f1e3098458670df95b3cb4a348  kernel-2.6.9-11.EL.audit.90.s390x.rpm
e0fdd02d5f746c540336543c288a2df5  nscd-2.3.4-2.9.audit.s390x.rpm
91aba7cbe8f4bee5bfba4188361024ec  openssh-3.9p1-8.RHEL4.7.s390x.rpm
951c418802016583854a30506205c46f  openssh-clients-3.9p1-8.RHEL4.7.s390x.rpm
c48edf0f98754fa3196091e227a1bc4f  openssh-server-3.9p1-8.RHEL4.7.s390x.rpm
c682178d4293a52e59dd6a00bd347638  openssl-0.9.7a-43.3.s390x.rpm
6295526064510e693e1ae72809e59ec1  openssl-devel-0.9.7a-43.3.s390x.rpm
b6115e0a26e9b4f86579cf7ffe1fcacd  pam-0.77-66.10.s390x.rpm
894f80b6b61e787c04c62396af29bdd2  pam-devel-0.77-66.10.s390x.rpm
8771df335079b3002e72b734fce0a3e9  passwd-0.68-10.1.s390x.rpm
```

```
f67876973135ac3076680f28d7f0991a  shadow-utils-4.0.3-50.RHEL4.s390x.rpm
3c173a25ec8bf87a368b2022b8aa4031  util-linux-2.12a-16.EL4.10.s390x.rpm
6e9ef2e6765007cc5056129c1fe27e37  vixie-cron-4.1-EL4.34.s390x.rpm
e4a492b85e24132c38f02f86c5ca29fa  vsftpd-2.0.1-5.EL4.3.s390x.rpm
```

Copy these RPM files into the directory */root/rpms/* of the system being installed.

When using the automated configuration, the installer will then handle the upgrade automatically. You MUST download the current version of the *capp-eal4-config-ibm* RPM package to use the automated configuration as described in the next section.

If installing manually, refer to section §3.5 "Add and remove packages" in this document for instructions on installing these packages.

3.3 Automated configuration of the system

It is strongly RECOMMENDED to install and use the *capp-eal4-config-ibm* package to achieve the evaluated configuration. This RPM package contains EAL4 specific configuration files, and the script */usr/sbin/capp-eal4-config* that sets up the evaluated configuration.

It is RECOMMENDED that you use the *capp-eal4-config* script to reset the configuration to its initial state after any updates, but you MAY also perform the steps listed here manually.

Install the certification RPM with the following command:

```
rpm -Uvh capp-eal4-config-ibm.rpm
```

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

```
capp-eal4-config -h
```

It is RECOMMENDED that you uninstall all unused kernel packages, such as the uniprocessor kernel on a SMP machine, before running the script. The script will upgrade the installed kernel package(s) to the required version, and if you have multiple packages, the wrong one might be activated due to the upgrade order. You MAY also manually upgrade the kernel package (and test it) before running the script.

You will need to specify a directory containing the required update packages (this is */root/rpms/* by default), and also a directory or media containing the RHEL4 Update1 RPM packages. Specify these with the `--rpm-path` parameter, with the update packages listed first. For example:

```
capp-eal4-config --rpm-path '/root/rpms /mnt/cd*'
```

If the RHEL4 Update1 RPM packages are stored on an NFS file server instead of on CD-R media, specify the path to the RPMS directory as in the following example, using the appropriate path to the mounted directory instead of /mnt/SERVER/U1/:

```
capp-eal4-config \
   --rpm-path '/root/rpms /mnt/SERVER/U1/RedHat/RPMS/'
```

You MAY also add the `--add-optional` flag to automatically install optional packages (useful for testing).

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 it is RECOMMENDED that you 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 configuration script does NOT create default audit rules since these depend strongly on local requirements. Please refer to section §3.14.2 ”Setting up the audit configuration files” of this document for more information.

WARNING: The `capp-eal4-config` script will reboot the system as the final step in the process, as described in the manual instructions in section §3.19 ”Reboot and initial network connection” of this guide. On zSeries, it will run the *zipl* boot configuration tool (with no arguments) before rebooting.

If the script has completed successfully, the remaining steps in this chapter were done automatically; you MAY skip ahead to section §4 ”System operation” of this guide.

3.4 Configuring filesystem parameters

You MUST add the mount option `acl` in the file */etc/fstab* for all ext3 file systems. You MAY also add the option `user_xattr`. Multiple options are separated with commas (not ”comma space”), for example `acl,user_xattr`.

Edit */etc/fstab* and replace the `defaults` option specification (fourth column) with `acl` for all file systems with type `ext3` (third column). Then, run `mount` *`MOUNTPOINT`* `-o remount` for each of the mount points (second column).

For more information, please refer to section §4.6 ”Mounting filesystems” of this guide.

CD/DVD devices MUST be accessed using the iso9660 filesystem type. You MUST NOT use an automounter in the evaluated configuration. See also section §4.6 ”Mounting filesystems” of this guide, specifically that writable removable media MUST NOT be used in the evaluated configuration.

3.4.1 Disable usbfs

The *usbfs* file system is not permitted in the evaluated configuration and MUST be disabled. Note that the only permitted USB devices are keyboards and mice connected at boot, and these also work without *usbfs* for the supported hardware. Please refer to sections §2.1 ”Supported hardware” and §4.6 ”Mounting filesystems” of this guide for more information.

usbfs is activated in the */etc/rc.d/rc.sysinit* file, use the following command to verify the current content:

