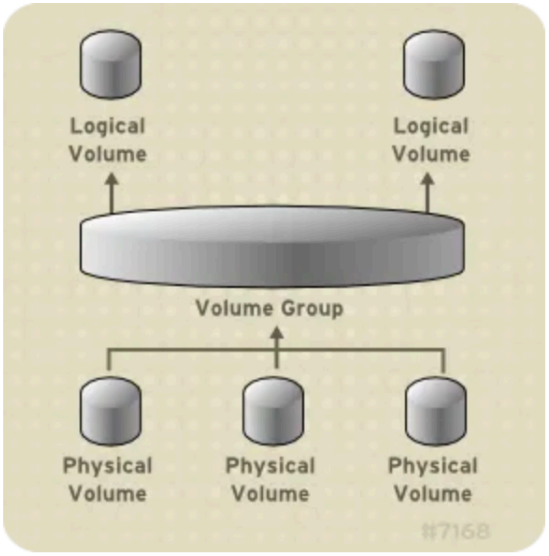



```
OBJECTIVE: SCORE
Manage basic networking: 100%
Understand and use essential tools: 10%
Operate running systems: 0%
Configure local storage: 25%
Create and configure file systems: 25%
Deploy, configure and maintain systems: 29%
Manage users and groups: 0%
Manage security: 0%
Manage containers: 0%
Create simple shell scripts: 0%
```

RHCSA

Kernel Package	Description
kernel	Contains no files, but ensures other kernel packages are accurately installed
kernel-core	Includes a minimal number of modules to provide core functionality
kernel-devel	Includes support for building kernel modules
kernel-modules	Contains modules for common hardware devices
kernel-modules-extra	Contains modules for not-so-common hardware devices
kernel-headers	Includes files to support the interface between the kernel and userspace libraries and programs
kernel-tools	Includes tools to manipulate the kernel
kernel-tools-libs	Includes the libraries to support the kernel tools

cat
cat
cat

groupadd -o -g 5000 dba
groupadd -o -g linuxadm
useradd user1000
usermod -aG dba user1000
/etc/group
/etc/passwd
groupmod -n sysadm linuxadm
groupmod -g 6000 sysadm
groupdel sysadm
/etc/group
visudo
groupadd -g 6000 lnxgroup
useradd -u 5000 -g 6000 user5000
passwd user5000
chage -m 4 -M 30 user5000

groupmod -g 4000 lnxgroup
`sudo groupmod -g 7000 lnxgrp`

When two groups have an identical GID, members of both groups get identical rights on each other's files.
Job scheduling and execution is taken care of by two service daemons: atd and crond.

While atd manages the jobs scheduled to run one time in the future, crond is responsible for running jobs repetitively at pre-specified times.
/var/spool/cron and /etc/cron.d directories
/etc directory for either service. These files are named at.allow and at.deny for the at service, and cron.allow and cron.deny for the cron service.

Variable	Description
DISPLAY	Stores the hostname or IP address for graphical terminal sessions
HISTFILE	Defines the file for storing the history of executed commands
HISTSIZE	Defines the maximum size for the HISTFILE
HOME	Sets the home directory path
LOGNAME	Retains the login name
MAIL	Contains the path to the user mail directory
PATH	Defines a colon-separated list of directories to be searched when executing a command. A correct setting of this variable eliminates the need to specify the absolute path of a command to run it.
PPID	Holds the identifier number for the parent program
PS1	Defines the primary command prompt
PS2	Defines the secondary command prompt
PWD	Stores the current directory location
SHELL	Holds the absolute path to the primary shell file
TERM	Holds the terminal type value
UID	Holds the logged-in user's UID
USER	Retains the name of the logged-in user

dnf list installed kernel*

export and unset command. env/printenv will print env variables. command subs: \u@\h

1. Where does GRUB2 read its configuration from on a BIOS system?/boot/grub2/grub.cfg
2. How can the redhat-support-tool be used to search and display the same Knowledgebase content as on the Red Hat Customer Portal? Using the search command followed by keywords or error codes
3.How does file system metadata alignment impact the performance of striped arrays (RAID 0, RAID 4, RAID 5, RAID 6)? If the write request is wider than the strip size, I/O requests could require two writes per disk instead of one or having all metadata ends up on one disk, causing that disk to become a hot spot.
4. How does the spare area of SSDs impact their performance on random writes?
improvement
5. How does data striping in RAID increase throughput?
By dividing data into stripes and distributing them among several disks in the RAID array
6. What are the steps in a typical change management procedure for performance tuning changes? Set a baseline by running the test workload and gathering metrics. 2. Perform changes one at a time, measuring the effect after each change. 3. Verify the effectiveness of the change by rerunning the test workload. 4. Reverse the change and compare with the baseline. 5. Apply and document the definitive change.
7. What are the main ideas behind the USE Method in performance tuning?
Checking Utilization, Saturation, and Errors for user interactions
What is a drop-in file in systemd and how is it used to configure unit settings?

file in systemd that overrides or adds specific options for a unit, created by making a directory under /etc/systemd/system/ named after the unit with .d appended, and then creating .conf files in this directory. For example, enabling memory accounting for sshd.service can be done by creating a 20-accounting.conf file in the directory /etc/systemd/system/sshd.service.d/.

While the sticky bit is most commonly used with directories, it can also be set on files. On files, the sticky bit has an outdated and limited use. It was historically used to keep a file in memory after execution.

How can you enable CPU, memory, and block I/O accounting for a service or a slice in systemd?

Create a drop-in file under /etc/systemd/system/ with the desired unit or slice name and .d appended and

include the CPUAccounting, MemoryAccounting, and BlockIOAccounting settings.

What are the advantages of using custom slices in systemd?

System resource granularity and distribution equality

chmod +t (add sticky bit) drwxrwxrwxt (t) at the end refers to sticky
chmod g-s /usr/bin/write -v (gid)

ncdu
sudo find / -type f -exec du -h {} + 2>/dev/null | sort -rh | head -20
sudo du -ah / 2>/dev/null | sort -rh | head -20

find /var/log -min -100 -exec file {} \;
find /usr -maxdepth -type d -name src
find /tmp -perm -u=r
find /tmp -type f -exec ls -ld {} \;
find /tmp -name *.txt -ok cp {} \;
locate .sh -n2
locate -S
setfacl -m u:user1:r a.txt
setfacl -dm u:user100:7,user200:rwx /tmp/prj

find /dev -type c -perm 660
useradd user1000
usermod -aG sgroup user1000

ps -efl
pidof rsyslogd
pgrep rsyslogd
ps -U user1
ps -G root
nice -n -10
renice 5 5572
can also renice from top command(type r and give pID)
cat /var/log/cron

*/1 * 1-10 3 * : Any day, in March, from 1 to 10th, every hour, every one minute.

Column	Description
UID	User ID or name of the process owner
PID	Process ID of the process
PPID	Process ID of the parent process
C	CPU utilization for the process
STIME	Process start date or time
TTY	The controlling terminal the process was started on. “Console” represents the system console and “?” represents a daemon process.
TIME	Aggregated execution time for a process
CMD	The command or program name

useradd user100
useradd user200
usermod -aG sgroup user100
usermod -aG sgroup user200

mkdir /sdir
chmod g+s /sdir
chmod o-t /tmp

tree -hapf
uname -snovpr
wc -l , -w, -c
rpm -qa (list all packages)
rpm -q perl (list perl packages)
rpm -qf /etc/passwd (see which package owns the file)
rpm -qf /etc/group
dnf install policycoreutils
dnf info policycoreutils
dnf deflist policycoreutils
rpm -qi setup
rpm sushi -ve (remove package)
rpm -qf /etc/chrony.conf (see where the package is coming from)
cd /tmp
rmp2cpio /mnt/baseos/package/chrony-3.3.e18.x86_64.rpm | cpio -imd
rpm2cpio
find . -name chrony.conf 9
rpm -K /tmp/chrony.. –no-signature (Use the MD5 checksum for verifying its integrity and the GNU Privacy Guard (GnuPG or GPG) public key signature for ensuring the credibility of its developer or publisher.
cp -r /tmp/chrony.. /etc/chrony
rpmkeys –import /etc/pki/rpm-gpg/rpm/gpg-key-redhat-release
rpmkeys -K /mnt/BaseOS/packages/zsh-3.3 (answer should be digests signatures ok)
rpm -q gpg-pubkey
rpm -qi <key> (view specific details)
rpm -Vf /etc/sysconfig
rpm -qi zlib
rpm -qa | sort

environment groups and package groups:
The environment groups available in RHEL 8 are server, server with GUI, minimal install, workstation, virtualization host, and custom operating system. These are listed on the software selection window during RHEL 8 installation. The package groups include container management, smart card support, security tools, system tools, network servers, etc. LOGS: **/var/log/dnf.log**
main configuration file for dnf is /etc/dnf/dnf.conf preferred configuration location /etc/yum.repos.d . **dnf runs rpm in the background.**
RHEL 8 is shipped with two core repositories called BaseOS and Application Stream (AppStream).
BOOTLOADING:
The firmware phase, the bootloader phase, the kernel phase, the initialisation phase.

```
[BaseOS_RHEL_8.0]
name= RHEL 8.0 base operating system components
baseurl=file:///mnt/BaseOS
enabled=1
gpgcheck=0
```

EXAM TIP: Knowing how to configure a dnf/yum repository using a URL plays an important role in completing some of the RHCSA exam tasks successfully. Use two forward slash characters (//) with the baseurl directive for an FTP, HTTP, or HTTPS source.

dnf module list (node.js, mariadb etc.)
dnf group list (security, monitoring vs)
dnf group info "system tools" (show content of group)
dnf group install "system tools"
dnf list installed
dnf repoquery cifs-utils
dnf list installed | grep cifs-utils
dnf check-update
creating a directory inside `/dev` is not advisable, because `/dev` is dynamically managed by the system and device nodes are created automatically.
dnf repolist

Use the MD5 checksum for verifying its integrity and the *GNU Privacy Guard* (GnuPG or GPG) public key signature for ensuring the credibility of its developer or publisher.
rpm -K /mnt/package/baseOS/zsh.3.3 —no-signature (checksum)
rpm -q gpg-pubkey (viewing keys)
rpm -qi <key> (view specific details)
rpm -Vf /etc/sysconfig (show package modification details)
chmod -v 644 /etc/sysconfig/atd (back to original state)

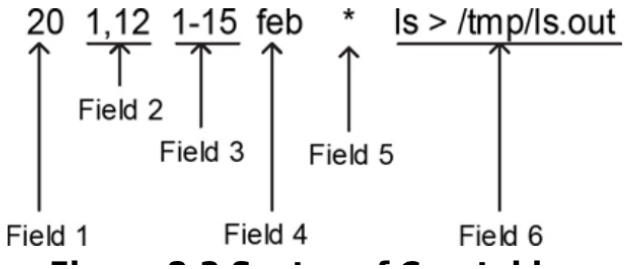
ls-lR
ls -lai | grep dir1
set -o noclobber
!! (repeat the last command)
!?grep? (repeat last command contains ls)
alias
ls -ld /etc/??? (prints all three letters folders)
ls /usr/bin/[g]* (all folders starting with g)
ls /usr/bin[a-c]* (folders between a and c]
ls /etc | less
grep operator /etc/passwd
grep -v nologin /etc/passwd (print lines that don't have nologin)
grep -n pattern /etc/passwd (print findings with number)
grep -w acce.. /etc/lvm/lvm.conf (prints lines including word acce..(i.e accept, access)

VIM <x> will delete current cursor, :<4,6d> ill delete lines
:%s/word/word1 -> replace word with word1
sed -i "s/old/new/g" replace old with new inplace
touch will change timestamp of the file
grep -i path ~/.bashrc (in-case-sensitive search)

file system check
 df -h (see mounted disks)
(disk should be not mounted)
umount /dev/sdb
vi test & (run in the background)
jobs (check jobs)
fg %1 (bring job to fg)
kill <pid> (kill job)
ls /cdr /usr > output 2>&1
top then r (renice)

at 12:13pm 3/7/25
> date &> date.out
>ctrl+d
at -l (list jobs)

crontables:



The system runs the /etc/profile file first, followed by .bash_profile, .bashrc, and finally the /etc/bashrc file.

mandb
man -k xfs
In addition to the manual pages, apropos, whatis, info, and pinfo commands as well as documentation located in the /usr/share/doc directory are also available on the system.
COMMANDS:

mkdir -p A/B/C
touch (will change mod time)
stat (will print brith, mod, access time)
find / -name passwd
find / -maxdepth 3
find . -user root
ls -l | head -20 >> files
chmod ugo+rwx file / cmod ugo-rwx file
echo "umask 027" >> ~/.bashrc (newly created files: 640, directories: 750)
cat > b (write your input)
tar cvf b.tar b a (compress)
tar tf (view)
tar xf (extract)
tar cvfz /root/com.gz /etc
grep -nr "pass" /etc/passwd > /mnt/pass
ls /etc/yum.repos.d

vi /etc/yum.repos.d/local.repo

ROOT PASSWORD
1. "e" on boot screen
2. after UUID section, "rd.break" , before initrd. and type ctrl+x. on vm: rw init=/bin/bash
3. chroot /sysroot
4. pwd (should be /)
4. mount -o remount,rw /
5. passwd (will be given in exam)
6. touch /.autorelabel
7. exit
8. reboot

kernel and support files are stored at different locations in the directory hierarchy, f which three locations **/boot, /proc and /usr/lib/modules.** kernel files are **vmlinuz, initramfs, config and system.**map. kernel version appended to their names. **efi** and **grub2** subdirectories under /boot hold bootloader information. **grub.cfg** and **grubevn** contain critical data such as bootable kernel information and environment information that the kernel uses.

/**proc** is a virtual memory-based file system. about processor, memory, storage, file systems, swap, processes, network interfaces, connections, routing. /proc/**cpuinfo && /proc/meminfo.** data from /proc is referenced from many system utilities: top, ps, uname, free, uptime.

