

sub title

# **The Title**

Title:  
Subtitle  
Month 2006

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# Forward

Author: *name contact BSD flavour*

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Welcome to the Quick Guide to BSD Administration. This book is a quick reference and great way to quickly learn BSD administration skills. These topics are based on the objectives published by the BSD Certification Group in the 2005 BSDA Certification Requirements Document. The BSDA (BSD Associate) Certification is for BSD Unix system administrators with light to moderate skills.

This book provides basic examples and pointers to further documentation and learning resources. This book is not a comprehensive reference. While this is a beginner's book, it is also useful for experienced administrators. It covers generic \*BSD administration and specific skills as necessary for NetBSD, FreeBSD, OpenBSD and DragonFly OS.



# 1 Chapter Installing and Upgrading the OS and Software

Author: *name contact BSD flavour*

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An important aspect of system administration is tracking installed versions of both the operating system and third-party applications. An advantage of using BSD systems is the availability of multiple tools to assist the system administrator in determining software versions and their dependencies. These tools indicate which software is out-of-date or has existing security vulnerabilities. Assist in upgrading or patching software and its dependencies. When and how installations and upgrades are done is specific to each organization. The successful admin knows how to use the tools which are available for these purposes, and the cautions that are necessary when working on production systems under the supervision of a more senior administrator.

- Recognize the installation program used by each operating system
- Recognize which commands are available for upgrading the operating system
- Understand the difference between a pre-compiled binary and compiling from source
- Understand when it is preferable to install a pre-compiled binary and how to do so
- Recognize the available methods for compiling a customized binary

- Determine what software is installed on a system
- Determine which software requires upgrading
- Upgrade installed software
- Determine which software have outstanding security advisories
- Follow the instructions in a security advisory to apply a security patch

## 1.1 Recognize the installation program used by each operating system

Author: *name contact BSD flavour*

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### 1.1.1 Concept

While BSDA candidates are not expected to plan an installation, they should be able to start and complete an installation according to a provided list of requirements. Since the install procedure is operating system dependent, it is recommended that the candidate have prior experience in the default install routine for each tested BSD operating system. Have some familiarity with release numbering practices in general (e.g. “dot-zero releases”) and where to find the release engineering practices at each BSD project’s website.

### 1.1.2 Introduction

### 1.1.3 Examples

### 1.1.4 Practice Exercises

### 1.1.5 More information

<http://www.bsdistaller.org> for DragonFly, `sysinstall(8)` for FreeBSD, `sysinst` on NetBSD install media, and `INSTALL.[arch]` on OpenBSD

install media

## 1.2 Recognize which commands are available for upgrading the operating system

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 1.2.1 Concept

Recognize the utilities which are used to keep the operating system up-to-date. Some utilities are common to the BSDs, some are specific to certain BSD operating systems and some are third-party applications.

### 1.2.2 Introduction

### 1.2.3 Examples

### 1.2.4 Practice Exercises

### 1.2.5 More information

make(1) including the 'buildworld', 'installworld', and 'quickworld' and similar targets; mergemaster(8); cvs(1) and the third-party utilities cvsup and cvsnc; build.sh, etcupdate(8), postinstall(8) and afterboot(8); src/UPDATING and src/BUILDING.

## 1.3 Understand the difference between a pre-compiled binary and compiling from source

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

### 1.3.1 Concept

Be familiar with the default location of both the ports collection and the pkgsrc collection and which BSDs use which type of collection. Also be able to recognize the extension used by packages. In addition, be aware of the advantages and disadvantages of installing a pre-compiled binary and the advantages and disadvantages of compiling a binary from source.

### 1.3.2 Introduction

The BSD operating systems provide software build systems for installing third-party add-on software from source code.

### 1.3.3 Examples

### 1.3.4 Practice Exercises

### 1.3.5 More information

## 1.4 Understand when it is preferable to install a pre-compiled binary and how to do so

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 1.4.1 Concept

Be aware that while pre-compiled binaries are quick and easy to install, they don't allow the customization of the binary to a system's particular needs. Know how to install a pre-compiled binary from either a local or a remote source, as well as how to uninstall a pre-compiled binary.

## 1.4.2 Introduction

## 1.4.3 Examples

## 1.4.4 Practice Exercises

## 1.4.5 More information

pkg\_add(1), pkg\_delete(1)

# 1.5 Recognize the available methods for compiling a customized binary

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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## 1.5.1 Concept

Many applications used by servers support `make(1)` options to compile a binary with the feature set required by a particular installation. While the BSDs all use `make(1)`, the admin should recognize that each BSD uses different mechanisms to use and preserve `make(1)` options.

## 1.5.2 Introduction

## 1.5.3 Examples

## 1.5.4 Practice Exercises

## 1.5.5 More information

DragonFly: `mk.conf(5)` or `make.conf(5)`, `PKG_OPTIONS`, `CFLAGS`

FreeBSD: `-DWITH_*` or `WITH_*=`, `pkgtools.conf(5)`, `make.conf(5)`

NetBSD: `PKG_OPTIONS.`, `CFLAGS`, `mk.conf(5)`, `PKG_DEFAULT_OPTIONS`

OpenBSD: `bsd.port.mk(5)`

## 1.6 Determine what software is installed on a system

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 1.6.1 Concept

Recognize that on BSD systems, software and dependencies are tracked by a package manager if the software was installed using packages, ports or pkgsrc. Be familiar with querying the package manager to determine what software and their versions are installed on the system.

### 1.6.2 Introduction

### 1.6.3 Examples

### 1.6.4 Practice Exercises

### 1.6.5 More information

`pkg_info(1)`

## 1.7 Determine which software requires upgrading

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 1.7.1 Concept

Recognize the importance of balancing the need to keep software up-to-date while minimizing the impact on a production system. Drag-



onfly and NetBSD use pkgsrc which provides utilities for determining which installed software is out-of-date. FreeBSD provides pkg\_version and third-party utilities are also available which integrate with the BSD package managers.

### 1.7.2 Introduction

### 1.7.3 Examples

### 1.7.4 Practice Exercises

### 1.7.5 More information

pkgsrc/pkgtool/pkg\_chk and make show-downlevel for Dragonfly and NetBSD; pkg\_version(1), and the third-party portupgrade

## 1.8 Upgrade installed software

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 1.8.1 Concept

Recognize the built-in and third-party commands which are available for upgrading installed software on BSD systems. In addition, be able to recognize which BSD systems use pkgsrc.

### 1.8.2 Introduction

### 1.8.3 Examples

### 1.8.4 Practice Exercises

### 1.8.5 More information

Dragonfly and NetBSD provide pkgsrc/pkgtools/pkg\_chk, pkgsrc/pkgtools/pkg\_comp, make update and make replace; portupgrade and cvsup are available as third-party utilities

## 1.9 Determine which software have outstanding security advisories

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 1.9.1 Concept

Recognize the importance of being aware of software security vulnerabilities. Also recognize the third-party utilities which integrate with the BSD package managers to determine which software has outstanding vulnerabilities.