```
grep 'mount.*usb' /etc/rc.d/rc.sysinit
```

Here is the output of the `grep` command before modification:

```
[ -d /proc/bus/usb ] && mount -n -t usbfs /proc/bus/usb /proc/bus/usb
[ -f /proc/bus/usb/devices ] && mount -f -t usbfs usbfs /proc/bus/usb
```

Either use a text editor to edit the files manually (putting a # hash mark comment character at the start of each of the two lines containing the usbfs mount command), or use the following automated method:

```
perl -pi.bak -e 's/^/#/ if /mount.*usb/' /etc/rc.d/rc.sysinit
```

After the modification, the file content MUST be as follows; verify by re-running the `grep` command:

```
#[ -d /proc/bus/usb ] && mount -n -t usbfs /proc/bus/usb /proc/bus/usb
#[ -f /proc/bus/usb/devices ] && mount -f -t usbfs usbfs /proc/bus/usb
```

You MUST NOT manually mount the *usbfs* file system.

3.5 Add and remove packages

The minimal system that was initially installed does not contain all packages required for the evaluated configuration, and some of the initially installed packages need to be removed.

In the following lists, the suffix `/cross` indicates a package using the non-default word size. For example, the default ”glibc” package on Opteron is named *glibc-*.x86_64.rpm*, while ”glibc/cross” refers to *glibc-*.i686.rpm*. The following table shows the mappings:

```
# Architecture        default        /cross
xSeries, eServer 326  x86_64         i386, i486, i586, or i686
iSeries, pSeries      ppc            ppc64
zSeries               s390x          s390
```

Please refer to section §3.2 ”Installing required updates” of this document for more information about package selection, specifically choosing a kernel.

The evaluated configuration consists of exactly the following packages:

```
One or more of the following kernel packages:

    kernel
    kernel-smp
    kernel/cross

Packages installed on all architectures:

    MAKEDEV                         man-pages
    SysVinit                        mdadm
    acl                             mingetty
    amtu                            mkinitrd
    ash                             mktemp
    aspell                          module-init-tools
    aspell-en                       mt-st
    at                              mtools
    atk                             mtr
    attr                            nano
    audit                           nc
    audit-libs                      ncurses
    authconfig                      net-tools
    autofs                          netconfig
    basesystem                      netdump
    bash                            newt
    bc                              nfs-utils
    beecrypt                        nscd
    bind-libs                       nss_ldap
    bind-utils                      ntsysv
    binutils                        openldap
    bzip2                           openssh
    bzip2-libs                      openssh-clients
    chkconfig                       openssh-server
    compat-openldap                 openssl
    comps                           pam
```

```
coreutils
cpio
cpp
cracklib
cracklib-dicts
crontabs
cups
cups-libs
cvs
cyrus-sasl
cyrus-sasl-gssapi
cyrus-sasl-md5
cyrus-sasl-plain
db4
dbus
dbus-glib
dbus-python
device-mapper
dhclient
dialog
diffutils
dos2unix
dosfstools
dump
e2fsprogs
ed
elfutils
elfutils-libelf
elinks
ethtool
expat
file
filesystem
findutils
finger
fontconfig
freetype
ftp
gawk
gdbm
gettext
glib
glib2
glibc
glibc-common
glibc-headers
glibc-kernheaders
gmp
gnupg
gpm
grep
groff
gtk2
gzip
pam_passwdqc
pam_smb
pango
parted
passwd
patch
pax
pciutils
pcre
perl
perl-DateManip
perl-Filter
perl-HTML-Parser
perl-HTML-Tagset
perl-URI
perl-libwww-perl
pinfo
policycoreutils
popt
portmap
postfix
prelink
procmail
procps
psacct
psmisc
pyOpenSSL
python
quota
rdate
rdist
readline
redhat-logos
redhat-menus
redhat-release
rhnlib
rhpl
rmt
rootfiles
rpm
rpm-python
rpmdb-redhat
rsh
rsync
schedutils
sed
selinux-policy-targeted
setarch
setup
setuptool
shadow-utils
sharutils
slang
slocate
```

