

## [▣ Section 1: Setting up a Secure Linux System](#)

### [▣ Running Linux in a Virtual Environment](#)

[Looking at the threat landscape](#)

[Why do security breaches happen?](#)

[Keeping up with security news](#)

[Differences between physical, virtual, and cloud setups](#)

[Introducing VirtualBox and Cygwin](#)

[Installing a virtual machine in VirtualBox](#)

[Installing the EPEL repository on the CentOS 7 virtual machine](#)

[Installing the EPEL repository on the AlmaLinux 8/9 virtual machines](#)

[Configuring a network for VirtualBox virtual machines](#)

[Creating a virtual machine snapshot with VirtualBox](#)

[Using Cygwin to connect to your virtual machines](#)

[Installing Cygwin on your Windows host](#)

[Using the Windows 10 SSH client to interface with Linux virtual machines](#)

[Using the Windows 11 SSH client to interface with Linux virtual machines](#)

[Cygwin versus the Windows shell](#)

[Keeping the Linux systems updated](#)

[Updating Debian-based systems](#)

[Configuring auto updates for Ubuntu](#)

[Updating Red Hat 7-based systems](#)

[Updating Red Hat 8/9-based systems](#)

[Managing updates in an enterprise](#)

[Summary](#)

[Questions](#)

[Further reading](#)

[Answers](#)

### [▣ Securing Administrative User Accounts](#)

[The dangers of logging in as the root user](#)

[The advantages of using sudo](#)

[Setting up sudo privileges for full administrative users](#)

[Adding users to a predefined admin group](#)

[Creating an entry in the sudo policy file](#)

[Setting up sudo for users with only certain delegated privileges](#)

[Hands-on lab for assigning limited sudo privileges](#)

[Advanced tips and tricks for using sudo](#)

[The sudo timer](#)

[View your sudo privileges](#)

[Hands-on lab for disabling the sudo timer](#)

[Preventing users from having root shell access](#)

[Preventing users from using shell escapes](#)

[Preventing users from using other dangerous programs](#)

[Limiting the user's actions with commands](#)

[Letting users run as other users](#)

[Preventing abuse via a user's shell scripts](#)

[Detecting and deleting default user accounts](#)

[New sudo features](#)

[Special sudo considerations for SUSE and OpenSUSE](#)

[Summary](#)

[Questions](#)

[Further reading](#)

[Answers](#)

▣ [Securing Normal User Accounts](#)

[Locking down users' home directories the Red Hat way](#)

[Locking down users' home directories the Debian/Ubuntu way](#)

[useradd on Debian/Ubuntu](#)

[adduser on Debian/Ubuntu](#)

[Hands-on lab for creating an encrypted home directory with adduser](#)

[Enforcing strong password criteria](#)

[Installing and configuring pwquality](#)

[Hands-on lab for setting password complexity criteria](#)

[Setting and enforcing password and account expiration](#)

[Configuring default expiry data for useradd for Red Hat-type systems only](#)

[Setting expiry data on a per-account basis with useradd and usermod](#)

[Setting expiry data on a per-account basis with chage](#)

[Hands-on lab for setting account and password expiry data](#)

[Preventing brute-force password attacks](#)

[Configuring the pam\\_tally2 PAM module on CentOS 7](#)

[Hands-on lab for configuring pam\\_tally2 on CentOS 7](#)

[Configuring pam\\_faillock on AlmaLinux 8/9](#)

[Hands-on lab for configuring pam\\_faillock on AlmaLinux 8 or AlmaLinux 9](#)

[Configuring pam\\_faillock on Ubuntu 20.04 and Ubuntu 22.04](#)

[Hands-on lab for configuring pam\\_faillock on Ubuntu 20.04 and Ubuntu 22.04](#)

[Locking user accounts](#)

[Using usermod to lock a user account](#)

[Using passwd to lock user accounts](#)

[Locking the root user account](#)

[Setting up security banners](#)

[Using the motd file](#)

[Using the issue file](#)

[Using the issue.net file](#)

[Detecting compromised passwords](#)

[Hands-on lab for detecting compromised passwords](#)

[Understanding centralized user management](#)

[Microsoft Active Directory](#)