### 1.9.2 Introduction

### 1.9.3 Examples

### 1.9.4 Practice Exercises

### 1.9.5 More information

audit-packages for Dragonfly and NetBSD; portaudit and vuxml for FreeBSD and OpenBSD

## 1.10 Follow the instructions in a security advisory to apply a security patch

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 1.10.1 Concept

Be aware that each BSD project maintains security advisories which are available both on the Internet and via mailing lists. Be able to

*1.10. FOLLOW THE INSTRUCTIONS IN A SECURITY  
ADVISORY TO APPLY A SECURITY PATCH*

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follow the instructions in an advisory when asked to do so by a supervisor.

**1.10.2 Introduction**

**1.10.3 Examples**

**1.10.4 Practice Exercises**

**1.10.5 More information**

patch(1), make(1), and fetch(1; ftp(1) and build.sh



## 2 Chapter Securing the Operating System

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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The mark of a good system administrator is the awareness of and adherence to best security practices. An admin is expected to be familiar with common security practices. BSD systems are designed with security in mind and provide many mechanisms which allow the system administrator to tune systems to the security requirements of an organization. While the BSDA candidate won't always be responsible for implementing these mechanisms, be able to recognize the features and commands available for securing BSD systems.

- Determine the system's security level
- Configure an SSH server according to a set of requirements
- Configure an SSH server to use a key pair for authentication
- Preserve existing SSH host keys during a system upgrade
- Recognize alternate authentication mechanisms
- Recognize alternate authorization schemes
- Recognize basic recommended access methods
- Recognize BSD firewalls and rulesets
- Recognize BSD mechanisms for encrypting devices
- Recognize methods for verifying the validity of binaries

- Recognize the BSD methods for restraining a service
- Change the encryption algorithm used to encrypt the password database
- Modify the system banner
- Protect authentication data

## 2.1 Determine the system's security level

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 2.1.1 Concept

BSD systems provide security profiles known as securelevels. Be able to recognize the restrictions set by each securelevel for each BSD operating system. Also understand under what circumstances a securelevel can be raised or lowered.

### 2.1.2 Introduction

The BSD kernels can limit – even from the superuser – changing immutable and append-only file flags, \*\*

In addition on NetBSD, the verified exec in-kernel fingerprint table can't be modified.

### 2.1.3 Examples

### 2.1.4 Practice Exercises

### 2.1.5 More information

init(8), sysctl(8), rc.conf(5)

## 2.2 Configure an SSH server according to a set of requirements

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 2.2.1 Concept

Be aware that the `sshd(8)` built into BSD systems can be configured to limit who can access a system via SSH.

### 2.2.2 Introduction

### 2.2.3 Examples

### 2.2.4 Practice Exercises

### 2.2.5 More information

`sshd_config(5)`

## 2.3 Configure an SSH server to use a key pair for authentication

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 2.3.1 Concept

Understand private/public key theory including: which protocols are available for generating key pairs, choosing an appropriate bit size, providing a seed, providing a passphrase, and verifying a fingerprint. In addition, able to generate their own keys and use them for authentication.

### **2.3.2 Introduction**

### **2.3.3 Examples**

### **2.3.4 Practice Exercises**

### **2.3.5 More information**

ssh-keygen(1) including these keywords: `authorized_keys`, `id_rsa`, and `id_rsa.pub`

## **2.4 Preserve existing SSH host keys during a system upgrade**

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### **2.4.1 Concept**

In addition to knowing how to generate a system's SSH keys, know where host keys are located and how to preserve them if the system is upgraded or replaced.

### **2.4.2 Introduction**

### **2.4.3 Examples**

### **2.4.4 Practice Exercises**

### **2.4.5 More information**

`/etc/ssh/ssh_host_key`

## **2.5 Recognize alternate authentication mechanisms**

Author: *name contact BSD flavour*



## 2.6. RECOGNIZE ALTERNATE AUTHORIZATION SCHEMES

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### **2.5.1 Concept**

Understand basic authentication theory and be aware that providing a username and password is only one way to authenticate on BSD systems. Have a basic understand of PAM and know it is available on Dragonfly, FreeBSD and NetBSD 3.x. Also understand basic theory regarding Kerberos, OTP and RADIUS. (Note: The BSDA candidate is not expected to know how to configure an alternate authentication mechanism.)

### **2.5.2 Introduction**

### **2.5.3 Examples**

### **2.5.4 Practice Exercises**

### **2.5.5 More information**

## **2.6 Recognize alternate authorization schemes**

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### **2.6.1 Concept**

Admins should understand basic authorization theory and how MAC and ACLs extend the features provided by the standard Unix permissions.

## 2.6.2 Introduction

## 2.6.3 Examples

## 2.6.4 Practice Exercises

## 2.6.5 More information

mac(4) and acl(3) on FreeBSD; systrace(1) on NetBSD and OpenBSD

## 2.7 Recognize basic recommended access methods

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 2.7.1 Concept

Be familiar with standard system administration practices used to minimize the risks associated with accessing a system. These include using ssh(1) instead of telnet(1), denying root logins, using the possibly third-party sudo utility instead of su(1) and minimizing the use of the wheel group.

### 2.7.2 Introduction

### 2.7.3 Examples

### 2.7.4 Practice Exercises

### 2.7.5 More information

ttys(5), sshd\_config(5), ftpusers(5); the possibly third-party utility sudo which includes visudo, suedit and sudoers

## 2.8 Recognize BSD firewalls and rulesets

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 2.8.1 Concept

Each BSD comes with at least one built-in firewall. Recognize which firewalls are available on each BSD and which commands are used to view each firewall's ruleset.

### 2.8.2 Introduction

### 2.8.3 Examples

### 2.8.4 Practice Exercises

### 2.8.5 More information

ipfw(8), ipf(8), ipfstat(8), pf(4), pfctl(8) and firewall(7)

## 2.9 Recognize BSD mechanisms for encrypting devices

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 2.9.1 Concept

Be aware that it is possible to encrypt devices on BSD systems and which utilities are available on each BSD system.

## 2.9.2 Introduction

## 2.9.3 Examples

## 2.9.4 Practice Exercises

## 2.9.5 More information

gbde(4) and gbde(8) on FreeBSD; cgd(4) on NetBSD; vnd(4) on OpenBSD

## 2.10 Recognize methods for verifying the validity of binaries

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 2.10.1 Concept

Recognize the utility of file integrity utilities such as tripwire. Recognize the built-in checks provided on some of the BSDs.

### 2.10.2 Introduction

### 2.10.3 Examples

### 2.10.4 Practice Exercises

### 2.10.5 More information

security(7) or (8); security.conf(5); veriexecctl(8)

## 2.11 Recognize the BSD methods for restraining a service

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

## 2.12. CHANGE THE ENCRYPTION ALGORITHM USED TO ENCRYPT THE PASSWORD DATABASE

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Reviewer: *name contact BSD flavour*

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### 2.11.1 Concept

Recognize the advantages of restraining a service on an Internet facing system and which utilities are available to do so on each of the BSDs.