Updating kernel:
by default dnf command adds new kernel to the system.
rpm -qa | grep kernel
go to rhel official page, look for kernel, download, move files to /tmp/, dnf install /tmp/kernel*,
dnf list installed kernel*, reboot, choose the latest downloaded from grub menu

/proc/cmdline -> booting arguments.
location of efi: **/boot/efi/efi**

chroot: change root directory of a process. only process can access files

RAID(redundant array of independent disks)
stripe, mirror
/etc/default/grub
sudo grub2-mkconfig -o /boot/grub2/grub.cfg (after editing /etc/default/grub issue command and restart after)
/etc/grub/ (script location)
/boot/grub/grub.cfg && /boot/grub/grubenv

chroot creates isolated environment for testing. changes root directory of a process.

making new kernel default boot kernel: **grub2-mkconfig -o /boot/grub2/grub.cfg.**
system initialisation and service management scheme: **systemd**
grub.cfg file stores the location information of th partition. chroot command changes the specified directory path to /.
uname -r , rpm -q kernel

You need to know how to boot a RHEL 8 system into a specific target from the GRUB2 menu to modify the fstab file or reset an unknown root user password.

rd.break, chroot /sysroot, mount -o remount, rw /, passwd, touch .autorelabel, exit
uname -snovmpr (m: architecture, r: kernel version)
IPTABLES

rule based firewall scans until it finds matches
allow block specific IP addresses or ports
powerful firewall built in linux
-
—----------

5. Initialisation, logging, system tuning
systemd remounts files once autofs finishes checks. d-bus is another communication method that allows multiple services running in parallel on a system to talk to one another.
units are systemd objects used for organising boot and maintenance tasks.
sshd.service, syslog.socket, umount.target, tmp.mount
units in /run/systemd/system are created at boot and destroyed when no longer needed.
initialisation scripts: /etc/rc.d/init.d
/usr/lib/systemd/system/sshd.service (see unit, service, install)

Unit Type	Description
Automount	Offers automount capabilities for on-demand mounting of file systems
Device	Exposes kernel devices in systemd and may be used to implement device-based activation
Mount	Controls when and how to mount or unmount file systems.
Path	Activates a service when monitored files or directories are accessed
Scope	Manages foreign processes instead of starting them
Service	Starts, stops, restarts, or reloads service daemons and the processes they are made up of
Slice	May be used to group units, which manage system processes in a tree-like structure for resource management
Socket	Encapsulates local inter-process communication or network sockets for use by matching service units
Swap	Encapsulates swap partitions
Target	Defines logical grouping of units
Timer	Useful for triggering activation of other units based on timers

Table 12-1 systemd Unit Types

Target	Description
halt	Shuts down and halts the system
poweroff	Shuts down and powers off the system
shutdown	Shuts down the system
rescue	Single-user target for running administrative and recovery functions. All local file systems are mounted. Some essential services are started, but networking remains disabled.
emergency	Runs an emergency shell. The root file system is mounted in read-only mode; other file systems are not mounted. Networking and other services remain disabled.
multi-user	Multi-user target with full network support, but without GUI
graphical	Multi-user target with full network support and GUI
reboot	Shuts down and reboots the system
default	A special soft link that points to the default system boot target (multi-user.target or graphical.target)
hibernate	Puts the system into hibernation by saving the running state of the system on the hard disk and powering it off. When powered up, the system restores from its saved state rather than booting up.

Table 12-2 systemd Targets

Targets

Targets are simply logical collections of units. They are a special systemd unit type with the .target file extension. They are also stored in the same directory locations as the other unit configuration files. Targets are used to execute a series of units. This is typically true for booting the system to a desired operational run level with all the required services up and running. Some targets inherit services from other targets and add their own to them. systemd includes several predefined targets that are described in Table 12-2.

VIRTUALISATION

```
yum install qemu-kvm libvirt virt-install virt-manager
```

REPOSITORY CONFIGURATION

0. dnf install <copy given epel release url>
1. dnf repolist
2.

CONTAINER

0. container file will be given
1. dnf install podman
2. podman build -t demo .
3. podman images
4. podman -d run -p 8080:80 <image>
5.

cal 2 2025

tar cvf , tar xvf

touch command can be used with -d and -t to add sepcific date and time, a and m will enable you to change access and modification time. touch -d 2020-09-20 sec.txt .

touch -m command will reverse it to original time.

soft link can link directories hard linnk can not link directories .

Boot: BIOS-> Master Boot Record(MBR)->partition Table(PT)->Boot loader(Grub)->Kernel-> Mounting / /usr->/etc/inittab(default run level)->/etc/fstab

run levels:
run level 0 power off
run level 1: singleuser mode text mode
run level 2 multiusr text mode except NFS, NIS
run level 3: support all services including NFS and NIS(network information service) (default)
run level 4: unused
run level 5: multiuser graphical mode

User account information for local users is stored in four files that are located in the /etc directory. These files—passwd, shadow, group, and gshadow.
UIDs between 1 and 200 are used by Red Hat to statically assign them to core service accounts. UIDs between 201 and 999 are reserved for non-core service accounts, and UIDs 1000 and beyond are employed for normal user accounts.
cat /etc/login.defs
head -3 /etc/passwd
tail -3 /etc/passwd

usermod -l user2new -u 2000 -d /home/user2new -m -s /sbin/nologin user2000
useradd user4 -s /sbin/nologin
echo redhat | passwd --stdin user4
vi /et

(nologin is when user does not need login access)
userdel user3new
grep user2new /etc/passwd

tuned-adm list
tuned-adm active (check which profile is active)
tuned-adm recommend
tuned-adm profile virtual-guest

docker run --cap-add=SYS_TIME -it bb4496e662fb /bin/bash

dnf install chrony (NTP)
dnf install -y procps

docker run --privileged -d --name systemd_container -v /sys/fs/cgroup:/sys/fs/cgroup:ro 5c79fba2bcae
What is the default number of days files in /tmp are kept before they are automatically deleted if not accessed or modified?
uname -v or cat /proc/version10 days (apropos -a list directory
apropos " list directory" / man -k ext4
The udev service (part of systemd-udevd) is responsible for creating device nodes dynamically at system startup.
Wayland has replaced the X Window System as the default display protocol in RHEL 8.
RHEL supports seven types of files: regular, directory, block special device, character special device, symbolic link, named pipe, and socket.

ln original.txt hardlink.txt # Create a hard link
ls -li original.txt hardlink.txt # Check inode numbers(same in hardlinnk)

local.repo
name=baseOS
baseurl=https://xyz.server.com/baseOS
gpgcheck=0
enabled=1

name=appStream
baseurl=https://xyz.server.com/appStream
gpgcheck=0
enabled=1

subscription-manager attach –auto
subscription-manager repos –list
subscription-manager repos –enable=rhel-9-for-x86_64-baseos-rpms
subscription-manager repos –enable=rhel-9-for-x86_64-appstream-rpms
dnf repolist
dnf clean all
dnf update
ping subscription.rhsm.redhat.com
sudo subscription-manager list –consumed
subscription-manager unregister
subscription-manager clean
subscription-manager register –username=<> –password=<>

These permission bits are set user identifier bit (commonly referred to as setuid or suid), set group identifier bit (a.k.a. setgid or sgid), and sticky bit.
The setuid and setgid bits may be defined on binary executable files to provide non-owners and non-group members the ability to run them with the privileges of the owner or the owning group, respectively. The setgid bit may also be set on shared directories for group collaboration. The sticky bit may be set on public directories for inhibiting file erasures by non-owners.

A common example is the su command that is owned by the root user. T

timedatectl set-ntp true

groupadd newgroup (should be listed in /etc/group)
useradd harsh -G newgroup
useradd nolog -s /sbin/nologin
passwd nolog (set password to redhat)
setfacl -m u:natasha:rw /var/fstab (m for modify)
getfacl /var/fstab
setfacl -m g:Mac:--- /var/fstab
4: read , 2: write 1 : execute
chmod u-x testfile -v (verbose)
chmod go+w testfile -v

chown :Mac /linux
groupadd blue
chgrp blue
chmod g+s . (now all the files will belong to group blue)
chmod +t (Sticky Bit: ensure only linux group can delete files)
chmod g-w, u+r testfile -v (from group remove writing, to user add read)
chmod -v u+s /usr/bin/su (adding user id to /usr/bin/su)

systemctl not default on container env. should enable cgroups while running:
(i. e. : docker run --privileged -d --name systemd_container -v /sys/fs/cgroup:/sys/fs/cgroup:ro centos:8 /usr/sbin/init)

DISK PARTITION:
lsblk (check devices)
fdisk /dev/sda2 (+1G for 1 GB partition, then n, p, w for write)
partprobe /dev/sda2
lsblk(check the newly created partition)
mkdir newdisk
mkfs.xfs /dev/sda2p1
mount /dev/sda2p1 /newdisk (not persistent yet)
vi /etc/fstab (write in the file: /dev/sdap1 /newdisk defaults 0 0)
mount -a

SWAP MANAGEMENT:
free -m
fdisk nvmep2 (from the input menu type:
0.(type letters, m for help)
1. n(new), p(primary), w(write)
2. partition number default
3. first sector: default
4. last sector: +750M
5. type: t
6. partition number: 3
7. L (get hex codes, 82 for linux swap) (change partition type to linux swap)
8. partprobe nvmep2 (will make changes permanent)
9. mkswap /dev/nvmep2
10. vi /etc/fstab (/dev/nvmep2 swap swap defaults 0 0)
11. swapon -a (if no error, check with free -m, see swap has has increased by 750Mb)

LVM: (create logical volume, give size, extend existing logical volumem)
1. Create Physical Volume (pv)
2. Create Volume Group (vg)
3. Create Logical Volume (lv)

pvcreate nvme0v3
pvcreate nvme0v4
pvcreate nvme0v5
pvs (show)
vgcreate vgtest /dev/nvme0v3 nvme0v4 nvme0v5 (create volume groups)
vgs (show)

(linear, striped, mirrored volumes)
lvcreate -L 8Gb -n lvtest vgtest
lvs
vi /etc/fstab (/dev/vgtest/lg1/ /lv xfs defaults 0 0)
mkdir /lv
mkfs.xfs /dev/vgtest/lvtest
mount -a

LVM Extension:
vgs
lvextend -r -L +2Gb /dev/vg1/lv1

vgextend vg1 /dev/nvme0v5
vgs
lvremove /dev/vg1/lv1 (you'll get warning filesystem is in use)
vim /etc/fstab (comment vg1/lv1)
unmount /lv
lvchange -an /dev/vg1/lv1
lvremove /dev/vg1/lv1
lvs
vgremove vg1
vgs
vgcreate -s 8M vg1 /dev/nvme0v3
lvcreate -l 10 -n lv2 /dev/vg1 (creating 80M logic volume 10 times)

STRATIS:
blockdev:minsize 1 gb
pool (combined block devices to create pool)
filesytem(no fixed size for filesystem, automatically grows)

dnf install stratisd stratis-cli
systemctl start stratisd
systemctl enable stratisd
stratis pool create pool1 /dev/nvme0n5 (create pool)
stratis pool list
stratis pool add-data pool1 /dev/nvme0n4 (extend pool)
stratis filesystem create pool1 fs1 (create filesystem)
stratis filesystem list
stratis filesystem create pool1 fs2
stratis filesystem list
mkdir /fs1
vi /etc/fstab (copy UUID from filesystem list output /fs1 xfs defaults,x-system.requires=stratisd.service 0 0)
mount -a

VIRTUAL DATA OPTIMISER (VDO)-deprecated.
New one: lvmvdo:
compression, thin provisioning, deduplication

dnf install lvm2 kmod-kvdo vdo

vdo create --name vdo1 --device /dev/nvme0n2 --vdoLogicalSize=50G
vdo list
mkfs.xfs /dev/mapper/vdo1
mkdir /vdo1
vi /etc/fstab (/dev/mapper/vdo1 /vdo1 auto defaults,x-systemd.requires=vdo.service 0 0)
mount -a
man vdo

dnf module info postresql:10
dnf module install -y postgresql:10

you can only have one module installed at a time.

CRON:
execute command /usr/local/bin/backup at 10:00 am on Feb 4th every year.
crontab -e (0 10 4 2 * /usr/local/bin/backup)

configure cron job for a user jiu at 12:08 every Thursday execute /bash/echo hello
crontab -u jiu -e (08 12 * * THU /bash/echo hello)

GREP:
grep -i "root" /etc/group
grep -i "sbin" /etc/passwd > /tmp/pass

CH ROOT PASSWD:
press "e" boot screen
put "rd.break" after word quiet --
mount -o remount,rw /sysroot --
chroot /sysroot --
passwd
touch /.autorelabel --
exit
reboot

NETWORKING/HOSTNAME

ip addr show ens160
nmcli con add con-name "Default" type ethernet ifname ens160
nmcli con show
nmcli con add con-name "Default1" type ethernet ifname ens160 ipv4 192.168.1.1/24 gw4 192.168.1.2
nmcli con up "Default1"
nmcli con show Default1
nmcli con mod "Default1" connection.autoconnect yes
nmcli con show Default1
nmcli con mod Default1 ipv4.addresses 192.168.2.2/16
nmcli con mod Default1 ipv4.dns 172.2.2.2
nmcli con mod Default1 ipv4.addresses 192.168.3.3/24 (multiple ip addresses can be added)
nmcli con add "Net" type ethernet ifname eth0 ipv4.addresses 200.0.0.12/16 gw4 20.0.0.1
nmcli con mod Net ipv4.dns 8.8.8.8
nmcli con show Net
nmcli con up Net

nmcli con add "net2" type ethernet ifname ens160 ipv4.addresses 172.24.5.10/24 gw4 172.24.5.48

nmtui (alternative to nmcli)
/etc/hostname
hostnamectl status
hostnamectl set-hostname server

SELINUX
touch /var/www/html
ls -ld /var
mkdir /new
touch /new/index.html
ls -ls /new/index
vi /etc/httpd/conf/httpd.conf (check DocumentRoot="/var/www/html"
vi /new/index "DocumentBoot "/var/www/html"
ls -lZ /var/www/html/index.html (httpd_sys_content_t) is the content
ls -lZ /new/index (default) is the content

```
<Directory "/new">
    AllowOverride All
    #Allow open access
```

    Require all granted
</Directory>

--> add above to /etc/httpd/conf/httpd.conf

SEMANAGE:
semanage fcontext -a -t httpd_sys_content_t "/new(/.*)?"
restorecon -Rv /new

SElinux modes: disabled permissive(0) enforced(1)
getenforce
setenforce 0 | 1
/etc/sysconfig/selinux (modify file to disable, reboot is required)
getsebool -a | grep httpd_enable (policy bool)
setsebool -P httpd_enable_homedirs on (-p flag permananent change)

selinux modes, booleans, context, port

httpd is able to access home dir: (getsebool | grep httpd_enable_homedirs)
system is not able to access httpd on port 82
semanage port -a -t http_port_t -p tcp 82 (systemctl restart httpd is required)

ensure httpd is able to access files at test directory.

PODMAN:
podman login registry.redhat.io (optional)
podman search httpd
podman pull docker.io/registry/httpd
podman rmi <image>
podman run -d --name httpd -p 8080:80 <imageID>
podman ps
curl localhost:8080 (outside the httpd container, see It works!)
podman stop <container>
podman rm <container>
podman run --d it <imageID> /bin/bash
podman exec -it <containerID> /bin/bash (inside the container check find . -name index.html see:
/usr/local/apache2/htdocs)
mkdir /web && touch /web/mypage.html && vi mypage.html (add some context)
podman run -d --name web1 -p 8080:80 -v /web:/usr/local/apache2/htdocs/:Z <imageid>
after mapping
semanage fcontext -a -t httpd_sys_content "/web(/.*)?"
restore con -Rv /web
curl localhost:8080/mypage.html

QUADLET
podman info --debug | grep "rootless"
systemctl --user enable podman-auto-update-timer
systemctl --user daemon-reload

/etc/containers/systemd/sleep.container
[Unit]
Description=A minimal container

[Container]
Image=centos
Exec=sleep 60

[Service]
Restart=always

systemctl daemon-reload
systemctl start sleep.service
systemctl start sleep.service (auto restart once system rebooted)
systemctl status sleep.service

Quadlet files to be stored in either:
user: /usr/share/containers/systemd/
system wide: /etc/containers/systemd/

https://dokumen.pub/qdownload/rhcsa-red-hat-enterprise-linux-8-training-and-exam-preparation-guide-ex200.html

FILESYSTEM:
fsck.ext4 /dev/sda1
xfs-repair -L /dev/sda1

GROUP QUOTA:
mount -o remount, usrquota, grpquota /dev/sdb2/ /quota

/dev/sdb2 /quota ext4 ->/etc/fstab

SCHEDULING AND PROCESS ADMIN
at 10:03am today
> command
ctrl+D
atq

CPIO: occupies less space compared to tar.
cpio -icvf -I /root/backup

FTP.