[Samba on Linux](#)

[FreeIPA/Identity Management on RHEL-type distros](#)

[Summary](#)

[Questions](#)

[Further reading](#)

[Answers](#)

▣ [Securing Your Server with a Firewall – Part 1](#)

[Technical requirements](#)

[An overview of the Linux firewall](#)

[An overview of iptables](#)

[Mastering the basics of iptables](#)

[Blocking ICMP with iptables](#)

[Blocking everything that isn't allowed with iptables](#)

[Hands-on lab for basic iptables usage](#)

[Blocking invalid packets with iptables](#)

[Restoring the deleted rules](#)

[Hands-on lab for blocking invalid IPv4 packets](#)

[Protecting IPv6](#)

[Hands-on lab for ip6tables](#)

[nftables – a more universal type of firewall system](#)

[Learning about nftables tables and chains](#)

[Getting started with nftables](#)

[Configuring nftables on Ubuntu](#)

[Using nft commands](#)

[Hands-on lab for nftables on Ubuntu](#)

[Summary](#)

[Questions](#)

[Further reading](#)

[Answers](#)

▣ [Securing Your Server with a Firewall — Part 2](#)

[Technical requirements](#)

[The Uncomplicated Firewall for Ubuntu systems](#)

[Configuring ufw](#)

[Working with the ufw configuration files](#)

[Hands-on lab for basic ufw usage](#)

[firewalld for Red Hat systems](#)

[Verifying the status of firewalld](#)

[Working with firewalld zones](#)

[Adding services to a firewalld zone](#)

[Adding ports to a firewalld zone](#)

[Blocking ICMP](#)

[Using panic mode](#)

[Logging dropped packets](#)

[Using firewalld rich language rules](#)

[Looking at iptables rules in RHEL/CentOS 7 firewalld](#)

[Creating direct rules in RHEL/CentOS 7 firewalld](#)

[Looking at nftables rules in RHEL/AlmaLinux 8 and 9 firewalld](#)

[Creating direct rules in RHEL/AlmaLinux firewalld](#)

[Hands-on lab for firewalld commands](#)

[Summary](#)

[Questions](#)

[Further reading](#)

[Answers](#)

## [☐ Encryption Technologies](#)

### [GNU Privacy Guard \(GPG\)](#)

[Hands-on lab – creating your GPG keys](#)

[Hands-on lab – symmetrically encrypting your own files](#)

[Hands-on lab – encrypting files with public keys](#)

[Hands-on lab – signing a file without encryption](#)

[Encrypting partitions with Linux Unified Key Setup \(LUKS\)](#)

[Disk encryption during operating system installation](#)

[Hands-on lab – adding an encrypted partition with LUKS](#)

[Configuring the LUKS partition to mount automatically](#)

[Hands-on lab – configuring the LUKS partition to mount automatically](#)

[Encrypting directories with eCryptfs](#)

[Hands-on lab – encrypting a home directory for a new user account](#)

[Creating a private directory within an existing home directory](#)

[Hands-on lab – encrypting other directories with eCryptfs](#)

[Encrypting the swap partition with eCryptfs](#)

[Using VeraCrypt for cross-platform sharing of encrypted containers](#)

[Hands-on lab – getting and installing VeraCrypt](#)

[Hands-on lab – creating and mounting a VeraCrypt volume in console mode](#)

[Using VeraCrypt in GUI mode](#)

[OpenSSL and the Public Key Infrastructure](#)

[Commercial certificate authorities](#)

[Creating keys, certificate signing requests, and certificates](#)

[Creating a self-signed certificate with an RSA key](#)

[Creating a self-signed certificate with an Elliptic Curve key](#)

[Creating an RSA key and a Certificate Signing Request](#)

[Creating an EC key and a CSR](#)

[Creating an on-premises CA](#)

[Hands-on lab – setting up a Dogtag CA](#)

[Adding a CA to an operating system](#)

[Hands-on lab – exporting and importing the Dogtag CA certificate](#)

[Importing the CA into Windows](#)

[OpenSSL and the Apache webserver](#)

[Hardening Apache SSL/TLS on Ubuntu](#)

[Hardening Apache SSL/TLS on RHEL 9/AlmaLinux 9](#)