### 2.11.2 Introduction

### 2.11.3 Examples

### 2.11.4 Practice Exercises

### 2.11.5 More information

chroot(8); jail(8); systrace(1); the third-party Xen application

## 2.12 Change the encryption algorithm used to encrypt the password database

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 2.12.1 Concept

Given a screenshot of a password database, an admin should be able to recognize the encryption algorithm in use and how to select another algorithm. Have a basic understanding of when to use DES, MD5 and Blowfish.

## 2.12.2 Introduction

## 2.12.3 Examples

## 2.12.4 Practice Exercises

## 2.12.5 More information

login.conf(5); auth.conf(5); passwd.conf(5); adduser.conf(5) and adduser(8)

## 2.13 Modify the system banner

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 2.13.1 Concept

Be aware of the banner(s) that may be seen depending on how a user accesses a system and which files are used to configure each banner.

### 2.13.2 Introduction

### 2.13.3 Examples

### 2.13.4 Practice Exercises

### 2.13.5 More information

motd(5), login.conf(5), gettytab(5), sshd\_config(5)

## 2.14 Protect authentication data

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### **2.14.1 Concept**

To prevent attacks against system security with password cracking attacks, BSD systems keep encrypted passwords visible to system processes only. An admin should have an understanding of the location of the password database files and their proper permission sets.

### **2.14.2 Introduction**

### **2.14.3 Examples**

### **2.14.4 Practice Exercises**

### **2.14.5 More information**

passwd(5), pwd\_mkdb(8)





# 3 Chapter Files, Filesystems and Disks

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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The usefulness of any computing system is related to the accessibility of the data stored on it. An admin is expected to thoroughly understand how to make data available both locally and remotely and how to use permissions to ensure authorized users can access that data. Be experienced in backing up data and in resolving common disk issues.

- Mount or unmount local filesystems
- Configure data to be available through NFS
- Determine which filesystems are currently mounted and which will be mounted at system boot
- Determine disk capacity and which files are consuming the most disk space
- Create and view symbolic or hard links
- View and modify ACLs
- View file permissions and modify them using either symbolic or octal mode
- Modify a file's owner or group
- Backup and restore a specified set of files and directories to local disk or tape

- Backup and restore a file system
- Determine the directory structure of a system
- Manually run the file system checker and repair tool
- View and modify file flags
- Monitor the virtual memory system

## 3.1 Mount or unmount local filesystems

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 3.1.1 Concept

Be familiar with all aspects of mounting and unmounting local filesystems including: how to mount/umount a specified filesystem, how to mount all filesystems, configuring filesystems to be mounted at boot, passing options to mount(1), and resolving mount(1) errors.

### 3.1.2 Introduction

### 3.1.3 Examples

### 3.1.4 Practice Exercises

### 3.1.5 More information

mount(8), umount(8), fstab(5)

## 3.2 Configure data to be available through NFS

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 3.3. DETERMINE WHICH FILESYSTEMS ARE CURRENTLY MOUNTED AND WHICH WILL BE MOUNTED AT SYSTEM BOOT

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#### 3.2.1 Concept

Be aware of the utilities associated with NFS and the security risks associated with allowing RPC through a firewall. In addition, be able to configure a NFS server or client according to a set of requirements on the data to be made available.

#### 3.2.2 Introduction

#### 3.2.3 Examples

#### 3.2.4 Practice Exercises

#### 3.2.5 More information

exports(5), nfsd(8), mountd(8), rpcbind(8) or portmap(8), rpc.lockd(8), rpc.statd(8), rc.conf(5) and mount\_nfs(8)

### 3.3 Determine which filesystems are currently mounted and which will be mounted at system boot

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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#### 3.3.1 Concept

Be able to determine which filesystems are currently mounted and which will be mounted at boot time.

### 3.3.2 Introduction

### 3.3.3 Examples

### 3.3.4 Practice Exercises

### 3.3.5 More information

mount(1), du(1), fstab(5)

## 3.4 Determine disk capacity and which files are consuming the most disk space

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 3.4.1 Concept

Be able to combine common Unix command line utilities to quickly determine which files are consuming the most disk space.

### 3.4.2 Introduction

### 3.4.3 Examples

### 3.4.4 Practice Exercises

### 3.4.5 More information

du(1), df(1), find(1), sort(1), systat(1)

## 3.5 Create and view symbolic or hard links

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 3.5.1 Concept

Know the difference between symbolic and hard links as well as how to create, view and remove both types of links. In addition, be able to temporarily resolve a low disk space issue using a symbolic link.

### 3.5.2 Introduction

### 3.5.3 Examples

### 3.5.4 Practice Exercises

### 3.5.5 More information

ln(1), ls(1), rm(1), stat(1)

## 3.6 View and modify ACLs

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 3.6.1 Concept

Be able to determine if a FreeBSD system is using ACLs, and if so, on which filesystems. In addition, be able to view and modify a file's ACL on a FreeBSD system.

### 3.6.2 Introduction

### 3.6.3 Examples

### 3.6.4 Practice Exercises

### 3.6.5 More information

mount(8), ls(1), getfacl(1)

## 3.7 View file permissions and modify them using either symbolic or octal mode

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 3.7.1 Concept

An admin is expected to have a thorough understanding of traditional Unix permissions including: how to view and modify permissions, why the sticky bit is important on /tmp and other shared directories, recognizing and using the SUID and SGID bits, and the difference between symbolic and octal mode. In addition, understand that a shell setting determines the default file and directory permissions and, given a umask value, be able to determine the default permission set.

### 3.7.2 Introduction

### 3.7.3 Examples

### 3.7.4 Practice Exercises

### 3.7.5 More information

ls(1), chmod(1), umask(1) or umask(2)

## 3.8 Modify a file's owner or group

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 3.8.1 Concept

Be able to modify a file's ownership as required. In addition, be aware of the importance of verifying one's own identity before creating files.

### 3.9. BACKUP AND RESTORE A SPECIFIED SET OF FILES AND DIRECTORIES TO LOCAL DISK OR TAPE

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#### 3.8.2 Introduction

#### 3.8.3 Examples

#### 3.8.4 Practice Exercises

#### 3.8.5 More information

chown(8), chgrp(1); su(1), mtree(8)

### 3.9 Backup and restore a specified set of files and directories to local disk or tape

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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#### 3.9.1 Concept

Admins should have experience using common Unix command line backup utilities. In addition, be able to recognize the device names for tape devices on BSD systems.

#### 3.9.2 Introduction

#### 3.9.3 Examples

#### 3.9.4 Practice Exercises

#### 3.9.5 More information

tar(1), cpio(1), pax(1), cp(1), cpdup(1)

### 3.10 Backup and restore a file system

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### **3.10.1 Concept**

Recognize the utilities used to backup an entire filesystem and the various dump(1) levels.

### **3.10.2 Introduction**

### **3.10.3 Examples**

### **3.10.4 Practice Exercises**

### **3.10.5 More information**

dump(8), restore(8), dd(1)

## **3.11 Determine the directory structure of a system**

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### **3.11.1 Concept**

Be able to quickly determine the directory layout used by BSD systems.

### **3.11.2 Introduction**

### **3.11.3 Examples**

### **3.11.4 Practice Exercises**

### **3.11.5 More information**

hier(7)



## 3.12 Manually run the file system checker and repair tool

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 3.12.1 Concept

Be aware of the utilities available to check the consistency of a file system and to use them under supervision.