```
    hesiod                          specspo
    hotplug                         star
    htmlview                        stunnel
    hwdata                          symlinks
    info                            sysklogd
    initscripts                     system-config-network-tui
    iproute                         system-config-securitylevel-tui
    iputils                         talk
    jwhois                          tar
    kernel-utils                    tcl
    krb5-libs                       tcp_wrappers
    krb5-workstation                tcpdump
    kudzu                           tcsh
    less                            telnet
    lftp                            termcap
    lha                             tftp
    libacl                          time
    libattr                         tk
    libcap                          tmpwatch
    libgcc                          traceroute
    libjpeg                         tzdata
    libpcap                         unix2dos
    libpng                          unzip
    libselinux                      up2date
    libstdc++                       usermode
    libtermcap                      utempter
    libtiff                         util-linux
    libtool-libs                    vconfig
    libuser                         vim-common
    libwvstreams                    vim-minimal
    libxml2                         vixie-cron
    libxml2-python                  wget
    lockdev                         which
    logrotate                       words
    logwatch                        xinetd
    lsof                            xorg-x11-Mesa-libGL
    lvm2                            xorg-x11-libs
    m4                              yp-tools
    mailcap                         ypbind
    mailx                           zip
    make                            zlib
    man

additional package on AS (not available on WS):

    vsftpd

additional package when using automated configuration

    capp-eal4-config-ibm

additional packages on x86_64 (xSeries and eServer 326)
```

```
        dmraid/cross
        device-mapper/cross
        eject
        fbset
        grub
        hdparm
        iptables
        kbd
        minicom
        ncurses/cross
        pyxf86config
        setserial
        synaptics
        syslinux
        system-config-mouse
        usbutils
        wireless-tools

    additional packages on ppc (pSeries) and ppc (iSeries):

        crash/cross
        diskdumputils/cross
        e2fsprogs/cross
        eject
        fbset
        hdparm
        hfsutils
        iptables/cross
        kbd
        kernel/cross
        minicom
        ncurses/cross
        ppc64-utils
        pyxf86config
        setserial
        system-config-mouse
        usbutils
        wireless-tools
        yaboot

    additional packages on s390x (zSeries):

        iptables
        s390utils
        libstdc++-devel/cross
```

In addition to these packages, certain additional software from the RHEL CDs MAY be installed without invalidating the evaluated configuration. The rules described in section §4.4 ”Installation of additional software” of this guide MUST be followed to ensure that the security requirements are not violated.

The following packages are examples of tolerated packages that MAY be added to the system according to these rules. Note that the software contained in these packages is not intended to be used with root privileges, but the presence of the packages does not invalidate the evaluated configuration. The `capp-eal4-config` script does not remove these packages if they are installed on the system, and MAY be used to install them automatically by specifying the `--add-optional` parameter to the command line. The example OPTIONAL packages are:

```
atk-devel
audit-libs-devel
autoconf
automake
bison
cracklib-dicts/cross
cracklib/cross
desktop-file-utils
e2fsprogs-devel
expat/cross
expect
expect-devel
flex
fontconfig-devel
fontconfig/cross
freetype-devel
freetype/cross
gcc
gcc-c++
glib/cross
glib2-devel
glib2/cross
glibc-devel
glibc-devel/cross
glibc/cross
gtk2-devel
hal
kernel
kernel-smp
krb5-devel
libacl/cross
libattr-devel
libattr/cross
libgcc/cross
libjpeg-devel
libmng
libmng-devel
libpng-devel
libselinux-devel
libselinux/cross
libsepol
libstdc++-devel
libstdc++/cross
libtermcap-devel
libtermcap/cross
libtool
libuser-devel
ncurses-devel
ncurses-devel/cross
netpbm
netpbm-progs
openldap-clients
openssl-devel
pam-devel
pango-devel
perl-Digest-HMAC
perl-Digest-SHA1
pkgconfig
psutils
qt
qt-devel
readline-devel
redhat-rpm-config
rpm-build
rpm-libs
strace
tetex
tetex-dvips
tetex-fonts
tetex-latex
texinfo
udev
xorg-x11-Mesa-libGL/cross
xorg-x11-devel
xorg-x11-libs/cross
zlib-devel
zlib-devel/cross
zlib/cross
```

The next steps involve installing selected packages from the distribution CD-ROMs. Due to dependency issues, the RECOMMENDED method is to first copy all needed RPMs to a temporary directory, and then installing them all in one step using `rpm -Uvh *.rpm`.

The *capp-eal4-config* script handles the package selection and installation automatically, and will prompt for the installation media as necessary. After installation, the package selection is again verified, and the script will indicate which packages are still missing or the wrong version. In this case, verify that the needed RPM packages are available in the locations specified, and that they are the correct versions and for the correct architecture.

If you are performing this step manually, first create a temporary directory to store the RPM files:

```
mkdir /root/rpms
```

Copy all the missing package files to that directory. This step is very time consuming when done manually, the RECOMMENDED method is to use the *capp-eal4-config* script to do this automatically. The following shows an example of the manual method, this needs to be repeated until all missing packages are copied:

```
# Get list of currently installed packages
rpm -qa | sort | less

# Search for one of the missing packages
find /mnt/cd* -name 'vsftpd*'

# Copy missing packages from the installation media
cp /mnt/cdrom/RedHat/RPMS/vsftpd-*.i386.rpm /root/rpms/

# Repeat these steps for the other missing packages
[...]
```

Note that due to dependency issues, you MUST install the *postfix* package before removing the *sendmail* package. For example, use the following command sequence:

```
rpm -Uvh /root/rpms/postfix*.rpm
rpm -e sendmail
rm /root/rpms/postfix*.rpm
```

You MUST uninstall all packages that are not listed as permitted in the evaluated configuation. Use the *rpm*(8) command to remove packages, repeating it for all packages not listed as required or tolerated:

```
rpm -e PACKAGENAME ...
```

Once the extraneous packages are removed and the new packages are all copied, install them all in one step with the following single command:

```
# Install all packages
rpm -Uvh /root/rpms/*.rpm
```

Error messages indicate that the installation is invalid and needs to be redone.

Now you can remove the temporary directory with the following command:

```
rm -rf /root/rpms
```

3.6 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:

```
atd             # the 'at' daemon
auditd          # the audit daemon
crond           # vixie-cron
irqbalance      # configures SMP IRQ balancing
                # (not available on zSeries/s390x)
kudzu           # new device discovery
network         # network interface configuration
syslog          # system logging
```

The following services are OPTIONAL for runlevel 3:

```
cups            # print subsystem
gpm             # console mouse management
mdmonitor       # software raid monitoring
postfix         # SMTP MTA
rawdevices      # Raw partition management (eg. for Oracle)
sshd            # Secure Shell
vsftpd          # FTP server
xinetd          # Internet Services
```

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.

3.7 Remove SUID/SGID root settings from binaries

Use of the SUID bit on binaries (to run with root privileges, a.k.a. ”setuid bit”) MUST be limited to those shown in the following list:

```
/bin/ping
/bin/su
/usr/bin/at
/usr/bin/chage
/usr/bin/chfn
/usr/bin/chsh
/usr/bin/crontab
/usr/bin/gpasswd
/usr/bin/newgrp
/usr/bin/passwd
```

The other binaries that were installed with the SUID bit set MUST have this bit removed. Administrators can still run these binaries normally, but they are not available for ordinary users.

There are also a number of SGID files on the system that are needed:

```
/usr/sbin/postdrop    # group "maildrop"
/usr/sbin/postqueue   # group "maildrop"
/usr/sbin/utempter    # group "tty"
```

Similarly, the SGID bit MUST NOT be used to give group root privileges to any binary.

Generate a list of all SUID/SGID programs on the system by running the following command:

```
find / -not -fstype ext3 -prune -o \
   -type f \( -perm -4000 -o -perm -2000 \) \
   -print
```

Then, for each file in this list that is not one of the permitted SUID or SGID programs, run the command `chmod -s FILE` to remove the SUID and SGID bits. When done, re-run the *find* command to verify that the list matches the permitted programs.

3.8 Update permissions for su

The */bin/su* binary MUST be restricted to members of the trusted 'wheel' group. This will be enforced both with PAM configuration (configured later) and the binary's permissions.