[Setting FIPS mode on RHEL 9/AlmaLinux 9](#)

[Hardening Apache SSL/TLS on RHEL 7/CentOS 7](#)

[Setting up mutual authentication](#)

[Introducing quantum-resistant encryption algorithms](#)

[Summary](#)

[Questions](#)

[Further reading](#)

[Answers](#)

## [☐ SSH Hardening](#)

[Ensuring that SSH protocol 1 is disabled](#)

[Creating and managing keys for passwordless logins](#)

[Creating a user's SSH key set](#)  
[Transferring the public key to the remote server](#)  
[Hands-on lab – creating and transferring SSH keys](#)  
[Disabling root user login](#)  
[Disabling username/password logins](#)  
[Hands-on lab – Disabling root login and password authentication](#)  
[Enabling two-factor authentication](#)  
[Hands-on lab – Setting up two-factor authentication on Ubuntu 22.04](#)  
[Hands-on lab – Using Google Authenticator with key exchange on Ubuntu](#)  
[Hands-on lab – Setting up two-factor authentication on AlmaLinux 8](#)  
[Hand-on lab – Using Google Authenticator with key exchange on AlmaLinux 8](#)  
[Configuring Secure Shell with strong encryption algorithms](#)  
[Understanding SSH encryption algorithms](#)  
[Scanning for enabled SSH algorithms](#)  
[Hands-on lab – Scanning with Nmap](#)  
[Disabling weak SSH encryption algorithms](#)  
[Hands-on lab – disabling weak SSH encryption algorithms – Ubuntu 22.04](#)  
[Hands-on lab – disabling weak SSH encryption algorithms – CentOS 7](#)  
[Setting system-wide encryption policies on RHEL 8/9 and AlmaLinux 8/9](#)  
[Hands-on lab – setting encryption policies on AlmaLinux 9](#)  
[Configuring more detailed logging](#)  
[Hands-on lab – configuring more verbose SSH logging](#)  
[Configuring access control with whitelists and TCP Wrappers](#)  
[Configuring whitelists within sshd\\_config](#)  
[Hands-on lab – configuring whitelists within sshd\\_config](#)  
[Configuring whitelists with TCP Wrappers](#)  
[Configuring automatic logouts and security banners](#)  
[Configuring automatic logout for both local and remote users](#)  
[Configuring automatic logout in sshd\\_config](#)  
[Creating a pre-login security banner](#)  
[Configuring other miscellaneous security settings](#)  
[Disabling X11 forwarding](#)  
[Disabling SSH tunneling](#)  
[Changing the default SSH port](#)  
[Managing SSH keys](#)  
[Setting different configurations for different users and groups](#)  
[Creating different configurations for different hosts](#)  
[Setting up a chroot environment for SFTP users](#)  
[Creating a group and configuring the sshd\\_config file](#)  
[Hands-on lab – Setting up a chroot directory for the sftpusers group](#)  
[Sharing a directory with SSHFS](#)  
[Hands-on lab – Sharing a directory with SSHFS](#)  
[Remotely connecting from Windows desktops](#)  
[Summary](#)  
[Questions](#)  
[Further reading](#)

## [Answers](#)

### [❏ Section 2: Mastering File and Directory Access Control \(DAC\)](#)

#### [❏ Mastering Discretionary Access Control](#)

[Using chown to change ownership of files and directories](#)

[Using chmod to set permissions on files and directories](#)

[Setting permissions with the symbolic method](#)

[Setting permissions with the numerical method](#)

[Using SUID and SGID on regular files](#)

[The security implications of the SUID and SGID permissions](#)

[Finding spurious SUID or SGID files](#)

[Preventing SUID and SGID usage on a partition](#)

[Using extended file attributes to protect sensitive files](#)

[Setting the a attribute](#)

[Setting the i attribute](#)

[Securing system configuration files](#)

[Summary](#)

[Questions](#)

[Further reading](#)

## [Answers](#)

### [❏ Access Control Lists and Shared Directory Management](#)

[Creating an ACL for either a user or a group](#)

[Creating an inherited ACL for a directory](#)

[Removing a specific permission by using an ACL mask](#)