### 3.12.2 Introduction

### 3.12.3 Examples

### 3.12.4 Practice Exercises

### 3.12.5 More information

fsck(8)

## 3.13 View and modify file flags

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 3.13.1 Concept

Understand how file flags augment traditional Unix permissions and should recognize how to view and modify the immutable, append-only and undelete flags.

### **3.13.2 Introduction**

### **3.13.3 Examples**

### **3.13.4 Practice Exercises**

### **3.13.5 More information**

ls(1), chflags(1)

## **3.14 Monitor the virtual memory system**

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### **3.14.1 Concept**

The virtual memory subsystem may have an important impact on a system's overall performance. Be able to configure a swap device and review swap usage.

### **3.14.2 Introduction**

### **3.14.3 Examples**

### **3.14.4 Practice Exercises**

### **3.14.5 More information**

pstat(8); systat(1); top(1); vmstat(8); swapctl(8); swapinfo(8)

# 4 Chapter Users and Accounts Management

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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All systems require at least one user account, and depending upon the role of the system, an admin's job duties may include supporting end-users in the maintenance of their accounts. Be able to create user accounts, modify account settings, disable accounts, and reset passwords. Know how to track account activity and determine which accounts are currently accessing a system.

- Create, modify and remove user accounts
- Create a system account
- Lock a user account or reset a locked user account
- Determine identity and group membership
- Determine who is currently on the system or the last time a user was on the system
- Enable accounting and view system usage statistics
- Change a user's default shell
- Control which files are copied to a new user's home directory during account creation
- Change a password

## 4.1 Create, modify and remove user accounts

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 4.1.1 Concept

Managing user accounts is an important aspect of system administration. Be aware that the account management utilities differ across BSD systems and should be comfortable using each utility according to a set of requirements.

### 4.1.2 Introduction

### 4.1.3 Examples

### 4.1.4 Practice Exercises

### 4.1.5 More information

`vipw(8)`; `pw(8)`, `adduser(8)`, `adduser.conf(5)`, `useradd(8)`, `userdel(8)`, `rmuser(8)`, `userinfo(8)`, `usermod(8)`, and `user(8)`

## 4.2 Create a system account

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 4.2.1 Concept

Understand that many services require an account and that such accounts should not be available for logins.

### 4.3. LOCK A USER ACCOUNT OR RESET A LOCKED USER ACCOUNT

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#### 4.2.2 Introduction

#### 4.2.3 Examples

#### 4.2.4 Practice Exercises

#### 4.2.5 More information

nologin(8); using a \* in the password field of passwd(5)

### 4.3 Lock a user account or reset a locked user account

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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#### 4.3.1 Concept

Know how to recognize a locked account and how to remove the lock.

#### 4.3.2 Introduction

#### 4.3.3 Examples

#### 4.3.4 Practice Exercises

#### 4.3.5 More information

vipw(8); chpass(1), chfn(1), chsh(1), pw(8), user(8)

### 4.4 Determine identity and group membership

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 4.4.1 Concept

In the context of the Unix permission system, determining one's identity and group membership is essential to determine what authorizations are available. Be able to determine, and as required, change identity or group membership.

### 4.4.2 Introduction

The `id` command

### 4.4.3 Examples

### 4.4.4 Practice Exercises

### 4.4.5 More information

`id(1)`, `groups(1)`, `who(1)`, `whoami(1)`, `su(1)`

## 4.5 Determine who is currently on the system or the last time a user was on the system

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 4.5.1 Concept

BSD systems maintain databases which can be queried for details regarding logins. Be familiar with the database names and the utilities available for determining login information.

### **4.5.2 Introduction**

### **4.5.3 Examples**

### **4.5.4 Practice Exercises**

### **4.5.5 More information**

wtmp(5), utmp(5), w(1), who(1), users(1), last(1), lastlogin(8), lastlog(5), finger(1)

## **4.6 Enable accounting and view system usage statistics**

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### **4.6.1 Concept**

Be aware of when it is appropriate to enable system accounting, recognize which utilities are available to do so, and know how to view the resulting statistics.

### **4.6.2 Introduction**

### **4.6.3 Examples**

### **4.6.4 Practice Exercises**

### **4.6.5 More information**

ac(8), sa(8), accton(8), lastcomm(1), last(1)

## **4.7 Change a user's default shell**

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### **4.7.1 Concept**

Know the default shells for both user accounts and the superuser account for each BSD. In addition, know how to change the default shell for each BSD operating system.

### **4.7.2 Introduction**

### **4.7.3 Examples**

### **4.7.4 Practice Exercises**

### **4.7.5 More information**

`vipw(8); chpass(1), chfn(1), chsh(1), pw(8), user(8)`

## **4.8 Control which files are copied to a new user's home directory during account creation**

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### **4.8.1 Concept**

BSD systems use a “skel” directory containing files which are copied over to a user's home directory when a user account is made. Be aware of the location of the skel directory on each BSD, as well as how to override the copying of its contents during account creation.



### **4.8.2 Introduction**

### **4.8.3 Examples**

### **4.8.4 Practice Exercises**

### **4.8.5 More information**

pw(8), adduser.conf(5), useradd(8) and usermgmt.conf(5)

## **4.9 Change a password**

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### **4.9.1 Concept**

Be able to change own password as well as the passwords of other users as required.

### **4.9.2 Introduction**

### **4.9.3 Examples**

### **4.9.4 Practice Exercises**

### **4.9.5 More information**

passwd(1), vipw(8)

*CHAPTER 4. CHAPTER USERS AND ACCOUNTS  
MANAGEMENT*

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# 5 Chapter Basic System Administration

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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An important component of system administration is an awareness of its subsystems and their interactions, as well as how to monitor the health of a running system. Demonstrate experience in interacting with BSD processes, a running kernel, and the BSD boot process. Demonstrate familiarity with BSD devices, the disk subsystem and the mail and print daemons.

- Determine which process are consuming the most CPU
- View and send signals to active processes
- Use an rc(8) script to determine if a service is running and start, restart or stop it as required
- View and configure system hardware
- View, load, or unload a kernel module
- Modify a kernel parameter on the fly
- View the status of a software RAID mirror or stripe
- Determine which MTA is being used on the system
- Configure system logging
- Review log files to troubleshoot and monitor system behavior
- Understand basic printer troubleshooting

- Create or modify email aliases for Sendmail or Postfix
- Halt, reboot, or bring the system to single-user mode
- Recognize the difference between hard and soft limits and modify existing resource limits
- Recognize the BSD utilities that shape traffic or control bandwidth
- Recognize common, possibly third-party, server configuration files
- Configure a service to start at boot time
- Configure the scripts that run periodically to perform various system maintenance tasks
- View the Sendmail or Postfix mail queue
- Determine the last system boot time and the workload on the system
- Monitor disk input–output
- Deal with busy devices
- Determine information regarding the operating system
- Understand the advantages of using a BSD license

## 5.1 Determine which process are consuming the most CPU

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 5.1.1 Concept

Be able to view active processes and recognize inordinate CPU usage. In addition, know how to end a process or change its priority.