AUTOFS:
SERVER
dnf install -y nfs* nfs-utils autofs
mkdir /share
touch /share/f1 /share/f2
chmod 777 /share
/share <clientIP>(ro,sync) >> /etc/exports
exportfs -avr
firewall-cmd --add-service={nfs,mountd,rpc-bind} --permanent
firewall-cmd --reload

CLIENT -in exam responsiblity only client part-
dnf install nfs-utils autofs
showmount -r <clientIP>
/auto_mount /etc/auto_misc --timeout=60 >> /etc/auto.master
access --rw,soft,intr <serverIP>:/share >> /etc/auto.misc
systemctl enable autofs --now (after this command /auto_mount or /afs directory should be created)
cd auto_mount && cd access && ls (should see files f1 and f2)

SHELL
if [$? -eq 0]; then
    echo "succesfull exit"

$0 -> script's name
$1 -> firstarg
$# -> number of args

SSH
systemctl status sshd
firewall-cmd --zone=public --permanent --add-service=ssh

A list of the users who have successfully signed on to the system with valid credentials can be printed using one of the two basic Linux tools: who and w.
last
last user1000
last root
lastb
lastlog
id
id user1000
groups user1000

Service accounts take care of their respective services, which include apache, ftp, mail, and chrony.

3 main: networking | storage | manage groups

find -mmin -300 -exec file {} \;
find / -type p -o -type s 2>/dev/null
find /usr -atime -100 -size -5M -user root
setfacl -x u:user2000 /tmp/testfile

in vi %s/tes/fes/
sed -i 's/globe/earth/g'

/etc/nologin.txt (custom no login test if -s /sbin/nologin is defined when creating useradd user5 -s /sbin/nologin)
useradd -D default login settings
useradd -D -s /bin/sh -b /custom/home: this would set the default shell to /bin/sh and home directory to /custom/home for all future users.
Name the four local user authentication files. /etc/passwd, /etc/group, /etc/shadow, /etc/gshadow
The who command in Linux consults the /var/run/utmp file to display information about currently logged-in users.
/var/log/wtmp: Keeps a history of all logins and logouts.
/var/log/btmp: Logs failed login attempts.
/etc/shadow- is the backup for /etc/shadow
/etc/nologin is a special file in Linux. When it exists, it prevents all non-root users from logging into the system.
who, w, id, groups

The lastlog command in Linux displays the most recent login information of all system users.

password aging is a secure mechanism to control user passwords in Linux
~

PACKAGES
rpm -q vsftpd
rpm -q createrepo
rpm -qf /bin/bash : Queries which installed RPM package provides the file `/bin/bash`.

NFS Server:
yum install nfs*
(remote server)
vi /etc/exports -> /remote 192.168.11.8(rw, sync)
exportfs
(on the client)
ifconfig -a (check IP can reach to remote server
show mount -2 192.168.11.7
mount -t nfs 192.168.11.7:/remote /nfs (change IP of client to 11.7 if it does not mount)
service network restart
df -h (check mount)
vi /etc/fstab -> 192.168.11.7:/remote /nfs defaults 0 0
yum list autofs
vi /etc/auto.master
vi /etc/auto.misc -> ram -fstype:nfs 192.168.11.7 (config for mount point)

SAMBA Server(device and file share across heterogenous OSes.
Ports: 137(name), 138(datagram), 139(session)
vi /etc/samba/smb.conf
cd /etc/samba && grep "log" *
service smb restart
(on the client)
smbclient -L //182.168.11.7/ -N
(exercise: secure shared shares in samba server)(disable printer sharing)

DHCP server:
PORTS: 67-bootp, 68-dhcp
yum install dhcp -y
cd /usr/share/doc/dhcp_server
cp dhcpd.conf.example /etc/dhcpd/dhcpd.conf
vi /etc/dhcpd.conf (edit subnet and range according to IP)
service dhcpd start

NETWORK INFORMATION SERVICE a.k.a YellowPages (NIS)

DNS RECORDS
CNAME. files.example.org alias hostname
A RECORD IP address of the domain. maps hostname to IPv4 address to be saved in icann.net
MX RECORD maps domain name to mailexchange server. host can have multiple MX
PTR RECORD maps ipv4 to the canonical name for the host. adds 192.168.1.10.in-addr.arpa (reverse address)
NS record maps domain name to list of DNS servers authoritative for that domain.
named-checkconf /etc/named.conf
named-checkconf /etc/rfc1912.zones
named-checkzone example.com example.for
named-checkzone 192.168.1.11.in-addr.arpa

APACHE:
port: 80
yum install http*

Additionally, certain configuration options have been deprecated or removed in recent BIND 9 releases. For instance, the `auto-dnssec` configuration statement was removed, and users are advised to use `dnssec-policy` or manual signing instead.
BIND 9 Documentation
It's advisable to consult the release notes of the specific BIND version you're using to stay informed about any changes to configuration options.

yum install system-config-kickstarter
system-config-kickstart(will bring gui)
add
root password
installation method: ftp: server 192.168.10.7, ftp: directory: pub
partition info: add 10GB mount boot filetype ext4,add swap 2048
network config: eth0: dhcp.
authentication: keep default settings
firewall: SElinux disabled
installation:
vmlinuz initrd.initrd.img repo=ftp://192.168.10.7/

Basic sendmail (deprecated)
yum install sendmail*
vi /etc/mail/sendmail.mc (nothing to be added)
make -C /etc/mail
vi /etc/mail/sendmail.mc
service sendmail start
service sendmail status
sendmail -v -s “Test Email” user@server.example.org

POSTFIX:
dnf remove sendmail
dnf install postfix
dnf install chkconfig
chkconfig postfix off
systemctl status postfix
vi postfix.sh …
vi /etc/rc.local -> /root/postfix.sh
LVM

redirection
umask 022
chmod ugo
tar xvf gz
chmod g-s /usr/bin/write -v (gid)

good practice to start heavy cpu consuming tasks in the background and with low priority.
renice -n 10 -p 1234
in rhel9 killing a parent makes children processes systemd process.
SIGTERM:15, SIGKILL:9, SIGHUP:1
kill -SIGCHLD <parentdID>
ps -ef | grep username
desired state: target
systemctl -t service

Subcommand	Description
daemon-reload	Re-reads and reloads all unit configuration files and recreates the entire user dependency tree.
enable (disable)	Activates (deactivates) a unit for autostart at system boot
get-default (set-default)	Shows (sets) the default boot target
get-property (set-property)	Returns (sets) the value of a property
is-active	Checks whether a unit is running
is-enabled	Displays whether a unit is set to autostart at system boot
is-failed	Checks whether a unit is in the failed state
isolate	Changes the running state of a system
kill	Terminates all processes for a unit
list-dependencies	Lists dependency tree for a unit
list-sockets	Lists units of type socket
list-unit-files	Lists installed unit files
list-units	Lists known units. This is the default behavior when systemctl is executed without any arguments.
mask (unmask)	Prohibits (permits) auto and manual activation of a unit to avoid potential conflict
reload	Forces a running unit to re-read its configuration file. This action does not change the PID of the running unit.
restart	Stops a running unit and restarts it
show	Shows unit properties
start (stop)	Starts (stops) a unit
status	Presents the unit status information

Table 12-3 systemctl Subcommands

systemctl list-unit-files
systemctl –failed
systemctl status atd
systemctl -t target (list all targets)
systemctl list-dependencies multi-user.target (list dependencies for multi-user target)
systemctl isolate multi-user (`systemctl isolate` command is used to change the current system's state by **isolating a specific target)**

SYSLOG: *rsyslogd* ***modern systems:*** *journalctl*

/var/log are the default location where the log files are stored. rsyslog service is modular, allowing modules listed in its configuration file to be dynamically loaded in the kernel as and when needed. each module brings new functionality to the system upon loading. ***systemctl start/stop/status rsyslog***
/etc/rsyslog.conf *:* configuration file. Rules section has **selectors**(left) **and action**(right), **facility**(left) and **priority**(right)**.**
rsyslogd logs messages based on priorities: emerg, alert, crit, error, warning, notice, info, debug. *it will keep for target level and higher levels.*

```
# Provides TCP syslog reception
# for parameters see http://www.rsyslog.com/doc/imtcp.html
#module(load="imtcp") # needs to be done just once
#input(type="imtcp" port="514")

#### RULES ####

# Log all kernel messages to the console.
# Logging much else clutters up the screen.
#kern.*                                                 /dev/console

# Log anything (except mail) of level info or higher.
# Don't log private authentication messages!
*.info;mail.none;authpriv.none;cron.none                /var/log/messages

# The authpriv file has restricted access.
authpriv.*                                              /var/log/secure

# Log all the mail messages in one place.
#mail.*                                                 -/var/log/maillog


# Log cron stuff
cron.*                                                  /var/log/cron

# Everybody gets emergency messages
*.emerg                                                 :omusrmsg:*

# Save news errors of level crit and higher in a special file.
#uucp,news.crit                                         /var/log/spooler

# Save boot messages also to boot.log
local7.*                                                /var/log/boot.log
```

/var/log/messages | /var/log/boot | ls -l /var/log
files under /var/log can be filled very quickly. To prevent this a script called logrotate under /etc/cron.daily invokes the *logrotate* command. /etc/logrotate.conf
– each time a log file is rotated, an empty replacement file is created with the date as a suffix to its name, and logging restarted. services have each different logrotate configuration. /*etc/logrotate.d/****script has option for postrotate (such as gzip) the log files. latest system messages: **/var/log/messages (tail -f).** It is helpful to tail the messages file when starting or restarting the service.

```
Mar 13 13:16:01 vbox systemd[1]: session-233.scope: Deactivated successfully.
Mar 13 13:17:01 vbox systemd[1]: Started Session 234 of User root.
Mar 13 13:17:01 vbox systemd[1]: session-234.scope: Deactivated successfully.
Mar 13 13:17:18 vbox systemd[1]: Starting Hostname Service...
Mar 13 13:17:18 vbox systemd[1]: Started Hostname Service.
Mar 13 13:17:48 vbox systemd[1]: systemd-hostnamed.service: Deactivated successfully.
Mar 13 13:17:55 vbox systemd[1]: Starting Hostname Service...
Mar 13 13:17:55 vbox systemd[1]: Started Hostname Service.
Mar 13 13:18:01 vbox systemd[1]: Started Session 235 of User root.
Mar 13 13:18:01 vbox systemd[1]: session-235.scope: Deactivated successfully.
Mar 13 13:18:25 vbox systemd[1]: systemd-hostnamed.service: Deactivated successfully.
[root@vbox ~]# cat /var/log/messages
[0] 0:bash- 1:user2  2:user1  3:root*
```

journalctl:
addition to rsyslog, systemd implements logging service for the collection of logs. this is implemented via **systemd-journald** daemon. *journalctl* command will print messages. **journalctl -o verbose**, **journalctl -b** (from last systemboot). -0: since the last system boot, -1: since previous system boot, -2: since two previous system boot.
journalctl -kb0 (only kernel generated alerts since last reboot)
journalctl -n5 (list only last 5 lines)
journalctl /usr/sbin/crond (see logs generated by crond)
journalctl _*SYSTEMD*_UNIT=sshd.service
journalctl _PID=$(pgrep chronyd) / journalctl _PID=$(pgrep sshd)
journalctl –since 2019-10-10 –until 2019-10-16 -p err
journalctl –since today -p warning -r
journalctl -f *(real time viewing, same as tail -f, logger to send messages to journal, “write root/user”to print msg on other logged in users)*

logs are stored in /run/log/journal and its transient. options: volatile(stores in memory only), persistent(permanent under **/var/log/journal)**, **auto**(similar to persistent but does not create /var/log/journal), none(disables both volatile and persistent storage, not recommended).
file is rotated once a month. settings at **/etc/systemd/journald.conf.**

/etc/machine-id : where the system's machine ID is kept.

SYSTEM TUNING:
tuned: monitor storage, networking, audio, video and a variety of other connected devices. adjust parameters for better performance. there are several predefined tuning profiles, that may be activated statically or dynamically. for example during large file transfer network connection use increases. 9 profiles default, can create custom and save it under **/etc/tuned.** predefined profiles at **/usr/lib/tuned.**
profile management: tuned-adm (**tuned-adm list**)
systemctl –now enable tuned (will stick tuned service to auto-start)
tuned-adm profile virtual-guest | tuned-adm active | tuned-adm recommend | tuned-adm off

Profile	Description
Profiles Optimized for Better Performance	
Desktop	Based on the balanced profile for desktop systems. Offers improved throughput for interactive applications.
Latency-performance	For low-latency requirements
Network-latency	Based on the latency-performance for faster network throughput
Network-throughput	Based on the throughput-performance profile for maximum network throughput
Virtual-guest	Optimized for virtual machines
Virtual-host	Optimized for virtualized hosts
Profiles Optimized for Power Saving	
Powersave	Saves maximum power at the cost of performance
Balanced/Max Profiles	
Balanced	Preferred choice for systems that require a balance between performance and power saving
Throughput-performance	Provides maximum performance and consumes maximum power

Table 12-5 Tuning Profiles

systemctl set-default graphical-target
systemctl get-default

Master Boot Record vs. GUID Partition | VDO | MBR Disk | GPT Disk
data is stored on disks that are logically divided into partitions.
VDO: newer storage management solutions capitalize on thin provisioning, deduplication and compression to conserve storage space and improve data throughput.
a disk is stored on the disk in a small region, which is read by the operating system at boot time. region is referred to as MBR on the BIOS, and GUID Partition Table(GPT) on UEFI. store disk partition information and the boot code.