[Using the tar --acls option to prevent the loss of ACLs during a backup](#)

[Creating a user group and adding members to it](#)

[Adding members as we create their user accounts](#)

[Using usermod to add an existing user to a group](#)

[Adding users to a group by editing the /etc/group file](#)

[Creating a shared directory](#)

[Setting the SGID bit and the sticky bit on the shared directory](#)

[Using ACLs to access files in the shared directory](#)

[Setting the permissions and creating the ACL](#)

[Hands-on lab – creating a shared group directory](#)

[Summary](#)

[Questions](#)

[Further reading](#)

## [Answers](#)

### [❏ Section 3: Advanced System Hardening Techniques](#)

#### [❏ Implementing Mandatory Access Control with SELinux and AppArmor](#)

[How SELinux can benefit a systems administrator](#)

[Setting security contexts for files and directories](#)

[Installing the SELinux tools](#)

[Creating web content files with SELinux enabled](#)

[Fixing an incorrect SELinux context](#)

[Using chcon](#)

[Using restorecon](#)

[Using semanage](#)  
[Hands-on lab – SELinux type enforcement](#)  
[Troubleshooting with setroubleshoot](#)  
[Viewing setroubleshoot messages](#)  
[Using the graphical setroubleshoot utility](#)  
[Troubleshooting in permissive mode](#)  
[Working with SELinux policies](#)  
[Viewing Booleans](#)  
[Configuring the Booleans](#)  
[Protecting your web server](#)  
[Protecting network ports](#)  
[Creating custom policy modules](#)  
[Hands-on lab – SELinux Booleans and ports](#)  
[How AppArmor can benefit a systems administrator](#)  
[Looking at AppArmor profiles](#)  
[Working with AppArmor command-line utilities](#)  
[Troubleshooting AppArmor problems](#)  
[Troubleshooting an AppArmor profile – Ubuntu 16.04](#)  
[Troubleshooting an AppArmor profile – Ubuntu 18.04](#)  
[Hands-on lab – Troubleshooting an AppArmor profile](#)  
[Troubleshooting Samba problems in Ubuntu 22.04](#)  
[Exploiting a system with an evil Docker container](#)  
[Hands-on lab – Creating an evil Docker container](#)  
[Summary](#)  
[Questions](#)  
[Further reading](#)  
[Answers](#)  
[📄 Kernel Hardening and Process Isolation](#)  
[Understanding the /proc filesystem](#)  
[Looking at user-mode processes](#)  
[Looking at kernel information](#)  
[Setting kernel parameters with sysctl](#)  
[Configuring the sysctl.conf file](#)  
[Configuring sysctl.conf – Ubuntu](#)  
[Configuring sysctl.conf – CentOS and AlmaLinux](#)  
[Setting additional kernel-hardening parameters](#)  
[Hands-on lab – scanning kernel parameters with Lynis](#)  
[Preventing users from seeing each others' processes](#)  
[Understanding process isolation](#)  
[Understanding Control Groups \(cgroups\)](#)  
[Understanding namespace isolation](#)  
[Understanding kernel capabilities](#)  
[Hands-on lab – setting a kernel capability](#)  
[Understanding SECCOMP and system calls](#)  
[Using process isolation with Docker containers](#)  
[Sandboxing with Firejail](#)

[Hands-on lab – using Firejail](#)

[Sandboxing with Snappy](#)

[Sandboxing with Flatpak](#)

[Summary](#)

[Questions](#)

[Further reading](#)

[Answers](#)

▣ [Scanning, Auditing, and Hardening](#)

[Installing and updating ClamAV and maldet](#)

[Hands-on lab – installing ClamAV and maldet](#)

[Hands-on lab – configuring maldet](#)

[Updating ClamAV and maldet](#)

[Scanning with ClamAV and maldet](#)

[SELinux considerations](#)

[Scanning for rootkits with Rootkit Hunter](#)

[Hands-on lab – installing and updating Rootkit Hunter](#)

[Scanning for rootkits](#)

[Performing a quick malware analysis with strings and VirusTotal](#)

[Analyze a file with strings](#)

[Scanning the malware with VirusTotal](#)

[Understanding the auditd daemon](#)

[Creating audit rules](#)