### 5.1.2 Introduction

### 5.1.3 Examples

### 5.1.4 Practice Exercises

### 5.1.5 More information

top(1), systat(1), ps(1), nice(1), renice(1), kill(1)

## 5.2 View and send signals to active processes

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 5.2.1 Concept

Be familiar with both the names and numbers of the most commonly used Unix signals and how to send a signal to an active process. Recognize the difference between a SIGTERM and a SIGKILL.

### 5.2.2 Introduction

### 5.2.3 Examples

### 5.2.4 Practice Exercises

### 5.2.5 More information

ps(1); kill(1); killall(1); pkill(1); pgrep(1)

## 5.3 Use an rc(8) script to determine if a service is running and start, restart or stop it as required

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 5.3.1 Concept

In addition to directly sending signals to processes, realize that BSD systems provide scripts which can be used to check the status of services and to stop, start and restart them as required. Be aware of the locations of these scripts on each of the BSD systems. Note: this objective does not apply to OpenBSD.

### 5.3.2 Introduction

### 5.3.3 Examples

### 5.3.4 Practice Exercises

### 5.3.5 More information

rc(8), rc.conf(5)

## 5.4 View and configure system hardware

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 5.4.1 Concept

BSD systems come with many utilities to determine what hardware is installed on a system. Know how to determine which hardware was

probed at boot time as well as some BSD specific utilities which can be used to troubleshoot and manipulate PCI, ATA, and SCSI devices.

### 5.4.2 Introduction

### 5.4.3 Examples

### 5.4.4 Practice Exercises

### 5.4.5 More information

dmesg(8), /var/run/dmesg.boot, pciconf(8), atacontrol(8) and cam-control(8); aactl(8) and /kern/msgbuf; scsictl(8) or scsi(8)

## 5.5 View, load, or unload a kernel module

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 5.5.1 Concept

Undertand the difference between a statically compiled kernel and one that uses loadable kernel modules. Be able to view, load and unload kernel modules on each BSD system but should be aware that kernel modules are discouraged on NetBSD and OpenBSD systems.

### 5.5.2 Introduction

### 5.5.3 Examples

### 5.5.4 Practice Exercises

### 5.5.5 More information

kldstat(8), kldload(8), kldunload(8), and loader.conf(5); modstat(8), modload(8), modunload(8), and lkm.conf(5)

## 5.6 Modify a kernel parameter on the fly

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 5.6.1 Concept

BSD systems maintain kernel MIB variables which allow a system administrator to both view and modify the kernel state of a running system. Be able to view and modify these MIBs both at run-time and permanently over a system boot. Recognize how to modify a read-only MIB.

### 5.6.2 Introduction

### 5.6.3 Examples

### 5.6.4 Practice Exercises

### 5.6.5 More information

sysctl(8), sysctl.conf(5)

## 5.7 View the status of a software RAID mirror or stripe

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 5.7.1 Concept

In addition to providing drivers for hardware RAID devices, BSD systems also provide built-in mechanisms for configuring software RAID systems. Know the difference between RAID levels 0, 1, 3 and 5 and



## 5.8. DETERMINE WHICH MTA IS BEING USED ON THE SYSTEM

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recognize which utilities are available to configure software RAID on each BSD system.

### 5.7.2 Introduction

### 5.7.3 Examples

### 5.7.4 Practice Exercises

### 5.7.5 More information

vinum(8), gmirror(8), gstripe(8), graid3(8), raidctl(8), ccdconfig(8)

## 5.8 Determine which MTA is being used on the system

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 5.8.1 Concept

Recognize the role of the MTA, recognize which MTA(s) are available during each BSD's operating system install routine and which configuration file indicates the MTA in use on the system. Recognize the difference between the mbox or maildir mail destination file format type.

### 5.8.2 Introduction

### 5.8.3 Examples

### 5.8.4 Practice Exercises

### 5.8.5 More information

mailer.conf(5)

## 5.9 Configure system logging

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 5.9.1 Concept

Understand that the system automatically maintains the creation and maintenance of many different logs. Be able to configure log rotation by either time or size, understand logging facilities and priorities, as well as view compressed logs.

### 5.9.2 Introduction

### 5.9.3 Examples

### 5.9.4 Practice Exercises

### 5.9.5 More information

Note that the `newsyslog(8)` implementations vary by BSD. `newsyslog(8)`, `newsyslog.conf(5)`, `syslog.conf(5)`, `zmore(1)`, `bzcat(1)`

## 5.10 Review log files to troubleshoot and monitor system behavior

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 5.10.1 Concept

Be aware of the importance of reviewing log files on a regular basis as well as how to watch a log file when troubleshooting.

### **5.10.2 Introduction**

### **5.10.3 Examples**

### **5.10.4 Practice Exercises**

### **5.10.5 More information**

tail(1), /var/log/\*, syslog.conf(5), grep(1), dmesg(8)

## **5.11 Understand basic printer troubleshooting**

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### **5.11.1 Concept**

Be able to view the print queue and manipulate the jobs within the queue. Be able to recognize the meaning of the first two field in an /etc/printcap entry.

### **5.11.2 Introduction**

### **5.11.3 Examples**

### **5.11.4 Practice Exercises**

### **5.11.5 More information**

lpc(8), lpq(1), lprm(1), printcap(5)

## **5.12 Create or modify email aliases for Sendmail or Postfix**

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 5.12.1 Concept

Understand when to create an email alias and how to do so for either Sendmail or Postfix.

### 5.12.2 Introduction

### 5.12.3 Examples

### 5.12.4 Practice Exercises

### 5.12.5 More information

`newaliases(1)`, `aliases(5)`, `postalias(1)`

## 5.13 Halt, reboot, or bring the system to single-user mode

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 5.13.1 Concept

Understand the ramifications associated with halting, rebooting, or bringing a system to single-user mode, recognize when it may be necessary to do so and how to minimize the impact on a server system.

### 5.13.2 Introduction

### 5.13.3 Examples

### 5.13.4 Practice Exercises

### 5.13.5 More information

`shutdown(8)`

## *5.14. RECOGNIZE THE DIFFERENCE BETWEEN HARD AND SOFT LIMITS AND MODIFY EXISTING RESOURCE LIMITS*

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### **5.14 Recognize the difference between hard and soft limits and modify existing resource limits**

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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#### **5.14.1 Concept**

Understand that resource limits are inherited by the shell as well as how to view their limits and change them both temporarily and permanently. In addition, understand the difference between soft and hard limits.

#### **5.14.2 Introduction**

#### **5.14.3 Examples**

#### **5.14.4 Practice Exercises**

#### **5.14.5 More information**

`limit(1)`, `limits(1)`, `login.conf(5)`; `sysctl(8)` on NetBSD

### **5.15 Recognize the BSD utilities that shape traffic or control bandwidth**

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

#### **5.15.1 Concept**

Understand when it is advantageous to create policies controlling the amount of bandwidth available to specified services. In addition, rec-

ognize the utilities available on BSD systems to create bandwidth policies.