- **MSDOS (MBR)** and **GPT** are the two most common partition schemes in use today.
- **Apple Partition Map (APM)** was used in older Macs.
- **BSD Disklabel** is used primarily by BSD-based operating systems.
- **LVM** provides flexible disk management and works on top of MBR or GPT.
- **Solaris Partition Table** was used by older versions of Solaris before GPT.
- **RAID** is a technology for combining multiple disks but isn't a partitioning scheme in itself.
- **BIOS Boot Partition** is part of GPT and needed for BIOS-based booting.
- **Logical Partitions** are a feature within MBR, allowing more than four partitions on a disk.

storage management tools: **parted, gdisk, vdo, lvm, stratis.**

parted is a simple tool that understands both MBR and GPT formats. **gdisk** is designed to support the GPT format only, it may be used as replacement of parted. **VDO** is a disk optimizer software that takes advantage of certain technologies to minimize the overall data footprint on storage devices. **LVM** is a feature rich logical volume management solution that gives flexibility in storage management. **Stratis** capitalizes on thin provisioning to create volumes much larger in size than the underlying storage options.

thin provisioning(lvm): economical allocation and utilisation of storage space by moving arbitrary data blocks to contiguous locations. i.e LVM, VDO, Stratis can create *thin pool* space and assign volumes much larger than the physical capacity of the pool. When a preset custom threshold(i.e 80%) on the actual consumption of the storage is reached, expand the pool dynamically by adding more storage. after creating the partition, **/proc/partitions** is also updated. repair: journalctl -xb, xfs_repair, smartctl -a /dev/sda

add 100mb.vdi: /dev/sdb

Subcommand	Description
print	Displays the partition table that includes disk geometry and partition number, start and end, size, type, file system type, and relevant flags.
mklabel	Applies a label to the disk. Common labels are gpt and msdos.
mkpart	Makes a new partition
name	Assigns a name to a partition
rm	Removes the specified partition

Table 13-1 Common parted Subcommands

parted provides commands for viewing, labeling, adding, naming and deleting partitions.

*sudo **parted** /dev/sdb **print** (see unrecognised label, disk must be labelled before usage)*
*sudo **parted** /dev/sdb **mklabel** msdos*
sudo parted /dev/sdc mklabel gpt
sudo parted /dev/sdb print (see label)
*sudo parted /dev/sdb **mkpart** primary 1 50m*
sudo parted /dev/sdc mkpart primary 1 50m
sudo parted /dev/sdd mkpart pri 1 200m
*sudo parted /dev/sdd **rm** 1 (will delete partition)*

gdisk utility partitions disks using the gpt format. gdisk can create up to 128 partitions on a single disk on systems with UEFI firmware.

*sudo **gdisk** /dev/sdd*
o: delete all partitions
p: print partitions(1,
n: new partition(+20M)
w: write changes to disk
d1: delete partition

write root (will start message sharing)

VDO
1. making use of the thin provisioning technology to identify and eliminate empty(zero-byte) data blocks, referred as *zero-block elimination.* removing randomization of data blocks by moving in-use data blocks to contiguous locations on the storage device -
2. keeping an eye on the data being written on the disk. If data is redundant vdo skips writing.(kernel module: universal deduplication service).
3. *kvdo* compresses the residual data blocks and distributes them on a lower number of blocks.

vdo runs in the background and processes inbound data through the three stages on vdo-enabled volumes. vdo is not cpu/memory intensive process, consuming a low amount of resources.

vdo can be initialised just like disk partitions or they can be used as lvm physical modules.

Subcommand	Description
create	Adds a new VDO volume on the specified block device
status	Returns the status and attributes of VDO volumes
list	Lists the names of all started VDO volumes
start	Starts a VDO volume
stop	Stops a VDO volume

Table 13-2 vdo Subcommands

dnf install vdo kmod-kvdo -y
systemctl –now enable vdo
systemctl status vdo
systemctl list-units –type=service | grep vdo
modprobe vdo (if vdo is not loaded on kernel)

*vdi is not treated as raw storage. vdi adds an extra layer. but, vdo should contact directly with the storage. Linux-based VMs, you can create a **logical volume** (LV) with LVM and then use VDO on top of it. This allows VDO to manage storage optimization directly on the block device. raw block devices(VirtIO, SCSI)*

vdo create –name vdo-vol1 –device /dev/sdc –vdoLogicalSize16G –vdoSlabSize 120
vdo list | vdostats –hu | vdostats –verbose | vdo status –name vdo-vol1
vdo remove –name vdo-vol1

exam vm will have no outside connection. refer to the manual pages and the documentation under /usr/share/doc directory.

hostnamectl set-hostname rhcsa2.example
nmcli con mod enp0s3 *ipv4.addresses* 192.168.0.242/24
nmcli con mod enp0s3 *ipv4.gateway* 192.168.0.1
nmcli con mod enp0s3 *ipv4.dns* 192.168.0.1
nmcli con *down* enp0s3 && nmcli con *up* enp0s3 && nmcli con *show* enp0s3

useradd -u 9000 -c “this is user90” -e $(date -d “+4 days” + %Y-%m-%d) user90
useradd -m -s /sbin/nologin user50 (create user with no login)
passwd -l user90 (lock user90 fro logging)

setfacl -m u:user10:rw /tmp/file
setfacl -d -m u:user10 /tmp

mkdir -p /dev/dvdrom
mount /dev/cdrom /dev/dvdrom
vi /etc/fstab (/dev/cdrom /dev/dvdrom iso9660 defaults 0 0)

vi /**etc/yum.repos.d/rhel9-local.repo**

[rhel9-local]
name=RHEL 9 Local Repo
baseurl=file:///mnt/dvdrom/AppStream/
enabled=1
gpgcheck=1
gpgkey=file:///mnt/dvdrom/RPM-GPG-KEY-redhat-release

PHYSICAL VOLUMES, VOLUME GROUPS AND LOGICAL VOLUMES
Volume Groups (VGs) are part of the Logical Volume Manager (LVM), which provides a flexible and dynamic way to manage disk storage. Here are the primary use cases for Volume Groups:

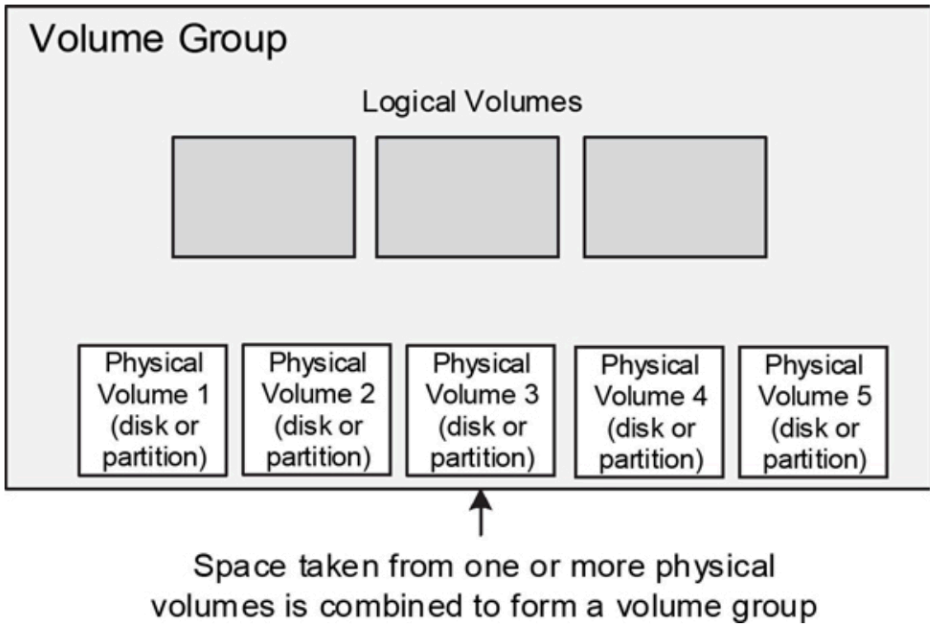


Figure 14-1 LVM Structure

*sudo **pvs***
*sudo **vgs***

*sudo **vgdisplay** (see PE: physical extent, LE: logical extent)*

logical extent can be smaller or larger than the physical extent.
*sudo **lvdisplay***
***sudo gdisk /dev/sdc** (n, +10m, w)*
sudo parted /dev/sdb set 1 lvm on
sudo parted /dev/sdd set 1 lvm on
sudo parted /dev/sdd set 2 lvm on
sudo parted /dev/sdc set 2 lvm on
sudo vgcreate -vs 1 vgnew /dev/sdd2
***sudo vgcreate -vs 1 vgnew2 /dev/sdc2** (add sdc2 to vgnew2)*

sudo pvcreate /dev/sdc1
sudo vgcreate vg100 –physicalextentsize 16M /dev/sdc1 (by default PE is 4MB)
sudo lvcreate -n lv100 -L 10M vg100
sudo lvremove /dev/vg100/lv100
sudo vgremove /dev/vg100

sudo pvcreate /dev/sdd1 (initialize pv)
sudo pvcreate /dev/sdb1
sudo pvs -v
sudo pvdisplay /dev/sdc1

***sudo vgextend vgnew /dev/sdb1** (will add sdb1 to vg(rhel))*
sudo vgextend vgnew2 /dev/sdc1
sudo vgs (show actual virtual group)
sudo vgdisplay -v vgnew
sudo lvcreate -l 1 -n lvnew vgnew
sudo lvcreate -l 1 -n lvnew2 vgnew2
sudo lvs
sudo lvdisplay /dev/vgnew/lvnew
sudo lvextend -L +10m /dev/vgnew/lvnew
sudo lvrename vgnew lvnew lvneww
sudo lvreduce -L 5m /dev/vgnew/lvneww
sudo lvresize -L 2m /dev/vgnew/lvneww
sudo pvmove /dev/sdc2 /dev/sdc3 (to another allocation in same vg)
sudo vgreduce vgnew2 /dev/sdc2 (before removal /dev/sdc2 data should be moved)
sudo pvremove /dev/sdc2

Command	Description
Create and Remove Operations	
pvcreate/pvremove	Initializes/uninitializes a disk or partition for LVM use
vgcreate/vgremove	Creates/removes a volume group
lvcreate/lvremove	Creates/removes a logical volume
Extend and Reduce Operations	
vgextend/vgreduce	Adds/removes a physical volume to/from a volume group
lvextend/lvreduce	Extends/reduces the size of a logical volume
lvresize	Resizes a logical volume. With the -r option, this command calls the resize2fs command and resizes the underlying file system as well. Applies to Ext2/Ext3/Ext4 file system types only.
Rename Operations	
vgrename	Renames a volume group
lvrename	Renames a logical volume
List and Display Operations	
pvs/pvdisplay	Lists/displays physical volume information
vgs/vgdisplay	Lists/displays volume group information
lvs/lvdisplay	Lists/displays logical volume information

Table 14-1 Common LVM Operations and Commands

sudo parted /dev/sdc set 1 lvm on (should update the flags part, see with print)
sudo pvcreate /dev/sdd1 /dev/sda -v (initialisation)
sudo vgcreate -vs -16 vgbook /dev/sdd1 /dev/sda
sudo vgdisplay -v vgbook
sudo pvdisplay /dev/sdd1

lv(pvcreate , vgcreate, lvcreate) and then apply vdo.

STRATIS(storage pool):
*stratis capitalizes three matured storage comp: **device mapper(dm),** kernel driver, the lvm solution and the xfs file system.*

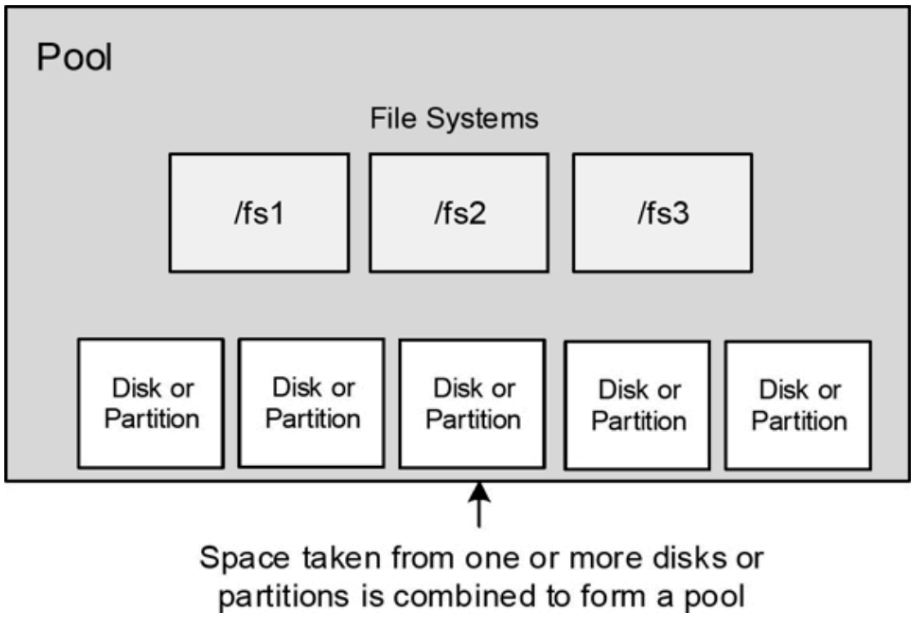


Figure 14-2 Stratis Structure

actual size grows with data stored. startis handles everything automatically so nothing should be manually configured.

Command	Description
pool	Administers storage pools. Subcommands are available to list, create, rename, expand, and destroy a pool.
blockdev	Lists block devices
filesystem	Administers file systems within storage pools. Subcommands are available to list, create, rename, and destroy a file system.

For each pool created, stratis creates a subdirectory under the /stratis directory. then creates symbolik link for each file system under the directory and keep actual files in /dev directory. **min disk size: 2gb for Stratis2.0**

stratis pool create poolnew /dev/sdb
stratis pool list
stratis blockdev list poolnew
stratis pool add-data poolnew /dev/sde
stratis filesystem create poolnew fsnew
stratis filesystem list
stratis filesystem destroy poolnew fsnew (remove fs from pool)
stratis pool rename poolnew poolneww
stratis pool destroy poolneww (remove pool)
stratis filesystem list (confirm removal)

mkdir /newfs
mount /stratis/newpool/newfs /newfs
umount /newfs
lsblk

LVM and Stratis can exist on the same system as long as they manage different partitions.
Stratis typically manages **pools** of storage, while **LVM** works with **volume groups** and logical volumes.