```
chgrp wheel /bin/su
chmod 4710 /bin/su
```

You MUST have at least one user account other than root configured to be a member of the 'wheel' group, otherwise system administration will ONLY be possible from the system console.

3.9 Configure root login

Login from the network with user ID 0 (root) MUST NOT be permitted over the network. Administrators MUST use an ordinary user ID to log in, and then use the `/bin/su -` command to switch identities. For more information, refer to section §4.3 "Gaining superuser access" of this guide.

It is RECOMMENDED that you remind administrators of this by adding the following alias to the bash configuration file */etc/profile* that disables the pathless *su* command:

```
alias su="echo \"Always use '/bin/su -' (see Configuration Guide)\""
```

This alias can be disabled for the root user in */root/.bashrc*:

```
unalias su
```

The restriction for direct root logins is enforced through two separate mechanisms. For network logins using ssh, the `PermitRootLogin no` entry in */etc/ssh/sshd_config* MUST be set (see next section). Console and serial terminal logins use the `pam_securetty.so` PAM module in the */etc/pam.d/login* file that verifies that the terminal character device used is listed in the file */etc/securetty*.

The file */etc/securetty* MUST NOT be changed from the secure default settings. The original contents are the following:

```
console
hvc0    # this entry is not available on all systems
vc/1
vc/2
vc/3
vc/4
vc/5
vc/6
vc/7
vc/8
vc/9
vc/10
vc/11
tty1
```

```
tty2
tty3
tty4
tty5
tty6
tty7
tty8
tty9
tty10
tty11
```

3.10 Setting up SSH

SSH protocol version 1 MUST be disabled. It has known security deficiencies.

The ssh client MUST NOT be set up SUID root (the SUID bit was removed in the post-install configuration). This prevents the use of some authentication methods normally supported by OpenSSH, but does not affect the evaluated configuration that uses password authentication exclusively.

The SSH Server MUST be configured to reject attempts to log in as root.

The permitted authentication mechanisms are per-user (nonempty) passwords and per-user DSS public key authentication. All other authentication methods MUST be disabled.

The setting `PAMAuthenticationViaKbdInt` MUST be disabled, since this would otherwise circumvent the disabled root logins over the network.

This results in the following option set for the SSH daemon that MUST be set in the */etc/ssh/sshd_config* file:

```
# Cryptographic settings. Disallow the obsolete (and
# insecure) protocol version 1, and hardcode a strong
# cipher.
Protocol 2
Ciphers 3des-cbc

# Configure password-based login. This MUST use the PAM
# library exclusively, and turn off the builtin password
# authentication code.
UsePAM yes
ChallengeResponseAuthentication yes
PasswordAuthentication no
PermitRootLogin no
PermitEmptyPasswords no

# No other authentication methods allowed
IgnoreRhosts yes
RhostsRSAAuthentication no
HostbasedAuthentication no
PubkeyAuthentication no
RSAAuthentication no
KerberosAuthentication no
GSSAPIAuthentication no

# Other settings, MAY change "X11Forwarding" to "yes"
X11Forwarding no
Subsystem sftp /usr/lib/ssh/sftp-server
```

All other options MUST NOT be changed from the defaults or from those settings specified here. Specifically, you MUST NOT add other authentication methods (AFS, Kerberos, host-based) to those permitted here.

3.11 Setting up xinetd

The *xinetd* super server 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/*.

The log method and the data that is to be logged are defined using the `defaults` entry in the */etc/xinetd.conf* file. The RECOMMENDED settings are:

```
defaults
{
       instances       = 60
       log_type        = FILE /var/log/xinetd.log
       log_on_success  = HOST PID EXIT DURATION
       log_on_failure  = HOST ATTEMPT
       cps             = 25 30
}

includedir /etc/xinetd.d
```

The *xinetd.conf*(5) man page contains more information on *xinetd* and configuration examples.

3.12 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 §3.16 ”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.

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.

3.13 Setting up additional services

3.13.1 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.

By default the *cupsd* daemon runs as user root, this is not acceptable for the evaluated configuration. You MUST reconfigure the service by putting the following settings in the */etc/cups/cupsd.conf* file:

```
User lp
Group sys
RunAsUser Yes
```

Verify that the printer daemon is able to access your printer devices with these 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.

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

3.13.2 Setting up Postfix

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.

3.14 Setting up the audit subsystem

This section describes only the initial setup and default configuration of the audit subsystem. Please refer to section §5.3 ”Configuring the audit subsystem” of this guide for information about how it works and what changes MAY be made to the configuration.

3.14.1 Installing the packages needed for auditing

The required packages have already been installed in the previous step described in section §3.2 ”Installing required updates” of this guide. This section describes the further changes that need to be made to reach the initial state of the evaluated configuration.

The audit subsystem consists of the following packages:

kernel-*

The kernels include the audit modifications, including the driver *drivers/audit/** and the required hooks in the rest of the kernel.

audit, audit-libs

Contains the userspace components of the audit subsystem. This includes *auditd*(8), the *libaudit.so* shared library, the */etc/rc.d/init.d/audit* startup script, the configuration in */etc/auditd.conf* and */etc/audit.rules*, the */lib/security/pam_loginuid.so* PAM module and the corresponding man pages. The corresponding development libraries and headers are in the *audit-libs-devel* RPM, which is not installed as part of the evaluated configuration.

at, cron, shadow-utils

These packages contain audit-enabled versions of the trusted programs, which will generate audit records for security relevant events.

3.14.2 Setting up the audit configuration files

The configuration script does NOT create default audit rules since these depend strongly on local requirements. Please refer to section §5.3.2 ”Selecting the events to be audited” of this guide for more information about configuring the */etc/audit.rules* file.

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