### **5.15.2 Introduction**

### **5.15.3 Examples**

### **5.15.4 Practice Exercises**

### **5.15.5 More information**

ipfw(8), altq(4), dumynet(4), altq(9), altqd(8), altq.conf(5)

## **5.16 Recognize common, possibly third-party, server configuration files**

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### **5.16.1 Concept**

BSD systems are often used to provide Internet services. Be able to view or make a specified change to a service's configuration file and recognize the names of the most commonly used configuration files and which applications they are associated with.

### **5.16.2 Introduction**

### **5.16.3 Examples**

### **5.16.4 Practice Exercises**

### **5.16.5 More information**

httpd.conf(5), sendmail.cf, master.cf, dhcpd.conf(5), named.conf(5), smb.conf(5)

## 5.17 Configure a service to start at boot time

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 5.17.1 Concept

Recognize that the BSD boot process does not use runlevels. Be able to configure essential services to start at boot time to minimize the impact of a system reboot.

### 5.17.2 Introduction

### 5.17.3 Examples

### 5.17.4 Practice Exercises

### 5.17.5 More information

rc.conf(5), rc(8), inetd(8)

## 5.18 Configure the scripts that run periodically to perform various system maintenance tasks

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 5.18.1 Concept

BSD systems provide many scripts that are used to maintain and verify the integrity of the system. Be able to locate and run these scripts manually as required as well as configure which scripts run daily, weekly and monthly on each BSD system.

### **5.18.2 Introduction**

### **5.18.3 Examples**

### **5.18.4 Practice Exercises**

### **5.18.5 More information**

periodic.conf(5) and periodic(8) on Dragonfly and FreeBSD; security.conf(5), daily.conf(5), weekly.conf(5), and monthly.conf(5) on NetBSD; daily(8), weekly(8), and monthly(8) on OpenBSD

## **5.19 View the Sendmail or Postfix mail queue**

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### **5.19.1 Concept**

Be able to view the mail queue to determine if any mail is stuck in the queue, and if necessary, ask the MTA to reprocess or flush the queue.

### **5.19.2 Introduction**

### **5.19.3 Examples**

### **5.19.4 Practice Exercises**

### **5.19.5 More information**

mailq(1), postqueue(1)

## **5.20 Determine the last system boot time and the workload on the system**

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*



Reviewer: *name contact BSD flavour*

---

### 5.20.1 Concept

Be able to monitor the system's workload using the time since last system reboot, as well as the system load over the last 1, 5 and 15 minutes in order to determine operation parameters.

### 5.20.2 Introduction

### 5.20.3 Examples

### 5.20.4 Practice Exercises

### 5.20.5 More information

uptime(1), w(1), top(1)

## 5.21 Monitor disk input-output

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### 5.21.1 Concept

A system's disk input/output can have a dramatic impact on performance. Know how to use the utilities available on BSD systems to monitor disk I/O and interpret their results.

### **5.21.2 Introduction**

### **5.21.3 Examples**

### **5.21.4 Practice Exercises**

### **5.21.5 More information**

iostat(8), systat(1), vmstat(1), nfsstat(1)

## **5.22 Deal with busy devices**

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

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### **5.22.1 Concept**

Understand what can cause a process to hang, how to detect related processes and how to fix the situation.

### **5.22.2 Introduction**

### **5.22.3 Examples**

### **5.22.4 Practice Exercises**

### **5.22.5 More information**

ps(1), fstat(1), kill(1), umount(8) and the third-party lsof utility

## **5.23 Determine information regarding the operating system**

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

## 5.24. UNDERSTAND THE ADVANTAGES OF USING A BSD LICENSE

---

### 5.23.1 Concept

Be able to determine the type and version of the operating system installed.

### 5.23.2 Introduction

### 5.23.3 Examples

### 5.23.4 Practice Exercises

### 5.23.5 More information

uname(1), sysctl(8); /etc/release on NetBSD

## 5.24 Understand the advantages of using a BSD license

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 5.24.1 Concept

Recognize the 2-clause BSD license and how the license does not place restrictions on whether BSD licensed code remains Open Source or becomes integrated into a commercial product.

### 5.24.2 Introduction

### 5.24.3 Examples

### 5.24.4 Practice Exercises

### 5.24.5 More information

*CHAPTER 5. CHAPTER BASIC SYSTEM ADMINISTRATION*

---

# 6 Chapter Network Administration

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

TCP/IP was originally implemented on BSD systems and BSD systems continue to provide core networking services for a substantial portion of the Internet. Demonstrate a strong understanding of both IPv4 and IPv6 addressing as well as basic networking theory. Trainers and material providers should provide conceptual depth similar to that found in Network+ or in the networking theory section of CCNA.

- Determine the current TCP-IP settings on a system
- Set a system's TCP-IP settings
- Determine which TCP or UDP ports are open on a system
- Verify the availability of a TCP-IP service
- Query a DNS server
- Determine who is responsible for a DNS zone
- Change the order of name resolution
- Convert a subnet mask between dotted decimal, hexadecimal or CIDR notation
- Gather information using an IP address and subnet mask
- Understand IPv6 address theory
- Demonstrate basic `tcpdump(1)` skills

- Manipulate ARP and neighbor discovery caches
- Configure a system to use NTP
- View and renew a DHCP lease
- Recognize when and how to set or remove an interface alias

## 6.1 Determine the current TCP–IP settings on a system

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 6.1.1 Concept

Be able to determine a system’s IP address(es), subnet mask, default gateway, primary and secondary DNS servers and hostname.

### 6.1.2 Introduction

### 6.1.3 Examples

### 6.1.4 Practice Exercises

### 6.1.5 More information

ifconfig(8), netstat(1), resolv.conf(5), route(8), hostname(1)

## 6.2 Set a system’s TCP–IP settings

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 6.3. DETERMINE WHICH TCP OR UDP PORTS ARE OPEN ON A SYSTEM

---

#### 6.2.1 Concept

Be able to modify required TCP/IP settings both temporarily and permanently in order to remain after a reboot.

#### 6.2.2 Introduction

#### 6.2.3 Examples

#### 6.2.4 Practice Exercises

#### 6.2.5 More information

hostname (1), ifconfig(8), route(8), resolv.conf(5), rc.conf(5), hosts(5), hostname.if(5), myname(5), mygate(5), netstart(8)

### 6.3 Determine which TCP or UDP ports are open on a system

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

#### 6.3.1 Concept

Be able to use the utilities found on BSD systems as well as third-party programs to determine which ports are open on a system and which ports are being seen through a firewall.

#### 6.3.2 Introduction

#### 6.3.3 Examples

#### 6.3.4 Practice Exercises

#### 6.3.5 More information

netstat(1), services(5) and fstat(1); sockstat(1) and third-party nmap and lsof

## 6.4 Verify the availability of a TCP-IP service

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 6.4.1 Concept

Be able to determine if a remote system is available via TCP/IP, and if so, telnet(1) to a particular TCP service to determine if it is responding to client requests.