FILESYSTEMS
logical container that stored files and directories. Each file system is created with a discrete partition, vdo volume, logical volume or stratis pool. production RHEL has */ and /boot* during installation, additionally other file systems created during boot are: */home, /opt, /tmp, /usr, /var.*

RHEL supports three basic groups: *disk-based, network-based, memory-based.*
disk-based: SATA, USB, Fibre and other, network: shared, memory: virtual.
EXT is divided into two: first is the metadata(inode, permission, ownership, access/creation times), second is the actual data.
XFS high performing 64bit extent based journaling file system type. it does not run file system checks at system boot, relies on the user to use *xfs_repair.* Only caveat to use is that XFS's inability to shrink. XFS uses *sophisticated techniques in its architecture for speedy input/output performance.* ***It can be snapshot in a mounted active state, and then be used for backup or other(migration) purposes.***
VFAT: FAT16, introduced early versions of ms-dos.
ISO9660: optical disc media(cd/dvd), originally high-sierra file system(hsfs)

Command	Description
Extended File System	
e2label	Modifies the label of a file system
mke2fs	Creates a file system. Can also be invoked as mkfs.ext3, mkfs.ext4, mkfs -t ext3, and mkfs -t ext4.
resize2fs	Resizes a file system. This command is automatically invoked when the lvresize command is run with the -r switch.
tune2fs	Tunes or displays file system attributes
XFS	
mkfs.xfs	Creates a file system. Can also be invoked as mkfs -t xfs.
xfs_admin	Tunes file system attributes
xfs_growfs	Extends the size of a file system
xfs_info	Exhibits information about a file system
VFAT	
mkfs.vfat	Creates a file system. It is equivalent to using mkfs -t vfat.
General File System Commands	
blkid	Displays block device attributes including their UUIDs and labels
df	Reports file system utilization
du	Calculates disk usage of directories and file systems
lsblk	Lists block devices and file systems and their attributes including their UUIDs and labels
mount	Mounts a file system for user access. Displays currently mounted file systems.
umount	Unmounts a file system

df -h
du -sh

Table 15-2 File System Management Commands

mount -t xfs *(getting information on the xfs file system)*

mount command requires sudo and absolute path. mount point should be empty. after mount, the kernel places an entry on the **/proc/self/mounts**. (file structure is similar to /etc/fstab).
remount is used to enable/disable an option.-

Option	Description
acl (noacl)	Enables (disables) the support for ACLs
auto (noauto)	Mounts (does not mount) the file system when the -a option is specified
defaults	Mounts a file system with all the default values (async, auto, rw, etc.)
_netdev	Used for a file system that requires network connectivity in place before it can be mounted. VDO and NFS are examples.
remount	Remounts an already mounted file system to enable or disable an option
ro (rw)	Mounts a file system read-only (read/write)

UUID: **xfs-admin -u /dev/sda1 /**
tune2fs (ext4)
blkid (all)
- UUID which is assigned to the file system remains persistent across system reboots.
- RHEL attempts to mount all file systems that are listed in /etc/fstab over its UUID or label.
- with the unmount kernel removes the corresponding file system entry from **/proc/self/mounts**.
monitoring disk: **df -h** (usage information) **du -sh** (amount of space a file or directory occupies)
-T to add the file system type to the output (example: **df -hT**)
-x to exclude the specified file system type from the output (example: **df -hx tmpfs**)
-t to limit the output to a specific file system type (example: **df -t xfs**)
-i to show inode information (example: **df -hi**)

Labelling:
xfs-admin -l /dev/sda1 , *lsblk -f /dev/sda1 (to view label)*
to create a label target must be unmounted.
umount /boot
xfs_admin -L bootfs /dev/sda1
mount /boot
e2label for ext filesystem, label is not recommended for VDO and LVM volumes. It is self-managed.

/etc/fstab file needs only one of four: block device, uuid, label, mount point. any missing or invalid entry may make the system unbootable, and should be booted in emergency mode to fix the file. find the line start with linux and add: **systemd.unit=emergency.target**

1: **path or UUID** 2: mount-point(**/, /boot, none, swap**) 3: filesystem: **Ext4, XFS, VFAT, ISO9660**, **swap** 4: comma-seperated options(**defaults**) 5: dump-check(**0**: disables) 6: sequence number runs e2fsck(repair utility) **0** for memory-based, remote and removable filesystems, **1** for /, and **2** for /boot and other physical systems. only valid for Ext.

UUID /boot xfs defaults 0 0

EX15.1
parted /dev/sdb mklabel msdos
parted /dev/sdb mkpart primary 1 20m
parted /dev/sdb mkpart primary 21 40m
mkfs -t ext4 /dev/sdb1
mkfs -t vfat /dev/sdb2
parted /dev/sdb print

mkfs.xfs /dev/sdd -f (parititon > 300mb, -f fore removal of old partition)
lsblk -f /dev/sdb /dev/sdb >> /etc/fstab (determine UUID) organise fstab after
mkdir /ext4fs1 /vfatfs1 /xfsfs1
mount -a
systemctl daemon-reload
df -hT
15.2 EXT with VDO
15.3 XFS with LVM
parted /dev/sde mklabel gpt
parted /dev/sde mkpart primary 1 160m
pvcreate /dev/sde1
vgcreate -s 16 vgfs /dev/sde1
lvcreate -n ext4vol -L 20 vgfs
lvcreate -n xfsvol -L 20 vgfs
mkfs.ext4 /dev/vgfs/ext4vol
mkfs.xfs /dev/vgfs/xfsvol -f
lsblk -f /dev/sde >> /etc/fstab
mkdir /ext4fs2 /xfsfs2
mount -a
df -hT | grep fs2
15.4 Resize Ext4 and XFS
pvcreate /dev/sde2
vgextend vgfs /dev/sde2
vgdisplay vgfs (check pv count:2)
lvextend -L +10m /dev/vgfs/ext4vol (adds 10m to ext4vol)
lvdisplay /dev/vgfs/ext4vol
lvextend -L +10m /dev/vgfs/xfsvol (adds 10m/one extent(16m) to xfsvol)
lvdisplay /dev/vgfs/xfsvol
lvresize -r -L +10m /dev/vgfs/xfsvol
lvresize -r -L +10m /dev/vgfs/ext4vol
15.5 Create, Mount, Expand with Stratis
stratis pool create /dev/sdf
stratis pool list
stratis blockdev list strpool
stratis filesystem create strpool strfs2
stratis filesystem list (UUID can be found)
lsblk /dev/stratis/strpool/strfs2 -o UUID (or such)
>/etc/fstab
“UUID” /strfs2 xfs **x-systemd.requires=stratisd.service** 0 0
mkdir /strfs2
mount -a
stratis pool add-data strpool /dev/sdg (add new pv to stratis pool)

SWAP
an independent region on the physical disk used for holding idle data until it is needed. Physical memory is split into small chunks: **pages** and maps their physical location to virtual locations on swap. Mapping information is stored in the *page table*, maintained by the kernel. Paging data out and in is known as demand paging. Excessive amount of paging causes system degradation called *thrashing.* When trashing begins, the system deactivates new processes to launch until the system reaches the threshold value back.
Swap may be twice or larger than the physical memory or smaller. *free -ht*

mkswap: create swapon: activate swapoff: deactivate swapon -s: list

15.6 Create and Activate Swap

parted /dev/sdb mkpart primary 1 80
parted /dev/sdb mkpart primary 80 160

parted /dev/sdb mkpart primary 160 240
vgcreate vgfs /dev/sdb1
lvcreate -n swapvol -L 80
mkswap /dev/vgfs/swapvol
mkswap /dev/sdb2
swapon -a
swapon
free -ht

```
[tm@vbox ~]$ free -ht
               total        used        free      shared  buff/cache   available
Mem:           1.7Gi       1.2Gi        76Mi        20Mi       637Mi       543Mi
Swap:          2.1Gi          0B       2.1Gi
Total:         3.8Gi       1.2Gi       2.2Gi
```

lsblk -f >> /etc/fstab
UUID="<>" swap swap pri=1 0 0
/dev/vgfs/swapvol swap swap pri=2 0 0
cat /proc/swaps

```
[tm@vbox ~]$ cat /proc/swaps
Filename                                Type            Size            Used            Priority
/dev/dm-1                               partition       2097148         0               -2
/dev/sdb3                               partition       59388           0               1
/dev/dm-2                               partition       40956           0               2
```

cat /proc/mounts

rhel99_1.vdi	399,66 MB	2,00 MB
rhel99_2.vhd	399,66 MB	3,00 KB
rhel99_3.vmdk	399,66 MB	64,00 KB
rhel99_4.vdi	399,66 MB	2,00 MB

VMDK (VMware Virtual Machine Disk):

- VMware uses a specific format for its virtual disks, and one key component of a VMDK file is the way it stores metadata for the virtual disk. The 64KB file size you're referring to is often related to the block size or the minimum allocation for a virtual disk in VMware. VMware may reserve small blocks of space in the virtual disk for things like metadata, snapshots, and disk management. Thus, a VMDK file might show up as 64KB, even if the actual disk content is smaller.

VHD (Virtual Hard Disk - used by Hyper-V):

- VHD files are also formatted in a way that has space reserved for disk management structures and metadata. The 3KB "real" size you mentioned may be the actual size of the metadata block or the overhead associated with tracking the virtual disk's state.

VDI (VirtualBox Disk Image):

- Similarly, VirtualBox's VDI format has a slightly larger size (2MB real size) because of the way it organizes blocks and metadata. VirtualBox manages virtual disks in a way that can result in some overhead storage for file system structures, although it's typically more efficient in terms of block size compared to VMware or Hyper-V.

15.1 Create VFAT, Ext4, XFS File Systems in partitions and mount persistently

```
NAME                FSTYPE      FSVER    LABEL UUID                                   FSAVAIL FSUSE% MOUNTPOINTS
sda
├─sda1              xfs                       0cdd878c-ed88-4631-9ed7-1df8a52c91c6    610.4M    36% /boot
└─sda2              LVM2_member LVM2 001      3KsWDq-77cJ-CIpv-SsST-FcJ6-x1If-h1ubyJ
  ├─rhel_vbox-root  xfs                       e1fd8d5c-58a0-49ce-bad7-2fee1450483a     12.2G    28% /
  └─rhel_vbox-swap  swap        1             a22b1e7b-52d6-42fb-bc94-c65c20f00f83
sdb
├─sdb1              vfat        FAT16         782A-1688                                74.8M     0% /vfatfs5
├─sdb2              ext4        1.0           db7ee7fa-d24e-4d6d-8622-59c0322a0d1a     60.4M     0% /ext4fs5
└─sdb3              xfs                       c090dd64-208d-49af-b62d-60adae8fef51     65.2M     6% /xfsfs5
```

```
[root@vbox tm]# df -h
Filesystem                  Size  Used Avail Use% Mounted on
devtmpfs                    4.0M     0  4.0M   0% /dev
tmpfs                       888M     0  888M   0% /dev/shm
tmpfs                       355M  5.7M  350M   2% /run
/dev/mapper/rhel_vbox-root   17G  4.8G   13G  28% /
/dev/sda1                   960M  350M  611M  37% /boot
tmpfs                       178M   96K  178M   1% /run/user/1000
/dev/sdb1                    75M     0   75M   0% /vfatfs5
/dev/sdb2                    66M   14K   61M   1% /ext4fs5
/dev/sdb3                    70M  4.5M   66M   7% /xfsfs5
```

15.2 Create XFS in VDO volume and mount persistently

sudo subscription-manager repos --enable=rhel-9-for-x86_64-baseos-rpms
--enable=rhel-9-for-x86_64-appstream-rpms

vdo create —name=vdo5 —device=/dev/sdc —size=1G —slab_size=1M
vdostatus
vdostats
mkfs.xfs /dev/mapper/vdo5
mkdir /vdofs5
nlkid /dev/mappers/vdo5
UUID="<>" /vdofs5 xfs defaults,_netdev 0 0
umount /vdofs5
mount -a
df -h

15.3 Create ext4 and xfs in lvm
pvcreate /dev/sdc
vgcreate vg20 /dev/sdc
lvcreate -L 120M -n lv200 vg20
lvcreate -L 100M -n lv100 vg20
mkfs.ext4 /dev/vg20/lv200
mkfs.xfs /dev/vg20/lv300
mkdir /lvmfs5 /lvmfs6
mount /dev/vg20/lv200 /lvmfs5
mount /dev/vg20/lv300 /lvmfs6
blkid /dev/vg20/lv200 >> /etc/fstab
blkid /dev/vg20/lv300 >> /etc/fstab
umount /lvmfs5 /lvmfs6
mount -a

df -h

```
[root@vbox tm]# df -h
Filesystem                  Size  Used Avail Use% Mounted on
devtmpfs                    4.0M     0  4.0M   0% /dev
tmpfs                       888M     0  888M   0% /dev/shm
tmpfs                       355M  5.7M  350M   2% /run
/dev/mapper/rhel_vbox-root   17G  4.8G   13G  28% /
/dev/sda1                   960M  350M  611M  37% /boot
tmpfs                       178M   96K  178M   1% /run/user/1000
/dev/sdb1                    75M     0   75M   0% /vfatfs5
/dev/sdb2                    66M   14K   61M   1% /ext4fs5
/dev/sdb3                    70M  4.5M   66M   7% /xfsfs5
/dev/mapper/vg20-lv200      107M   14K   99M   1% /lvmfs5
/dev/mapper/vg20-lv300       95M  6.0M   89M   7% /lvmfs6
```

15.4 Extend ext4 and xfs in lvm

pvcreate /dev/sdd
vgextend vg20 /dev/sdd
lvextend -L +80m /dev/vg20/lv200 (additional)
lvextend -L 300m /dev/vg20/lv300 (final)
/etc/fstab modification is not necessary

```
[root@vbox tm]# lsblk
NAME                MAJ:MIN RM   SIZE RO TYPE MOUNTPOINTS
sda                   8:0    0    20G  0 disk
├─sda1                8:1    0     1G  0 part /boot
└─sda2                8:2    0    19G  0 part
  ├─rhel_vbox-root  253:0    0    17G  0 lvm  /
  └─rhel_vbox-swap  253:1    0     2G  0 lvm
sdb                   8:16   0 312.2M  0 disk
├─sdb1                8:17   0    75M  0 part /vfatfs5
├─sdb2                8:18   0    76M  0 part /ext4fs5
└─sdb3                8:19   0    75M  0 part /xfsfs5
sdc                   8:32   0 399.7M  0 disk
├─vg20-lv200        253:2    0   320M  0 lvm  /lvmfs5
└─vg20-lv300        253:3    0   300M  0 lvm  /lvmfs6
sdd                   8:48   0 399.7M  0 disk
├─vg20-lv200        253:2    0   320M  0 lvm  /lvmfs5
└─vg20-lv300        253:3    0   300M  0 lvm  /lvmfs6
sde                   8:64   0 399.7M  0 disk
sdf                   8:80   0 399.7M  0 disk
sr0                  11:0    1  1024M  0 rom
```