```
max_log_file_action = KEEP_LOGS
```

Please refer to section §5.3 ”Configuring the audit subsystem” of this guide for more information.

3.14.3 Starting `auditd` at boot as a system service

The evaluated configuration runs `auditd` as a standard daemon service launched as part of the normal startup sequence, this is activated with the following command:

```
chkconfig auditd on
```

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 Configuring the boot loader ”Configuring the boot loader” of this document for more details.

3.15 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.

3.16 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_tally.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_tally.so* module is used in the `auth` stack to increment a counter in the file */var/log/faillog*, 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 six failed attempts, corresponding to the setting `deny=6`, 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 §4.7 "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.

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:

3.16.1 /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 §3.5 ”Add and remove packages” of this guide.

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

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
```

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

```
auth        required      pam_tally.so onerr=fail no_magic_root
auth        required      pam_env.so
auth        required      pam_unix.so likeauth nullok

account     required      pam_unix.so
account     required      pam_tally.so deny=5 reset no_magic_root

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
```

3.16.2 /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.

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 CAPP-compliant fail-secure operating mode that disables login if audit is not working. Please refer to section §4.8 ”Using serial terminals” of this guide for more information.

```
auth       required     pam_securetty.so
auth       required     pam_stack.so service=system-auth
auth       required     pam_nologin.so

account    required     pam_stack.so service=system-auth

password   required     pam_stack.so service=system-auth
```

```
# pam_selinux.so close should be the first session rule
session    required     pam_selinux.so close
session    required     pam_stack.so service=system-auth
session    optional     pam_console.so
# add 'require_auditd' option to pam_loginuid.so for fail-secure mode
session    required     pam_loginuid.so
# pam_selinux.so open should be the last session rule
session    required     pam_selinux.so multiple open
```

3.16.3 /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
```

3.16.4 /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.

```
auth       required     pam_stack.so service=system-auth
auth       required     pam_nologin.so

account    required     pam_stack.so service=system-auth

password   required     pam_stack.so service=system-auth

session    required     pam_stack.so service=system-auth
session    required     pam_loginuid.so require_auditd
```

3.16.5 /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       required     pam_stack.so service=system-auth
```

```
account    required     pam_stack.so service=system-auth

password   required     pam_deny.so

# pam_selinux.so close must be first session rule
session    required     pam_selinux.so close
session    required     pam_stack.so service=system-auth
# pam_selinux.so open and pam_xauth must be last two session rules
session    required     pam_selinux.so open multiple
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,

3.16.6 /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.

```
auth       required     pam_listfile.so item=user sense=deny \
                        file=/etc/vsftpd.ftpusers onerr=succeed
auth       required     pam_stack.so service=system-auth
auth       required     pam_shells.so

account    required     pam_stack.so service=system-auth
account    required     pam_loginuid.so require_auditd

password   required     pam_deny.so

session    required     pam_stack.so service=system-auth
```

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

3.17 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.

```
# Mailbox settings:
#   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_FILE      .mail
MAIL_DIR        /var/spool/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_WARN_AGE    7    # MAY be changed
PASS_MIN_LEN     5    # no effect in the evaluated configuration
#
# 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 ORed with the -m flag on
# useradd command line.
#
# MAY be changed.
#
CREATE_HOME      yes
```

3.18 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.

3.18.1 GRUB boot loader configuration

The GRUB boot loader is used on the xSeries 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=10
splashimage=(hd0,0)/boot/grub/splash.xpm.gz
password --md5 $1$O471l/$H/JW2MYeugX6Y1h3v.1Iz0
title Red Hat Enterprise Linux AS (2.6.9-11.EL.audit.87)
        lock
        root (hd0,0)
        kernel /vmlinuz-2.6.9-11.EL.audit.87 ro root=LABEL=/
        initrd /initrd-2.6.9-11.EL.audit.87.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.

3.18.2 Yaboot boot loader configuration

Yaboot is used on the pSeries 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/
```