### 6.4.2 Introduction

### 6.4.3 Examples

### 6.4.4 Practice Exercises

### 6.4.5 More information

ping(8), traceroute(8), telnet(1); nc(1) on FreeBSD and OpenBSD

## 6.5 Query a DNS server

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 6.5.1 Concept

Understand basic DNS theory, including types of resource records, types of DNS servers, reverse lookups and zone transfers. Be able to query a DNS server for a particular type of resource record, understand which servers are authoritative for a zone and determine if a DNS server is willing to do a zone transfer.



## 6.6. DETERMINE WHO IS RESPONSIBLE FOR A DNS ZONE

### **6.5.2 Introduction**

### **6.5.3 Examples**

### **6.5.4 Practice Exercises**

### **6.5.5 More information**

dig(1), host(1), nslookup(1), ping(8), telnet(1)

## **6.6 Determine who is responsible for a DNS zone**

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### **6.6.1 Concept**

Be able to perform a reverse DNS lookup to determine the network associated with an IP address and gather contact information regarding that network.

### **6.6.2 Introduction**

### **6.6.3 Examples**

### **6.6.4 Practice Exercises**

### **6.6.5 More information**

dig(1) and whois(1)

## **6.7 Change the order of name resolution**

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 6.7.1 Concept

Be able to determine the default order of host name resolution on BSD systems and recognize which configuration file controls the order of host name resolution.

### 6.7.2 Introduction

### 6.7.3 Examples

### 6.7.4 Practice Exercises

### 6.7.5 More information

ping(8), telnet(1), nsswitch.conf(5), resolv.conf(5), host.conf(5)

## 6.8 Convert a subnet mask between dotted decimal, hexadecimal or CIDR notation

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 6.8.1 Concept

Be familiar with IPv4 addressing and how to convert a subnet mask from a given notation to another specified notation.

### 6.8.2 Introduction

### 6.8.3 Examples

### 6.8.4 Practice Exercises

### 6.8.5 More information

## 6.9 Gather information using an IP address and subnet mask

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 6.9.1 Concept

Given an IPv4 address and subnet mask, be able to determine the subnet address, broadcast address and the valid host addresses available on that subnet address.

### 6.9.2 Introduction

### 6.9.3 Examples

### 6.9.4 Practice Exercises

### 6.9.5 More information

## 6.10 Understand IPv6 address theory

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 6.10.1 Concept

Be able to recognize basic IPv6 addressing theory including: the components of an IPv6 address; the support for multiple addresses (link, local, global) per interface; address and prefix representation (aaaa:bbbb::dddd/17) and the address format (48bit prefix, 16bit subnet, 64 hostbits). In addition, understand the autoconfiguration process where the router sends its prefix or gets queried and the host adds its 64 host-bits which are derived from its MAC address. Finally, be able to troubleshoot basic IPv6 connectivity.

### 6.10.2 Introduction

### 6.10.3 Examples

### 6.10.4 Practice Exercises

### 6.10.5 More information

ifconfig(8), ping6(8), rtsol(8)

## 6.11 Demonstrate basic tcpdump(1) skills

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 6.11.1 Concept

Given some tcpdump(1) output, an admin should be able to answer basic network connectivity questions. Recognize common TCP and UDP port numbers, the difference between a TCP/IP server and a TCP/IP client, and the TCP three-way handshake.

### 6.11.2 Introduction

### 6.11.3 Examples

### 6.11.4 Practice Exercises

### 6.11.5 More information

tcpdump(1)

## 6.12 Manipulate ARP and neighbor discovery caches

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 6.12.1 Concept

Understand basic ARP theory as well as the neighbor discovery cache used on IPv6 networks. Be able to view, modify and clear these caches and recognize when it is necessary to do so.

### 6.12.2 Introduction

### 6.12.3 Examples

### 6.12.4 Practice Exercises

### 6.12.5 More information

arp(8), ndp(8)

## 6.13 Configure a system to use NTP

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 6.13.1 Concept

Be familiar with the concepts in RFC 868, the importance of synchronizing time on server systems and which services in particular are time sensitive. Be able to configure NTP and manually synchronize with a time server as required.

### 6.13.2 Introduction

### 6.13.3 Examples

### 6.13.4 Practice Exercises

### 6.13.5 More information

`ntpdate(8)`, `ntpd.conf(5)`, `rc.conf(5)`, `rdate(8)`

## 6.14 View and renew a DHCP lease

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 6.14.1 Concept

An admin should have a basic understanding of DHCP leases and how to configure a client to override the settings received from a DHCP server. In addition, be able to view the current lease, release it and renew a lease. Since the DHCP client used varies, be familiar with using the DHCP client commands on each BSD.

### 6.14.2 Introduction

### 6.14.3 Examples

### 6.14.4 Practice Exercises

### 6.14.5 More information

`dhclient(8)`, `dhclient.leases(5)`, `dhclient.conf(5)`, `rc.conf(5)`

## **6.15 Recognize when and how to set or remove an interface alias**

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### **6.15.1 Concept**

Recognize when it is appropriate to set or remove an interface alias and the available commands on each of the BSDs.

### **6.15.2 Introduction**

### **6.15.3 Examples**

### **6.15.4 Practice Exercises**

### **6.15.5 More information**

ifconfig(8), rc.conf(5), ifaliases(5), hostname.if(5)





# 7 Chapter Basic Unix Skills

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

BSD has its roots in Unix and many Unix utilities were originally developed on BSD systems. Demonstrate proficiency in the most commonly used Unix command line utilities.

- Demonstrate proficiency in using redirection, pipes and tees
- Recognize, view and modify environmental variables
- Be familiar with the vi(1) editor
- Determine if a file is a binary, text, or data file
- Locate files and binaries on a system
- Find a file with a given set of attributes
- Create a simple Bourne shell script
- Find appropriate documentation
- Recognize the different sections of the manual
- Verify a file's message digest fingerprint (checksum)
- Demonstrate familiarity with the default shell
- Read mail on the local system
- Use job control
- Demonstrate proficiency with regular expressions

- Overcome command line length limitations
- Understand various “domain” contexts
- Configure an action to be scheduled by cron(8)

## 7.1 Demonstrate proficiency in using redirection, pipes and tees

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 7.1.1 Concept

Be able to to redirect standard input, output or error, use a pipe to send the output of one command to another command or file, and use a tee to copy standard input to standard output.

### 7.1.2 Introduction

### 7.1.3 Examples

### 7.1.4 Practice Exercises

### 7.1.5 More information

<, >, |, tee(1), >\& and |&

## 7.2 Recognize, view and modify environmental variables

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 7.2.1 Concept

Be able to view and modify environmental variables both temporarily and permanently for each of the default shells found on BSD systems.

### 7.2.2 Introduction

### 7.2.3 Examples

### 7.2.4 Practice Exercises

### 7.2.5 More information

env(1), sh(1), csh(1), tcsh(1), environ(7)

## 7.3 Be familiar with the vi(1) editor

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 7.3.1 Concept

The default editor on BSD systems is often vi(1) and many system utilities require familiarity with vi(1) commands. Be able to edit files using this editor, as well as modify a read-only file or exit vi(1) without saving any edits to the file.