15.5 create xfs in stratis volume
stratis pool create strpool5 /dev/sdg
stratis filesystem create strfs5
stratis pool list
stratis filesystem list
mkdir /strfs5
mkfs.xfs /dev/stratis/strpool5/strfs5
mount /dev/stratis/strpool5/strfs5 /strfs5
blkid /dev/stratis/strpool5/strfs5 >> /etc/fstab

```
[root@vbox tm]# mount /dev/stratis/strpool5/strfs5 /strfs5
mount: (hint) your fstab has been modified, but systemd still uses
       the old version; use 'systemctl daemon-reload' to reload.
[root@vbox tm]# systemctl daemon-reload
[root@vbox tm]# lsblk
NAME                                                                                                  MAJ:MIN RM   SIZE RO TYPE    MOUNTPOINTS
sda                                                                                                     8:0    0    20G  0 disk
├─sda1                                                                                                  8:1    0     1G  0 part    /boot
└─sda2                                                                                                  8:2    0    19G  0 part
  ├─rhel_vbox-root                                                                                    253:0    0    17G  0 lvm     /
  └─rhel_vbox-swap                                                                                    253:1    0     2G  0 lvm     [SWAP]
sdb                                                                                                     8:16   0 312.2M  0 disk
├─sdb1                                                                                                  8:17   0    75M  0 part    /vfatfs5
├─sdb2                                                                                                  8:18   0    76M  0 part    /ext4fs5
└─sdb3                                                                                                  8:19   0    75M  0 part    /xfsfs5
sdc                                                                                                     8:32   0 399.7M  0 disk
├─vg20-lv200                                                                                          253:2    0   320M  0 lvm     /lvmfs5
└─vg20-lv300                                                                                          253:3    0   300M  0 lvm     /lvmfs6
sdd                                                                                                     8:48   0 399.7M  0 disk
├─vg20-lv200                                                                                          253:2    0   320M  0 lvm     /lvmfs5
└─vg20-lv300                                                                                          253:3    0   300M  0 lvm     /lvmfs6
sde                                                                                                     8:64   0 399.7M  0 disk
sdf                                                                                                     8:80   0 399.7M  0 disk
sdg                                                                                                     8:96   0   1.1G  0 disk
└─stratis-1-private-d029a98f8495483581bc1316909e58bf-physical-originsub                               253:4    0   1.1G  0 stratis
  ├─stratis-1-private-d029a98f8495483581bc1316909e58bf-flex-thinmeta                                  253:5    0     4M  0 stratis
  │ └─stratis-1-private-d029a98f8495483581bc1316909e58bf-thinpool-pool                                253:8    0   636M  0 stratis
  │   └─stratis-1-d029a98f8495483581bc1316909e58bf-thin-fs-d484bffb8ccc4117a644dcb18442e5b7 253:9    0     1T  0 stratis /strfs5
  ├─stratis-1-private-d029a98f8495483581bc1316909e58bf-flex-thindata                                  253:6    0   636M  0 stratis
  │ └─stratis-1-private-d029a98f8495483581bc1316909e58bf-thinpool-pool                                253:8    0   636M  0 stratis
  │   └─stratis-1-d029a98f8495483581bc1316909e58bf-thin-fs-d484bffb8ccc4117a644dcb18442e5b7 253:9    0     1T  0 stratis /strfs5
  └─stratis-1-private-d029a98f8495483581bc1316909e58bf-flex-mdv                                       253:7    0   512M  0 stratis
sr0                                                                                                    11:0    1  1024M  0 rom
```

15.6 create swap in partition and lvm volume and activate persistently

parted /dev/sde mklabel msdos
parted /dev/sde mkpart primary 1 100
parted /dev/sde mkpart primary 101 200
mkswap /dev/sde1 -L swapp1
lsblk -f /dev/sde >> /fstab
swapon -a && swapon -s

pvcreate /dev/sde2
vgextend vg20 /dev/sde2
lvcreate -L 80m -n swapvol vg20
mkswap /dev/vg20/swapvol
mkswap /dev/sde2
lsblk -f /dev/sde2 >> fstab (none swap defaults 0 0)
swapon -a && swapon -s

```
sde                                                                                                     8:64   0 399.7M  0 disk
├─sde1                                                                                                  8:65   0    94M  0 part    [SWAP]
└─sde2                                                                                                  8:66   0    95M  0 part    [SWAP]
sdf                                                                                                     8:80   0 399.7M  0 disk
```

Remote File System

- network file system service(mount/unmount)
- autofs

multiple nfs clients can access single share simultaneously
supports linux, unix, windows.
enables sharing of common application binaries, read-only information, reducing administration overhead and storage cost.
consolidation of scattered user home directories.
nfsv4 uses usernames and group names instead of UID and GIDs.
4.0, 4.1-> TCP, 4.2-> UDP

ex16.1 export share on nfs
(on server2)
dnf install -y nfs-utils
mkdir /common
chmod 755 /common
firewall-cmd –permanent –add-service nfs
firewall-cmd –reload
systemctl status nfs-server && systemctl start nfs-server
/common 192.168.0.110(rw) >> /etc/exports
exportfs -av

exportfs -u 192.168.0.110:/common (unexport)

16.2 mount share on nfs
(on server1)
dnf install -y nfs-utils
mkdir /local
mount 192.168.0.120:/common /local
192.168.0.120:/common /local nfs _netdev 0 0 >> /etc/fstab
mount | grep local
df -h
umount /local
mount -a
touch /local/nfsfile (on srv1)
ls -l /common (on srv2)

AutoFS

autofs is a client side service.autofs mounts share automatically, it's not accessed over time. mounts need no entry in /etc/fstab while using autofs. **/etc/autofs.conf.**

autofs requires nfs shares be defined in config files called maps, located in /etc or /etc/auto.master.d.
autofs does not need root privileges .
autofs map types: master, direct, indirect.
/etc/auto.master.d/auto.direct is automatically parsed at startup. **/etc/auto.misc**: indirect
direct mounted shares are always visible to users. **/etc/mtab** maintains a list of all mounted file systems.

ex16.3 access NFS using direct map
dnf install -y autofs
mkdir /autodir
/- /etc/auto.master.d/auto.dir >> /etc/auto.master
/autodir 192.168.0.120:/common >> /etc/auto.master/auto.dir
systemctl enable –now autofs
systemctl status –autofs -l –no-pager
ls /autodir

Indirect Map: is preferred over direct map if all of the shares are mounted under one common parent directory.
local and indirect shares cannot coexist under the same parent directory.

ex16.4 access NFS using indirect map
autoindir 192.168.0.120:/common >> /etc/auto.misc
systemctl enable –now autofs
systemctl status autofs -l –no-pager
ls /misc/autoindir

*:references to specific mount points
&: references to specific mount points
* *-rw &:/home/& >> /etc/auto.master.d/auto.home*

with this no need to update autoFS config files.
user30 can find its home directory in both servers.

ex16.5 automount user home using indirect map
(server2)
useradd -u 3000 user30
echo pass30 | passwd –stdin user30
/home 192.168.0.110(rw) >> /etc/exports
exportfs -avr

(server1)
dnf install -y autofs
useradd -u 3000 -Mb /nfshome user30
echo pass30 | passwd –stdin user30
mkdir /nfshome
/nfshome /etc/auto.master.d/auto.home >> /etc/auto.master
** -rw 192.168.0.120:/home/user30* (for multiple user setup, replace user30 with &, ensure all users exist in both systems with same name and id)
systemctl enable autofs –now
systemctl status autofs -l –no-pager
su - user30 & pwd/ls

user is successfully logged in with their home directory automounted from the NFS server. (mount | grep user30)

17. Networking
nmcli device status
ip route show
journalctl -xe | grep network
hostnamectl set-hostname server1
nmcli con mod enp0s3 ipv4.addresses 10.0.4.2/24
nmcli con mod enp0s3 ipv4.dns 10.0.4.1

public: A(16m nodes(0-127), B 64k nodes(128-191), C 254 nodes(192-223))
private: D(multicast), E(experimental)
all nodes in a given subnet have same mask, each subnet acts as isolated network and requires router to talk other subnets.
protocols: /etc/protocols
well known ports: /etc/service
ipv6 packet size: 1280 bytes, ipv4 packet size: 576 bytes
network (NIC) can have multiple connection profiles, but only one profile is active at a time.
/etc/sysconfig/network-scripts/enp0s3

Directive	Description
BOOTPROTO	Defines the boot protocol to be used. Common values include dhcp to obtain IP assignments from a DHCP server and none or static to use a static IP as set with the IPADDR directive.
BROWSER_ONLY	Works if PROXY_METHOD is set to auto. Default is no.
DEFROUTE	Whether to use this connection as the default route
DEVICE	Specifies the device name for the network interface
DNS1	Defines the IP address or the hostname of the first DNS server. This address/hostname is placed in the /etc/resolv.conf file if the PEERDNS directive is set to no in this file.
GATEWAY	Specifies the gateway address for the connection if the BOOTPROTO directive is set to none or static
HWADDR	Describes the hardware address for the device
IPADDR	Specifies the static IP for the connection if the BOOTPROTO directive is set to none or static
IPV4_FAILURE_FATAL	Whether to disable the device if IPv4 configuration fails. Default is no.
IPV6INIT	Whether to enable IPv6 support for this connection
NAME	Any description given to this connection. The default matches the device name.
NETMASK	Sets the netmask address for the connection if the BOOTPROTO directive is set to none or static
NM_CONTROLLED	Whether the NetworkManager service is to be allowed to modify the configuration for this connection. It should be turned off on computers that use static IP addresses. Default is yes.
ONBOOT	Whether to auto-activate this connection at system boot
PEERDNS	Whether to modify the DNS client resolver

man nm-settings

	file /etc/resolv.conf.Default is yes if BOOTPROTO is set to dhcp.
PREFIX	Defines the number of subnet bits. This directive may be used in lieu of NETMASK.
PROXY_METHOD	Method to be used for proxy setting. Default is no.
UUID	The UUID associated with this connection
TYPE	Specifies the type of this connection

Table 17-2 Network Connection Configuration Directives

17.3 manual interface configuration

settings: enable network adapter-> internal network. (establishes new enp0s8)

vi /etc/sysconfig/network-script/enp0s8

```
"/etc/sysconfig/network-scripts/ifcfg-enp0s8" [New] 11L, 166B written
[root@server1 ~]# cat /etc/sysconfig/network-scripts/ifcfg-enp0s8
TYPE=Ethernet
BOOTPROTO=static
DEFROUTE=yes
IPV4_FAILURE_FATAL=no
IPV6INIT=no
NAME=enp0s8
DEVICE=enp0s8
ONBOOT=yes
IPADDR=172.10.10.110
PREFIX=24
GATEWAY=172.10.10.1
```

ifup enp0s8 / nmcli con up enp0s8

Object	Description
Connection: activates, deactivates, and administers network connections	
show	Lists connections
up / down	Activates/deactivates a connection
add	Adds a connection
edit	Edits an existing connection or adds a new one
modify	Modifies one or more properties of a connection
delete	Deletes a connection
reload	Instructs NetworkManager to re-read all connection profiles
load	Instructs NetworkManager to re-read a connection profile
Device: displays and administers network interfaces	
status	Exhibits device status
show	Displays detailed information about all or the specified interface

17.4 nmcli interface configuration

nmcli con show
nmcli dev show
*nmcli c**on add type Ethernet ifname enp0s8 con-name enp0s8 ipv4 172.10.10.120/24 gw4 172.10.10.1***
cat /etc/sysconfig/network-scripts/ifcfg-enp0s8 (old-fashion)
*cat **/etc/NetworkManager/system-connections***

ip a
nmcli c down enp0s8
nmcli c up enp0s8
nmcli c s

/etc/hosts
192.168.0.110 server1.example.com server1
192.168.0.120 server2.example.com server2
172.10.10.119 server1p0s8.example.com server1s8
172.10.10.120 server2p0s8.example.com server2s8
ping 192.168.0.120 -c 2
ping -c2 server2
ping -c1 server2s8

nmcli con add type Ethernet ifname enp0s8 con-name enp0s8 ipv4 172.10.10.100/24 gw4 172.10.10.1
nmcli con add type Ethernet ifname enp0s8 con-name enp0s8 ipv4 172.10.10.200/24 gw4 172.10.10.1
/etc/hosts
172.10.10.100 server1.example.com server1
172.10.10.200 server2.example.com server2

Chrony
new implementation of network time protocol. port 123. response time efficiency carries the highest importance.
/etc/chrony.conf
dnf install -y chrony
cat /etc/chrony.conf | grep ntp (check for the pool info)
systemctl enable chronyd –now
hwclock –systhoc
hwclock –show
chronyc sources
dig <srv>
Geolookup: curl https://ipinfo.io/<srv>

server <NTP-server> >> /etc/chrony.conf
timedatectl set-timezone CET
timedatectl set-ntp true

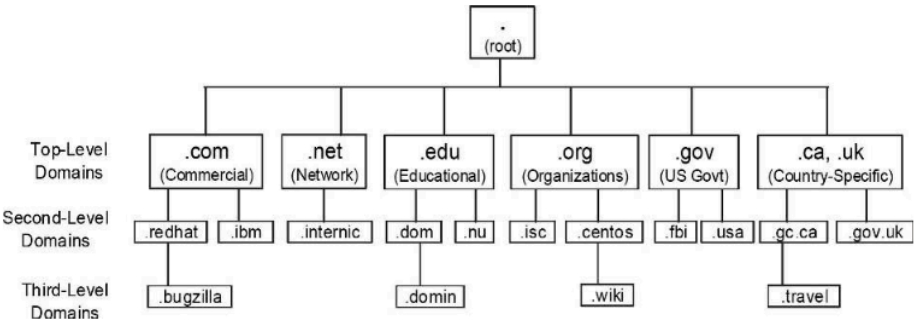


Figure 18-2 Sample DNS Hierarchy

dns roles: primary, secondary or client.

Keyword	Meaning	Default Action
success	Information found in source and provided to the requester	return (do not try the next source)
notfound	Information not found in source	continue (try the next source)
unavail	Source down or not responding; service disabled or not configured	continue (try the next source)
tryagain	Source busy, retry later	continue (try the next source)

dig -X <ip> (reverse lookup)
host redhat.com
host -v <ip>
getent hosts redhat.com

OPENSSH
symmetric / asymmetric : secret / public key encryption
GSSAPI based auth - with Kerberos
Host-bases auth- ~/.shosts
priv/pub key based
challenge resp
pass based - checks /etc/passwd
RSA: Rivest-Shamir Adleman, DSA: Digital Signature Algorithm, ECDAS: Elliptic Curve Digital Signature.
client: /etc/ssh/ssh_config server: /etc/ssh/sshd_config
ssh-copy-id: copy pubilc key to remote servers
/var/log/secure : logs related to authentication

Directive	Description
Port	Specifies the port number to listen on. Default is 22.
Protocol	Specifies the default protocol version to use.
ListenAddress	Sets the local addresses the sshd service should listen on. Default is to listen on all local addresses.
SyslogFacility	Defines the facility code to be used when logging messages to the /var/log/secure file. This is based on the configuration in the /etc/rsyslog.conf file. Default is AUTHPRIV.
LogLevel	Identifies the level of criticality for the messages to be logged. Default is INFO.
PermitRootLogin	Allows or disallows the root user to log in directly to the system. Default is yes.
PubKeyAuthentication	Enables or disables public key-based authentication. Default is yes.
AuthorizedKeysFile	Sets the name and location of the file containing a user's authorized keys. Default is ~/.ssh/authorized_keys.
PasswordAuthentication	Enables or disables local password authentication. Default is yes.
PermitEmptyPasswords	Allows or disallows the use of null passwords. Default is no.
ChallengeResponseAuthentication	Enables or disables challenge-response authentication mechanism. Default is yes.
UsePAM	Enables or disables user authentication via PAM. If enabled, only root will be able to run the sshd daemon. Default is yes.

ssh-keygen -N "" -q
ssh-copy-id server2
ssh-copy-id i ~/.ssh/id_rsa.pub user2@server2 (more specific)
scp server2:/tmp/test .
sftp
rsync -avz (copies only updated files, -a option to preserve all file attributes, -v to use verbosity, z: compression, -P: show progression)
firewall: secure inbound and outbound traffic flow. /usr/lib/firewalld directory. /etc/firewalld
/etc/services: common ports
packet classification: *nftables*.
network connection can be part of one zone at a time. a zone can have multiple network connections assigned to it. zone configuration may include ports, protocols that may be open or closed. firewalld makes inspection for

each package, applies package to that zone, if nothing applies then to default zone.