[Auditing a file for changes](#)

[Auditing a directory](#)

[Auditing system calls](#)

[Using ausearch and aureport](#)

[Searching for file change alerts](#)

[Searching for directory access rule violations](#)

[Searching for system call rule violations](#)

[Generating authentication reports](#)

[Using pre-defined rulesets](#)

[Hands-on lab – using auditd](#)

[Hands-on lab –Using pre-configured rules with auditd](#)

[Auditing files and directories with inotifywait](#)

[Applying OpenSCAP policies with oscap](#)

[Installing OpenSCAP](#)

[Viewing the profile files](#)

[Getting the missing profiles for Ubuntu](#)

[Scanning the system](#)

[Remediating the system](#)

[Using SCAP Workbench](#)

[Choosing an OpenSCAP profile](#)

[Applying an OpenSCAP profile during system installation](#)

[Summary](#)

[Questions](#)

[Further reading](#)



## [Answers](#)

### [📁 Logging and Log Security](#)

[Understanding the Linux system log files](#)

[The system log and the authentication log](#)

[The utmp, wtmp, btmp, and lastlog files](#)

[Understanding rsyslog](#)

[Understanding rsyslog logging rules](#)

[Understanding journald](#)

[Making things easier with Logwatch](#)

[Hands-on lab – installing Logwatch](#)

[Setting up a remote log server](#)

[Hands-on lab – setting up a basic log server](#)

[Creating an encrypted connection to the log server](#)

[Creating a stunnel connection on AlmaLinux 9 – server side](#)

[Creating a stunnel connection on AlmaLinux – client side](#)

[Creating a stunnel connection on Ubuntu – server side](#)

[Creating a stunnel connection on Ubuntu – client side](#)

[Separating client messages into their own files](#)

[Maintaining Logs in Large Enterprises](#)

[Summary](#)

[Questions](#)

[Further reading](#)

## [Answers](#)

### [📁 Vulnerability Scanning and Intrusion Detection](#)

[Introduction to Snort and Security Onion](#)

[Obtaining and installing Snort](#)

[Hands-on lab – installing Snort via a Docker container](#)

[Using Security Onion](#)

[IPFire and its built-in Intrusion Prevention System \(IPS\)](#)

[Hands-on lab – Creating an IPFire virtual machine](#)

[Scanning and hardening with Lynis](#)

[Installing Lynis on Red Hat/CentOS](#)

[Installing Lynis on Ubuntu](#)

[Scanning with Lynis](#)

[Finding vulnerabilities with the Greenbone Security Assistant](#)

[Web server scanning with Nikto](#)

[Nikto in Kali Linux](#)

[Hands-on lab–Installing Nikto from Github](#)

[Scanning a web server with Nikto](#)

[Summary](#)

[Questions](#)

[Further reading](#)

## [Answers](#)

### [📁 Prevent Unwanted Programs from Running](#)

[Mount Partitions with the no options](#)

[Understanding fapolicyd](#)

[Understanding the fapolicyd rules](#)

[Installing fapolicyd](#)

[Summary](#)

[Further reading](#)

[Questions](#)

[Answers](#)

📖 [Security Tips and Tricks for the Busy Bee](#)

[Technical requirements](#)

[Auditing system services](#)

[Auditing system services with systemctl](#)

[Auditing network services with netstat](#)

[Hands-on lab – viewing network services with netstat](#)

[Auditing network services with Nmap](#)

[Port states](#)

[Scan types](#)

[Hands-on lab – scanning with Nmap](#)

[Password-protecting the GRUB2 bootloader](#)

[Hands-on lab – resetting the password for Red Hat/CentOS/AlmaLinux](#)

[Hands-on lab – resetting the password for Ubuntu](#)

[Preventing kernel parameter edits on Red Hat/CentOS/AlmaLinux](#)

[Preventing kernel parameter edits or recovery mode access on Ubuntu](#)

[Disabling the submenu for Ubuntu](#)

[Securely configuring BIOS/UEFI](#)

[Using a security checklist for system setup](#)

[Summary](#)

[Questions](#)

[Further reading](#)

[Answers](#)

📖 [Other Books You May Enjoy](#)

📖 [Index](#)