3.18.3 ZIPL boot loader configuration

The ZIPL boot loader is used on the zSeries 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"
```

3.18.4 iSeries kernel slots

Similar to zSeries, the iSeries hosts use an initial program load (IPL) system to load and initialize a virtual Linux instance. There is no boot loader program on the Linux side, the host platform’s boot loader is configured through device drivers accessed via virtual files in the */proc/* file system.

The system supports multiple kernel slots. Usually, slot A contains the production kernel, and slot B is reserved for experimental kernels. The default boot image is selected via the */proc/iSeries/mf/side* virtual file.

The kernel slot can contain either just a plain kernel (file name ”vmlinux” or similar), or a combined kernel plus initial root disk (file name ”vmlinitrd” or similar). Use the combined kernel+initrd if available to ensure that all necessary modules will be available for booting.

There are usually several different kernels and/or kernel+initrd files in */boot/*, be careful to use the right file based on the version number information contained in the file name.

Here is a sample session to copy an image to kernel slot B, and activate it:

```
dd if=/boot/vmlinitrd of=/proc/iSeries/mf/B/vmlinux bs=4k
cat /proc/cmdline > /proc/iSeries/mf/B/cmdline
echo "B" > /proc/iSeries/mf/side
```

For more information, please refer to:

```
http://www-1.ibm.com/servers/eserver/iseries/linux/tech_faq.html
```

3.19 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 zSeries, 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 xSeries 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/
/var/spool/at/
```

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 superuser access

System administration tasks require superuser privileges. Since directly logging on over the network as user root is disabled, 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.

4.4 Installation of additional software

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

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 1000. 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) or `at`

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.

4.5 Scheduling processes using cron and at

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.

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.

The *at*(1) and *batch*(1) programs execute a command line at a specific single point of time. The same rules apply as for jobs scheduled via *cron*(8). Use *atq*(1) and *atrm*(1) to manage the scheduled jobs.

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

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

```
/etc/at.allow
/etc/at.deny
/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* and *at*.

It is RECOMMENDED to restrict the use of *cron* and *at* 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/at.deny
chmod 600 /etc/at.deny
cp /etc/at.deny /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 */etc/at.allow* and/or */etc/cron.allow* files to explicitly list users who are permitted to use these services. If you do create these files, they MUST be owned by the user root and have file permissions 0600 (no access for group or others).

4.6 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, please refer to section §3.4.1 ”Disable usbfs” of this guide for more information.

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.

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.

4.7 Managing user accounts

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
```

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.

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

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

The *pam_tally.so* PAM module enforces automatic lockout after excessive failed authentication attempts, as described in section §3.16 ”Required Pluggable Authentication Module (PAM) configuration” of this guide. Use the program *pam_tally* to view and reset the counter if necessary, as documented in the file */usr/share/doc/pam-*/txts/README.pam_tally*. Note that the *pam_tally* 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_tally --user jdoe

# set new password, and reset the counter
passwd jdoe
pam_tally --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.

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 and at jobs
crontab -u $U -r
find /var/spool/at -user $U -exec rm {} \;

# Now delete the account
userdel $U
```

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

Group passwords are NOT supported in the evaluated configuration, and have been disabled by removing the SUID bit from the *newgrp*(8) program. You MUST NOT re-enable this feature and MUST NOT use *passwd*(1) with the `-g` switch or the *gpasswd*(1) command to set group passwords.

4.8 Using serial terminals

You MAY attach serial terminals to the xSeries, pSeries, and eServer 326 (Opteron) systems that are accessible to non-administrative users. Serial terminals on the iSeries and zSeries systems 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 CAPP-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 §3.16.2 ”/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
```

4.9 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 Configuring secure network connections with *stunnel*

4.10.1 Introduction

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:

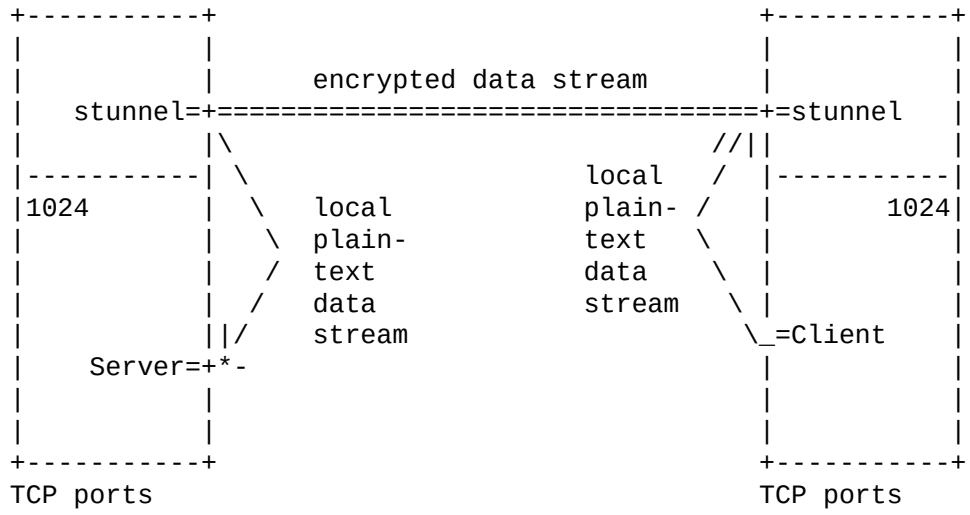
- Accept incoming SSL-encrypted TCP connections, and run a specific program to handle the request.

  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.

4.10.2 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.

4.10.3 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.

4.10.4 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 CAPP 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 CAPP 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.

4.10.5 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.

4.10.6 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
```

4.10.7 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/
```

4.10.8 Example 1: 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.

4.11 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 §3.5 ”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.

4.12 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.

4.13 SELinux configuration

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.

The CAPP/EAL4+ evaluation did not test SELinux features and does not provide any assurance related to SELinux functionality.

The */etc/selinux/config* file has the following content by default:

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

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/EAL4+ security target. (Note that reconfiguring the SELinux policy is likely to affect your support contract status. This is also beyond the scope of this document.)

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/at.allow
/etc/at.deny
/etc/auditd.conf
/etc/audit.rules
/etc/cron.d/*
/etc/cron.daily/*
/etc/cron.hourly/*
/etc/cron.monthly/*
/etc/cron.weekly/*
/etc/crontab
/etc/vsftpd.ftpusers
/etc/group
/etc/gshadow
/etc/hosts
/etc/rc.d/init.d/*
/etc/inittab
/etc/ld.so.conf
/etc/login.defs
/etc/modprobe.conf
/etc/pam.d/*
/etc/passwd
/etc/securetty
```

```
/etc/shadow
/etc/ssh/sshd_config
/etc/sysconfig/*
/etc/vsftpd/vsftpd.conf
/etc/stunnel/*

/var/log/lastlog
/var/log/faillog
/var/spool/at/*
/var/spool/cron/tabs/*

/etc/cron.allow
/etc/cron.deny
/etc/security/opasswd
/etc/localtime
/etc/sysctl.conf

/etc/xinetd.conf
/etc/xinetd.d/*
```

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

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

```
atq
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)
warn           Written by syslog
wtmp           Written by the PAM susbystem, see who(1)
```

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 section §3.14.2 ”Setting up the audit configuration files” of this guide and the *auditd*(8), *auditd.conf*(8), and *auditctl*(8) man pages for more information.

5.3.1 Intended usage of the audit subsystem

The Controlled Access Protection Profile (CAPP) specifies the auditing capabilities that a compliant system must support. The evaluated configuration described here is based on these requirements.

WARNING: Some of the CAPP requirements can conflict with your specific requirements for the system. For example, a CAPP-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 is 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 requires 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 a suggested audit configuration for CAPP systems in the */usr/share/doc/audit-*/capp.rules* file. It 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 this file 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.

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

```
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.

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.

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.

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/auditd.conf* file. You MAY change the *auditd.conf* file to suit your local requirements.

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. For example, 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 = SINGLE
disk_error_action = SINGLE
```

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

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/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 Online 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
```

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. 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).

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.

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.

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.

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.

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 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.

”Red Hat Enterprise Linux 4 Installation Guide for the x86, Itanium and AMD64 Architectures”, */usr/share/doc/rhel-ig-x8664-multi-en-3/index.html*

”Red Hat Enterprise Linux 4 Installation Guide for the IBM eServer iSeries and IBM eServer pSeries Architectures”, */usr/share/doc/rhel-ig-ppc-multi-en-3/index.html*

”Red Hat Enterprise Linux 4 Installation Guide for the IBM S/390 and IBM eServer zSeries Architectures”, */usr/share/doc/rhel-ig-s390-multi-en-3/index.html*

”Red Hat Enterprise Linux 4 System Administration Guide”, */usr/share/doc/rhel-sag-en-3/index.html*

”Red Hat Enterprise Linux 4 Reference Guide”, */usr/share/doc/rhel-rg-en-3/index.html*

”Red Hat Enterprise Linux 4 Security Guide”, */usr/share/doc/rhel-sg-en-3/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

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