Zone	Description
trusted	Allow all incoming
internal	Reject all incoming traffic except for what is allowed. Intended for use on internal networks.
home	Reject all incoming traffic except for what is allowed. Intended for use in homes.
work	Reject all incoming traffic except for what is allowed. Intended for use at workplaces.
dmz	Reject all incoming traffic except for what is allowed. Intended for use in publicly-accessible demilitarized zones.
external	Reject all incoming traffic except for what is allowed. Outgoing IPv4 traffic forwarded through this zone is masqueraded to look like it originated from the IPv4 address of an outgoing network interface. Intended for use on external networks with masquerading enabled.
public	Reject all incoming traffic except for what is allowed. It is the default zone for any newly added network interfaces. Intended for us in public places.
block	Reject all incoming traffic with icmp-host-prohibited message returned. Intended for use in secure places.
drop	Drop all incoming traffic without responding with ICMP errors. Intended for use in highly secure places.

Table 20-1 firewalld Default Zones

/usr/lib/firewalld/zones -> **/etc/firewalld/zones**

20.1 Add Services, Port and Manage Zones

firewall-cmd –get-default-zone
firewall-cmd –permanent –add-service http
firewall-cmd –reload
firewall-cmd –list-services
cat /etc/firewalld/zones/public.xml | grep http
firewall-cmd –add-port 443/tcp
firewall-cmd –list-ports
firewall-cmd –add-port 5901-5910/tcp –permanent –zone internal
cat /etc/firewalld/zones/internal.xml
firewall-cmd –set-default-zone internal
firewall-cmd –reload
firewall-cmd –list-ports
firewall-cmd –remove-port 5901-5910/tcp –permanent
firewall-cmd –remove-service ssh
firewall-cmd –add-service ssh
nft list ruleset
SELINUX
subject: system_u for Selinux system user, unconfined_u: subjects that are not bound by Selinux.
object: resource(file, dir, hardware, device, network interface/connection, port, pipe socket.
access: action performed by subject on an object.
policy: defined ruleset (targeted(confined domain) / mls(tight security / minimum(light security)

user cannot run su or sudo for programs that are located in their home dir if they are mapped to the selinux user *user_u*

seinfo -u
semanage port -l

domain transitioning: allowing a process to enter another domain to execute an application taht is restricted to run in that domain only. entrypoint: control processes that can transition into another domain.
ls -lZ /usr/bin/passwd (see passed has passwd_exec_t type) but passwd has to access /etc/shadow file with type shadow_t. this happens via selinux.
booleans; /sys/fs/selinux/booleans (setsebool, getseebool) restorecon
/etc/selinux/config. use permissive while debugging. see status with *sestatus, /etc/sestatus.conf*

Command	Description
Mode Management	
getenforce	Displays the current mode of operation
sestatus	Shows SELinux runtime status and Boolean values
setenforce	Switches the operating mode between enforcing and permissive temporarily
Context Management	
chcon	Changes context on files (changes do not survive file system relabeling)
restorecon	Restores default contexts on files by referencing the files in the /etc/selinux/targeted/contexts/files directory
semanage	Changes context on files with the fcontext subcommand (changes survive file system relabeling)
Policy Management	
seinfo	Provides information on policy components
semanage	Manages policy database
sesearch	Searches rules in the policy database
Boolean Management	
getsebool	Displays Booleans and their current settings
setsebool	Modifies Boolean values temporarily, or in the policy database
semanage	Modifies Boolean values in the policy database with the boolean subcommand
Troubleshooting	
sealert	The graphical troubleshooting tool

Table 21-1 SELinux Management Commands

21.1
mkdir sedir && touch sedir/sefile
chcon -vu user_u -t public_content_t sedir -R
21.2
semanage fcontext -a -s user_u -t public_content_t '/tmp/sedir(/.)?'*

will add entry into: /etc/selinux/targeted/contexts/files/file_context.local
validate : *semanage fcontext -Cl*
chcon -vu staff_u -t etc_t sedir -R
restorecon -Rv sedir
21.3 Adding non-standard network port(8010) to http
semanage port -at http_port_t -p tcp 8010
semanage port -l | grep http

any non-standard port should be added to selinux policy database with correct type.

21.4 context preservation
preserving context: cp /tmp/sefile /etc/default **–preserve-context** (see user_tmp_t is preserved)

21.5 toggle selinux values
getsebool -a | grep nfs_export_all_rw
sestatus -b | grep nfs_export_all_rw
semanage boolean -l | grep nfs_export_all_rw (will see “on”)
setsebool -P nfs_export_all_rw off (-P for persistent)
semanage boolean -l | grep nfs_export_all_rw (will see “off”)

selinux alert> /var/log/audit/audit.log (when mode is enforcing and permissive)
sealert -a /var/log/audit/audit.log (will log any failed attempts such as changing passwd)

21.2 resursive labelling
semanage fcontext -Cl /tmp/dir1
semanage fcontext -a -t etc_t “/tmp/dir1(/.*)?”
restorecon -Rv /tmp/dir1

21.3
semanage port -a -t http_port_t -p tcp 9001
semanage port -l | grep 9001

21.5
sestatus ssh_use_tcpd
getsebool -a | grep ssh_use_tcpd
setsebool -P ssh_use_tcpd off

Glossary:
block: collection of bytes of data transmitted as a single unit.
block device file: file associated with devices that transfer data randomly in blocks(disk).
chrony: implementation of Network Time Protocol for time synchronization on network devices.
CIDR: classless inter domain routing
DAC(SELinux): Discretionary Access Control(set of traditional access controls)
De-deplication: removal of redundant data blocks
De-encapsulation: Reverse of encapsulation
Defunct process: zombie process
firewalld: a dynamic firewall manager
firewalld zone: a method of segregating incoming network traffic
globbing: regex
GPG: Gnu privacy guard. open source implementation of PGP(pretty good privacy).
host table: maintains UP and hostname mappings.
index node: hold’s file properties: permissions, size, creation/modification time pointer to the data blocks that is stored.
IPC: inter-process comm(data sharing, synchronization, resource sharing). Types: Pipes, message queue, shared memory, semaphores, sockets, signals, remote procedure calls.
job: process started in the background
journaled file system: file system that uses the journaling mechanism for a swift recovery after crash.
kerberos: authentication over unsecure networks.
logical extent: a unit of space allocation for logical volumes in lvm
logical volume: logical container in lvm that holds a file system or swap
masquerading: SNAT
mbr(master boot record): small region that stores disk partition information.
named group: specific group that receives ACLs.
named pipe: two unrelated process (on a same/separate system) exchange data.
named user: specific user that receives ACLs.
NDP: neighbor discovery protocol

nftables: packet classification framework to monitor network traffic.
octal mode: method for setting permissions on a file or directory using octal numbering system.
on-demand activation: systemd way of activation of a service when needed.
orphan process: alive child process of a terminated parent process.
package integrity: complete and error-free package
paging: process of transferring data between memory and swap space.
pam: :pluggable authentication module
pattern matching: regex. metachars: chars that have special meaning for machines.
public key encryption: asymmetric encryption.
forward proxy: content filtering, anonymity, internet access behind firewalld (shodowsocks, squid, privoxy, tor, proxychains)
reverse proxy: load balancing, ssl termination, security caching
sticky bit: disable non-owners to delete files.
symmetric encryption technique : technique that employs secret key for private communication between two network entities.
target: logical collection of systemd units. all units within a target are treated as a single entity.
unit: systemd object to organize service startups, socket creation etc.
thin pool: pool of storage allows to create volumes larger than actual size.
thin provisioning: economical technique of storage allocation and utilization.
trashing: excessive amount of paging.
udevd: dynamic device management service
vfat: virtual file allocation table
wayland: superior networking protocol that has replaced the x window system.
workload: any application that runs on the system.
zero-block elimination: technique removing empty data blocks from storage.
hardware-assisted virtualization will have either the **vmx** (Intel) or **svm** (AMD) flags in the */proc/cpuinfo*.

SANDER VAN GUT
working with files:
under /run to find temporary files after last boot
mount with noexec for more security
ls -lrt show newest files listed last
cp /etc/*.file
cp /etc/a? (single char)

hard links can be created only by the owner of the file. multiple hard links can point to single file. removing one hard link does not effect others. can not be applied to directories. when soft link is removed, files also removed.

tar -czvf student.tar ./ (-z option will compress at the same time)*
tar -rvf student.tar new (append new)
tar -tvf student.tar (monitor the archive content)
tar -uvf (update files)
tar -xvf student.tar (extract, use -C option to specify target directory)
tar -xvf student.tar ./file (will extract only "file")
star (for non default file attributes such as access list, current tar can also do)
gzip student.tar (compression)
rm !(student.tar) (remove all files except tar)

less > G move to the end of the file.
cut -d1: -f 1 /etc/passwd (show only first)
ps aux | sort -k3 (sort third column)
grep chrony /etc/passwd
grep colou?r (will print both color and colour)
grep ab+ (b have to match, will find ab, abb, abc,..)
tail -n5 /etc/passwd | head -n1 (first of the last 5)
cut -d: -f1 /etc/passwd | sort -n (show the third column and sorts)
sort -k1 -t : /etc/passwd (sort in alphanumerical

ps aux | sort -k 4 -n (find the busiest process on the kernel)
grep ^user /etc/passd (starting patterns)
grep nologin$ etc/passwd (ending pattern)
file r[aou]t (will scan for rat rot rut)
grep -v [^#;] (exclude files starting with # or ;
grep -B 5 "^PATH" (print lines starting with PATH and 5 lines before)
sed -n '9p' file (show line nr 9 on file)
sed 's/user/users/g' file
ps aux | sort -k3 -r (sort in reverse order for 3rd column highest)
sed -i '6d' file (delete sixth line)
ps aux | awk {print 6} (print 6th column)
ForwardX11 yes

Table 5-3 Common **rsync** Options

Option	Use
-r	Synchronizes the entire directory tree
-l	Copies symbolic links as symbolic links
-p	Preserves permissions
-n	Performs only a dry run, not actually synchronizing anything
-a	Uses archive mode, thus ensuring that entire subdirectory trees and all file properties will be synchronized
-A	Uses archive mode, and in addition synchronizes ACLs
-X	Synchronizes SELinux context as well

*	Matches zero to an infinite number of the previous character.
\{2\}	Matches exactly two of the previous character.
\{1,3\}	Matches a minimum of one and a maximum of three of the previous character.
colou?r	Matches zero or one of the previous character. This makes the previous character optional, which in this example would match both *color* and *colour*.
(…)	Used to group multiple characters so that the regular expression can be applied to the group.

wheel group should have sudo privileges.
sudo command1 | command2
/etc/default/useradd (defa location for all new users)
get info about password properties: chage -l
create file /etc/nologin to no users can login except root.
hashed passwords are stored in /etc/shadow
pkexec alternative to sudo
passwd -n 30 -w 3 -x 90 linda
newgrp sales: all new files will belong to sales.
find . -user linda (find all files belong to linda)
umask in /etc/profile with if.
lsattr file
find / -group users
man nmcli-examples
dnf config-manager –add-repo=http://reposerver.example.com/BaseOS
dnf config-manager –add-repo=file:///repo/BaseOS
dnf config-manager –add-repo=file:///repo/AppStream
/dev/sr0 /repo iso9660 defaults 0 0 >> /etc/fstab , mount -a , mount | grep sr0
dnf list installed

rpm -qi nmap
rpm -ql nmap
dnf group list && dnf group info "Security Tool"
dnf module switch-to php:7.1 –dry-run
dnf install createrepo
mkdir /repo2 && cd /repo2 && createrepo_c .
shell jobs(interactive processes) that started from the command line.
Daemons are processes that provide services. often run with root privileges
kernel threads are part of linux kernel. you cannot manage kernel using common tools.
&: start command in the background
ctrl+z: stops and move job to background
ctrl+d: sends EOF. should stop waiting further
ctrl+c: cancel the current job.
bg: continue the job that has just been frozen, fg: brings job back to the foreground
ps -efaux
cgroups has three slices:
system: all systemd-managed processes are running
user: all user(including root) processes are running
machine: optional slice used for virtual machines and containers
cp stress.service /etc/systemd/system
systemctl daemon-reload && systemctl start stress **systemctl -t service**
while true; do true; done
export SYSTEMD_EDITOR=/bin/vi
most important unit type for systemd is service such as apache, ssh etc. **systemctl -t help** (list available unit types)
unit files: **/run/systemd/system & /etc/systemd/system & /usr/lib/systemd/system**
if same unit file exist in multiple location, ones under /run will have precedence.
The **forking** type is commonly used by daemon processes, but you can also use other types, such as **oneshot** and **simple**, which will start any command from a Systemd unit.

target unit is "a group of units."
systemctl enable : automatically restarting on the boot.
systemctl -t help,
systemctl -t service
systemctl list-units -t service –all
systemctl list-dependencies, systemctl show sshd, systemctl edit sshd.service
Unit types socket, timer and path are directly related to a service unit. Systemd can make the connection because the first part of the name is the same. cockpit.socket works with cockpit.service, accessing either of these unit types will trigger the service.
export SYSTEMD_EDITOR="/bin/vi"
systemctl edit logrotate
[Service]
Restart=always
RestartSec=5s
systemctl daemon-reload
systemctl status logrotate
dnf install httpd -y
systemctl cat httpd.service
systemctl list-units –type=serv**ice**
atq (see listed at jobs)
systemd timers are the default scheduling solution for RHEL9. service will have under same name timer. logrotate.service-> logrotate.timer.
[Timer]
OnCalendar=daily
AccuracySec=1h
Persistent=true
systemctl list-units -t timer
systemctl list-dependencies
systemctl list-unit-files logrotate.*
systemctl cat logrotate.service
systemctl status logrotate.service
dnf install sysstat
systemctl list-unit-files sysstat*

man 5 crontab. never change /etc/crontab directly. /etc/cron.hourly /etc/cron.weekly /etc/cron.monthly. files kept under /var/spool/cron. can put files (myhourly.cron under /etc/cron.d/ also). syntax is important. /etc/cron.allow & /etc/cron.deny
12 * * * * logger writen from crontab
12 * * * * root logger written from cron.d > /etc/cron.d/eachhour , chmod +x eachhour
at 14:17 logger "sth" ctrl+d, atq, atrm
myservice.service -> /etc/systemd/system

[Unit]
Description=My Service
[Service] ExecStart=/path/to/your/service/executable
[Install] WantedBy=multi-user.target

myservice.timer -> /etc/systemd/system

[Unit]
Description=Timer to start my-service 5 minutes after boot

[Timer]
OnBootSec=5min
Unit=myservice.service

[Install]
WantedBy=multi-user.target

systemctl daemon-reload
systemctl start myservice.timer
systemctl enable myservice.service (make it autorun at boot)

easiest way to create service: every 7 hours.