### 7.3.2 Introduction

### 7.3.3 Examples

### 7.3.4 Practice Exercises

### 7.3.5 More information

vi(1) including: :w, :wq, :wq!, :q!, dd, y, p, x, i, a, /, :, :r, ZZ, :set number, :set list

## 7.4 Determine if a file is a binary, text, or data file

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 7.4.1 Concept

While BSD systems use naming conventions to help determine the type of file, an admin should be aware that these are conventions only and that there is a magic database to help determine file type.

### 7.4.2 Introduction

### 7.4.3 Examples

### 7.4.4 Practice Exercises

### 7.4.5 More information

file(1), magic(5)

## 7.5 Locate files and binaries on a system

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 7.5.1 Concept

Be able to quickly find the location of any file on the system as needed and know which utilities can be used to find binaries, source, man-pages and files. In addition, be able to update the locate(1) database.

## 7.5.2 Introduction

## 7.5.3 Examples

## 7.5.4 Practice Exercises

## 7.5.5 More information

whatis(1); whereis(1); which(1); locate(1); find(1); sh(1) including “type” built-in, -v and -V; locate.updatedb(8) or locate.conf(5)

# 7.6 Find a file with a given set of attributes

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

## 7.6.1 Concept

The find(1) utility is invaluable when searching for files matching a specific set of attributes. Be comfortable in using this utility and may be asked to locate files according to last modification time, size, type, file flags, UID or GID, permissions or by a text pattern.

## 7.6.2 Introduction

## 7.6.3 Examples

## 7.6.4 Practice Exercises

## 7.6.5 More information

find(1)

# 7.7 Create a simple Bourne shell script

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

### 7.7.1 Concept

Most system administration tasks can be automated with shell scripts. Be aware of the advantages and disadvantages of using a Bourne shell script rather than a `csh(1)` or `bash(1)` shell script. Be able to recognize a shebang, comments, positional parameters and special parameters, wildcards, the proper use of quotes and backslashes and: `for`, `while`, `if`, `case`, and `exec`. In addition, know how to make a script executable and how to troubleshoot a script.

### 7.7.2 Introduction

### 7.7.3 Examples

### 7.7.4 Practice Exercises

### 7.7.5 More information

`sh(1)`, `chmod(1)`

## 7.8 Find appropriate documentation

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 7.8.1 Concept

BSD systems are well documented and there are many detailed resources available to the system administrator. Be able to use the documentation found on the system itself as well as be aware of the resources available on the Internet.

## 7.8.2 Introduction

## 7.8.3 Examples

## 7.8.4 Practice Exercises

## 7.8.5 More information

`apropos(1)`, `man(1)`, `man.conf(5)`, `whatis(1)`, and `info(1)`; `share/doc/` and `share/examples/`; in addition, each BSD project maintains an on-line handbook and several mailing lists

# 7.9 Recognize the different sections of the manual

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

## 7.9.1 Concept

Recognize what type of information is found in each section of the manual. In addition, be able to specify a specific section of the manual, ask to see all sections of the manual, and do a search query within the manual.

## 7.9.2 Introduction

## 7.9.3 Examples

## 7.9.4 Practice Exercises

## 7.9.5 More information

`man (1)`, `intro(1)` to `intro(9)`, “/”

## 7.10 Verify a file's message digest fingerprint (checksum)

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 7.10.1 Concept

Be familiar with the theory behind a message digest fingerprint and why it is important to verify a file's fingerprint. In addition, be able to create a fingerprint as well as verify an existing fingerprint.

### 7.10.2 Introduction

### 7.10.3 Examples

### 7.10.4 Practice Exercises

### 7.10.5 More information

md5(1), openssl(1), sha1(1), cksum(1)

## 7.11 Demonstrate familiarity with the default shell

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 7.11.1 Concept

Be comfortable using the sh(1), csh(1) or tcsh(1) shells. Be able to modify shell behavior both temporarily and permanently including:



prevent the shell from clobbering existing files, use history substitution, and set command aliases to save time at the command line. Know how to temporarily bypass a command alias.

### 7.11.2 Examples

### 7.11.3 Practice Exercises

### 7.11.4 More information

sh(1), csh(1), and tcsh(1) including: !, !!, \\$, 0, h, t, r, p, Introduction

## 7.12 Read mail on the local system

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 7.12.1 Concept

Be aware that by default, system messages may be emailed to the root user on the local system and that a third-party MUA may not be installed. Be able to both read and send mail using the built-in mail(1) command. Know the location of user mailbox files.

### 7.12.2 Introduction

### 7.12.3 Examples

### 7.12.4 Practice Exercises

### 7.12.5 More information

mail(1), /var/mail/\\$USER

## 7.13 Use job control

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 7.13.1 Concept

Know how to start a process in the background, place an existing process into the background, and return a background process to the foreground. Be able to verify if any jobs are currently in the background and be aware of the difference between `kill(1)` and the shell built-in “kill”.

### 7.13.2 Introduction

### 7.13.3 Examples

### 7.13.4 Practice Exercises

### 7.13.5 More information

\&, CTRL-Z, jobs, bg, fg, and “kill” which are all built-in to the shell

## 7.14 Demonstrate proficiency with regular expressions

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 7.14.1 Concept

Regular expressions are part of the daily life of a system administrator. Be able to match text patterns when analyzing program output or searching through files. Be able to specify a range of characters within brackets [], specify a literal, use a repetition operator, recognize a metacharacter and create an inverse filter.

## 7.15. OVERCOME COMMAND LINE LENGTH LIMITATIONS

### **7.14.2 Introduction**

### **7.14.3 Examples**

### **7.14.4 Practice Exercises**

### **7.14.5 More information**

grep(1), egrep(1), fgrep(1), re\_format(7)

## **7.15 Overcome command line length limitations**

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### **7.15.1 Concept**

The command line length is limited, and often a command should be applied to more arguments than fit on a command line. Understand how to run the command multiple times with different arguments for each call using xargs(1) or a shell “while” read loop.

### **7.15.2 Introduction**

### **7.15.3 Examples**

### **7.15.4 Practice Exercises**

### **7.15.5 More information**

xargs(1), find(1)

## **7.16 Understand various “domain” contexts**

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 7.16.1 Concept

The term “domain” is used in Unix for several facilities. Understand the meaning of the term in the context of the Network Information System (NIS), the Domain Name System (DNS), Kerberos, and NTLM domains.

### 7.16.2 Introduction

### 7.16.3 Examples

### 7.16.4 Practice Exercises

### 7.16.5 More information

domainname(1), resolv.conf(5), krb5.conf(5), smb.conf(5)

## 7.17 Configure an action to be scheduled by cron(8)

Author: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

Reviewer: *name contact BSD flavour*

---

### 7.17.1 Concept

Understand the difference between the system crontab and user crontabs. In addition, be familiar with using the crontab editor, be able to recognize the time fields seen in a crontab, and understand the importance of testing scripts before scheduling their execution through cron(8). Recognize that the files `/var/cron/allow` and `/var/cron/deny` can be created to control which users can create their own crontabs.

*7.17. CONFIGURE AN ACTION TO BE SCHEDULED BY  
CRON(8)*

---

**7.17.2 Introduction**

**7.17.3 Examples**

**7.17.4 Practice Exercises**

**7.17.5 More information**

crontab(1), cron(8), crontab(5)



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