7hour.service -> **/etc/systemd/system**
[Unit]
Description=7 hour service

[Service]
ExecStart=/path/to/service/executable

[Install]
WantedBy=multi-user.target

7hour.timer -> **/etc/systemd/**
[Unit]
Description=Timer to restart my service

[Timer]
OnCalendar=*00:7:00
Unit=7hour.service

[Install]
WantedBy=multi-user.target

systemd-analyze verify /etc/systemd/system/hello.*

systemctl enable delayed.timer
systemctl start delayed.timer
systemctl status delayed.timer
systemctl status delayed.service
systemctl list-timers

hello.service
[Unit]
Description=hello service

[Service]
ExecStart=/usr/local/bin/hello.sh

/usr/local/bin/hello.sh
#!/bin/bash
logger hello-service is pinging

hello.timer
[Unit]
Description=hello timer

[Timer]
OnBootSec=5min
OnUnitActiveSec=24h
OnCalendar=Mon..Fri *-*-* 10:00:*
Unit=hello.service

[Install]

WantedBy=multi-user.target

tail -f /var/log/messages
less +F /var/log/messages

systemd-journald is a replacement of rsyslog
create /var/log/journal for persistency
selinux events-> /var/log/audit/audit.log
authentication related events-> /var/log/secure
`:omusrmsg:\*`: This destination starts with a colon (`:`), which, as explained previously, signifies that it's an `rsyslogd` module. In this case, `omusrmsg` is an output module that sends messages to users. The `*` implies all users.

journalctl -p err
journalctl _SYSTEMD_UNIT=sshd.service
journalctl –dmesg
journalctl –since yesterday
journalctl -o verbose
journalctl -u sshd

/run/log/journal

entire /run directory contains process related information.
/etc/systemd/journald.conf

journalctl
making it persistent:
mkdir /var/log/journal
chown root:systemd-journal /var/log/journal
chmod 2755 /var/log/html

rsyslogd:
/etc/rsyslog.conf
modules, global directives, rules

/etc/logrotate

mkfsxfs /dev/sdd1
tune2fs /dev/sdd1
xfs_admin -L mylabel

swap dd if=/dev/zero of=/swapfile
mkswap swapfile
/swapfile none swap defaults 0 0 >> /etc/fstab
swapon /swapfile
mount /dev/sdb2 /mnt
lsblk, blkid
mount LABEL=swaplabel /mnt
if /etc/fstab fails boot is not possible will cause exam failure.
check with:
findmnt –verify /etc/fstab
mount -a

mkfs/ext4 /dev/sdc1
mkdir /exercise
vi /etc/systemd/system/exercise.mount

[Unit]
Before=local-fs.target

[Mount]
What=/dev/sdc1
Where=/exercise
Type=ext4

[Install]
WantedBy=multi-user.target

systemctl daemon-reload
systemctl enable –now exercise.mount
systemctl start exercise.mount
mount | grep exercise

8e00: LVM partition type
xfs_growfs to grow the file system to the size available in the logical volume.
lvcreate -n lvdata -l 50%FREE vgdata
stratis metadata storage: 4 mb
ext4 can be shrinked and extending, xfs can only be extending.
MBR 8e, GUID 8e00 set n lvm on (partition nr). pvcreate
fdisk /dev/sdc, p, g, n, t, lvm, p, w, lsblk, pvcreate /dev/sdc1, pvs, pvdisplay /dev/sdc1
vgcreate vgdata /dev/sdc1
-l 50%FREE (use 50 of available space)
lvcreate -L 1M vgdata -n lvdata
lvresize -r 50%VG /dev/vgdata/lvdata

vgremove vgdata (vgdata belongs to /dev/sdc1)
vgextend vgdata2 /dev/sdc1

stratis pool create newpool /dev/sde
stratis pool add-data newpool /dev/sde
stratis fs create newpool fsname
stratis fs list
x-systemd.requires=stratisd.service

Kernel management
kernel driver that is not available as open source will make the kernel tainted.
show kernel events since booting: dmesg
uname -r : find the actual version of the kernel
cat /etc/redhat-release

udevd: name of the device helps to initialise hardware devices properly: udevd
/usr/lib/udev/rules.d: default rules for new hardware devices.
/usr/lib/udev/rules.d/ → default rules for new hw devices
modprobe -r (remove unused kernel modules)
lscpi -k (see loaded kernel modules)
/etc/modprobe.d/filename
lsmod | modprobe | modinfo | modprobe -r
dnf upgrade kernel
dnf install kernel

GRUB
/etc/default.grub
grub2-mkconfig > /boot/grub2/grub.cfg
targets are units together;
emergency.target
rescue.target
multi-user.target
graphical.target

systemctl –type=target –all
isolation: stopping the target and running only with required units.

cd ***/usr/lib/systemd/system***
grep Isolate.target*
systemctl isolate rescue.target

initramfs: contains drivers that are needed to start the server. contains a mini file system that is mounted during boot. Inside exists kernel modules that are needed during the rest of the process(i. e LVM and SCSI modules for accessing disks that are not supported by default). grub2 does not need much configuration, however in some cases ***/etc/default/grub*** *file needs to be modified.* ***rhgb*** *and* ***quiet*** *can be removed from /etc/default/grub* ***GRUB_CMDLINE_LINUX*** *to see more verbose. increase* ***GRUB_TIMEOUT*** *if it takes longer.*
boot options: ***man 7 bootparam***
grub2-mkconfig -o /boot/grub2/grub.cfg *(on bios)*
grub2-mkconfig -o /boot/efi/EFI/redhat/grub.cfg *(on uefi)*

want is a non-critical dependency: systemctl enable <service> –target=<target>
grub2-kernel-initramfs-systemd

mount -o rw, remount /sysroot
initramfs contains complete operational system.
/etc/dracut.conf -> responsible generating initramfs. after making changes to configuration: dracut -f
make sure to identify which process boot process is failing.

poweroff.target	runlevel 0
rescue.target	runlevel 1
multi-user.target	runlevel 3
graphical.target	runlevel 5
reboot.target	runlevel 6

chroot /sysroot
mount -o rw,remount /
passwd
touch /.autorelabel
exit
reboot

—----------------------------
grub2-install /dev/sdb
dracut –force (will rewrite the initramfs)

systemd.unit=rescue.target / systemd.unit=emergency.target /

rescue mode: journalctl -xb

—----------------------------------
BASH
echo $? (result of the last command, 0 is success)
running bash <>.sh does not need script to be executable
[-z $1] checks whether variable is non existent

[-z $1] && echo no argument provided (if first is true second will be issued)
ping -c 1 10.0.0.20 2>/dev/null || echo node is not available (if first is false second will be issued) && and ||

debugging bash script: -x

semanage port -a -t ssh_port_t -p tcp 2022
semanage port -l | grep ssh
firewall-cmd --zone=public --add-port=2022/tcp --permanent
var/log/secure

ssh-agent /bin/bash
ssh-add
maxSessions option is 10 (if multiple users are connected to same IP same time, increase)

ssh enhancement:
disable root login, disable password login, configure nondefault port for SSH to listen on, allow specific users to log in.
/etc/ssh/sshd.config -> AllowUsers student, useradd student, passwd student
/etc/ssh/sshd.config -> PasswordAuthentication No
ssh-keygen -t rsa -b 4096
maximum number of authentication attempts per SSH connection. it just starts logging once the number is reached.
ssh-copy-id user@remote

vi /etc/ssh/sshd.config -> Port 2022
AllowUsers student
useradd student
passwd student
systemctl status -l sshd
semanage port -a -t ssh_port_t -p tcp 2022
firewall-cmd –add-port=2022/tcp
firewall-cmd –add-port=2022/tcp –permanent
systemctl restart sshd
systemctl status -l sshd
ssh -p 2022 student@localhost

firewall-cmd –list-all
semanage port -l | grep ssh
ClientAliveInterval: 30 ClientAliveCountMax: 5 minutes

ssh–agent /bin/bash
ssh-add

dnf install httpd
cat /etc/httpd/conf/httpd
/etc/httpd/conf.modules.d
/etc/httpd.conf
*<VirtualHost *:80>*
dnf group install “Basic Web Server”

touch /var/www/html/index.html
echo “welcome” >> index.html
systemctl enable httpd –now
systemctl status httpd
curl http://localhost

virtual host
apache can host multiple websites in a single server. using different names but same IP, virtual hosts.

/etc/hosts | 10.0.2.15 server1.example.com server1
/etchosts | 10.0.2.16 server2.example.com server2
10.0.2.15 sales.example.com
10.0.2.16 account.example.com
setenforce 0

/etc/httpd/conf/httpd.conf
<Directory /www/docs>
Require all granted
AllowOverride None
</Directory>
mkdir /www/docs/sales.example.com
mkdir /wwwdocs/account.example.com
touch /www/docs/sales.example.com/index.html | tee welcome from sales
touch /www/docs/account.example.com/index.html | tee welcome from account

*touch **/etc/httpd/conf.d/account.example.com.conf***
*<VirtualHost *:80>*
ServerAdmin webmaster@account.example.com
DocumentRoot /www/docs/account.example.com

ServerName account.example.com
ErrorLog logs/account.example.com-error.log
CustomLog logs/account.example.com-access_log common
</VirtualHost>

systemctl restart httpd
curl http://account.example.com

semanage fcontext -a -t httpd_sys_content_t "/web(/.*)?"
restorecon /new/filename
use m to modify the port context: not -a to add it. semanage port -a -t ssh_port_t -p tcp 443
setsebool -P

context types:
chcon is not used anymore.
see type: ls -Z /var/www

semanage -a -t "mydir((/.)?"*
restorecon -R -v mydir

/etc/httpd/conf/httpd.conf
<Directory "/mydir">
AllowOverride None
Require all granted
</Directory>

man -k selilnux
port label: semanage port -a -t http_port_t -p tcp 8008
setenforce 0, systemctl restart httpd, setenforce 1
semanage port -a -t http_port_t -p tcp 82, systemctl restart httpd

setsebool ftpd_anon_write on
getsebool ftp_anon_write on
/var/log/audit.log | grep AVC
sealert -a /var/log/audit/audit.log
firewall-cmd –list-all
firewall-cmd –add-service=http –permanent
firewall zones: untrusted, trusted, external, internal

iptables replaced with nftables in RHEL9.
firewall-cmd –get-services
firewall-cmd –add-port=2020/tcp –permanent
firewall-cmd –reload
firewall-cmd --zone=public --add-interface=eth0
firewall-cmd –zone=public –add-port=2345/udp –permanent

firewall-cmd –get-active-zones
_netdev should be used to mount nfs shares in the fstab
NFS
Create local directory to share. Edit /etc/exports to define NFS share. Start NFS server.

autofs:
/etc/auto.master
/mymounts /etc/auto.mymounts

/etc/auto.mymounts
docs -rw server:/nfs/docs

systemctl -enable autofs –now

timedatectl set-ntp 1.
podman run -it nginx

/etc/container/registers

date, hwclock
systemctl status chronyd
podman:
podman run -d nginx
buildah: special tool to create custom images
skopeo: tool to use for managing and testing container images
namespaces: mount, network, user, process, interprocess
rootless containers don't hav IP address and can access only to unpriviliged parts on tcp/udp
podman run ngnix
podman build -t imagename:tag
podman stop
podman kill
podman restart
podman exec container ls
podman run -d –rm –name=web2 docker.io/library/nginx
podman ps
podman exec -it web2 /bin/bash
docker run -it docker.io/library/ubuntu
cat /etc/os-release
root user namespace and therefore is not accessible or visible by ordinary users. T
podman run -d -e MYSQL_ROOT_PASSWORD=password -e MYSQL_USER=anna -e

bind-mount is a special service that binds directory instead of storage to container.
podman run -d –name mydb -v /home/$(id-un)/dbfiles:/var/lib/mysql:Z -e MYSQL_USER=user =e MYSQL_PASSWORD=password -e MYSQL_DATABASE=mydatabase registry.redhat.io/rhel9/mariadb/mariadb-105.
podman login registry.redhat.io

chown $(id -un) /opt/dbfiles

podman inspect mydb
containers become more common to start services. practical way to utilise them is the systemd services. In orchestration platforms usage is easy, containers are started automatically. on standalone platform rootless containers should be set for autostart.

systemctl enable –now myservice.service
systemctl –user start myservice.service

loginctl: login manager
useradd linda , passwd linda, loginctl enable-linger linda (linger will keep session active even user logs out)
mkdir ~/.config/systemd/user
cd ~/.config/systemd/user
podman run -d –name mynginx -p 8081:80 nginx
podman ps
podman generate systemd –name mynginx –files
vi ~/.config/systemd/user
systemctl –user daemon-reload
systemctl –user enable container-mynginx.service
systemctl –user status container-mynginx.service
ps faux | grep -A3 -B3 mynginx

mkdir ~/mydata
podman run -it -v ~/mydata:/data ubuntu bash

podman login registry.redhat.io
podman pull mariadb

EXAM ORDER:
networking-> **repos**->**services**->**storage**->**user&groups**->**permissions**->**selinux**->**everything else**.

system should survive reboots, remove quiet and rhgb option from grub.

/etc/skel/NEWFILE

firewalld is replacing iptables
nfstables: kernel firewalling
dnf module list
dnf group list

dd if=efidisk.img of=/dev/sdd
systemctl isolate rescue.target
vmlinuz initrd=initrd.img

CKAD: https://kodekloud.com/pages/free-labs/assessments/cncf
ACL is the second level of security. discretionary control. overriding standar ugo/rwx permissions. with NFS 4 now ACLs can be shared over a network.

setfacl -x u:michael /home/examprep/TheAnswers

eBPF:

BCC: BPF Compiler Collection

ks=nfs:192.168.122.1/pub/ks.cfg
ks=http://192.168.122.1/ks.cfg

URI ldap://127.0.0.1
HOST tester1.example.com
BASE dc=example,dc=com
TLS_CACERTDIR /etc/openldap/cacerts

🔍 Alternatives to FreeIPA in 2025:

Alternative	Key Features	Best For
t	/eb-based IAM, SSO, OpenID Connect, OAuth2, LDAP n	s, SSO, microservices
irectory (AD)	ecosystem, GPO, cross-platform via Azure AD	-heavy or mixed environments
AP + Kerberos	able, lightweight, modular	l admins needing minimal setups
ud	ectory with SSO, MDM, cross-platform support	hybrid cloud setups
/ Authentik	ht access proxy with MFA & LDAP backend	access control (esp. Docker/k8s)

top and ps may be showing snapshot. so better way to monitor actual process statuses: **iostat and sar**
reports are stored in /**etc/sysconfig/systat** file. sa1 and sa2 also alternative commands to observe disk data every 10 minutes.

nice -n 19 ./myscript (starting process with nice value)
renice -10 1234 (1234 : PID)
tar czvf home.tar.gz /home create: c compress:z verbose:v filename:f
tar xvzf hom.tar.gz /home extract:x

env: HOME SHELL LOGNAME

scan patterns in log files through cron tasks regularly to find out about security breaches.
logrotate to create new log files. /var/log/secure wrong login attempts. /var/log/lastlog

iptables:
-t
filter: sets rule for filtering(default)
nat: configure masquerading
mangle: change packet header
action
-A appends rule to the end of the chain
-D delete rule from a chain
-L lists the currently configured rules in the chain
-F flushes all of the rules in the current chain.

ps: running processes top: task browser iostat: CPU and storage device stats sar, sa1, sa2: system activity reports

allow forward reject drop
firewall rules specify two things: conditions of a packet must meet to match the rule, action if the packet matches.