Welcome To:
Module 7

Networking, Services and System Updates

Internet Access to VM

- Open **Virtualbox Manager**
- Select the machine you cannot get internet on in the left pane
- Click the **Settings** button in the top menu
- Click **Network** in the left pane in the settings window
- Switched to **Bridged Adaptor** in the **Attached to** drop-down menu
- Hit **OK** to save your changes
- Start your VM

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Network Components

- IP
- Subnet mask
- Gateway
- Static vs. DHCP

- Interface
- Interface MAC.

Network Files and Commands

- Interface Detection
- Assigning an IP address
- Interface configuration files
  - /etc/nsswitch.conf
  - /etc/hostname
  - /etc/sysconfig/network
  - /etc/sysconfig/network-scripts/ifcfg-nic
  - /etc/resolv.conf

- Network Commands
  - **`ping`**
  - **`ifconfig`**
  - **`ifup or ifdown`**
  - **`netstat`**
  - **`tcpdump`**

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NIC Information

NIC = Network Interface Card

Example:

```
ethtool enp0s3
```

Other NICs

`lo` = The loopback device is a special interface that your computer uses to communicate with itself. It is used mainly for diagnostics and troubleshooting, and to connect to servers running on the local machine

`virb0` = The virbr0, or "Virtual Bridge 0" interface is used for NAT (Network Address Translation). Virtual environments sometimes use it to connect to the outside network

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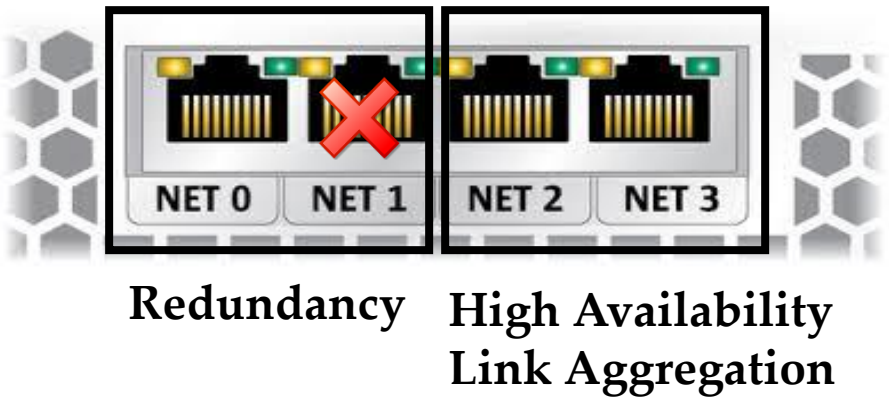
NIC Bonding

NIC = Network Interface Card (PC or laptop)

NIC(Network Interface Card) bonding is also known as Network bonding. It can be defined as the aggregation or combination of multiple NIC into a single bond interface.

It's main purpose is to provide high availability and redundancy



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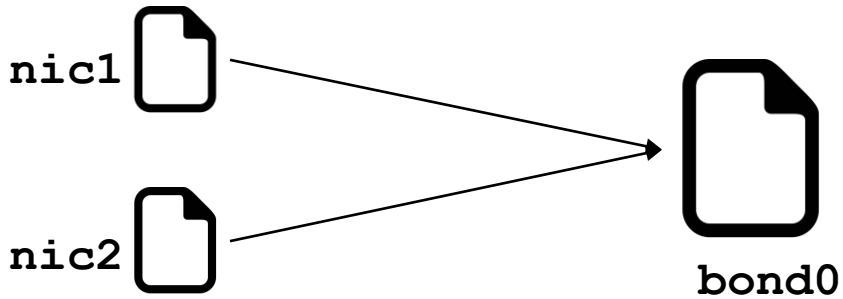
NIC Bonding Procedure

- modprobe bonding
- modinfo bonding
- Create /etc/sysconfig/network-scripts/ifcfg-bond0
- Edit /etc/sysconfig/network-scripts/ethernet1
- Edit /etc/sysconfig/network-scripts/ethernet2



- Restart network = systemctl restart network

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New Network Utilities

What we will learn in this lecture…

- Getting started with **NetworkManager**
- Network configuration methods
  - **`nmtui`**
  - **`nmcli`**
  - **`nm-connection-editor`**
  - **`GNOME Settings.`**

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New Network Utilities

✓ Getting started with `NetworkManager`

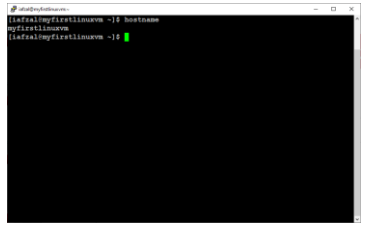
- NetworkManager is a service that provides set of tools designed specifically to make it easier to manage the networking configuration on Linux systems and is the default network management service on RHEL 8
- It makes network management easier
- It provides easy setup of connection to the user
- NetworkManager offers management through different tools such as **`GUI, nmtui, and nmcli.`**

New Network Utilities

✓ Network configuration methods

- **`nmcli`** – Short for network manager command line interface. This tool is useful when access to a graphical environment is not available and can also be used within scripts to make network configuration changes
- **`nmtui`** – Short for network manager text user interface. This tool can be run within any terminal window and allows changes to be made by making menu selections and entering data
- **`nm-connection-editor`** - A full graphical management tool providing access to most of the NetworkManager configuration options. It can only be accessed through the desktop or console
- **`GNOME Settings`** - The network screen of the GNOME desktop settings application allows basic network management tasks to be performed

- Let's practice in our Linux machine…



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Manage Linux Networking

✓ Using nmcli to configure static IP

- `# nmcli device` *(Get the listing of network interface)*
- `# nmcli connection modify enp0s3 ipv4.addresses 10.253.1.211/24`
- `# nmcli connection modify enp0s3 ipv4.gateway 10.253.1.1`
- `# nmcli connection modify enp0s3 ipv4.method manual`
- `# nmcli connection modify enp0s3 ipv4.dns 8.8.8.8`
- `# nmcli connection down enp0s3 && nmcli connection up enp0s3`
- `# ip address show enp0s3`

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Manage Linux Networking

✓ Adding secondary static IP using nmcli

- `# nmcli device status`
- `# nmcli connection show –active`
- `# ifconfig`
- `# nmcli connection modify enp0s3 +ipv4.addresses 10.0.0.211/24`
- `# nmcli connection reload`
- `# systemctl reboot`
- `# ip address show`

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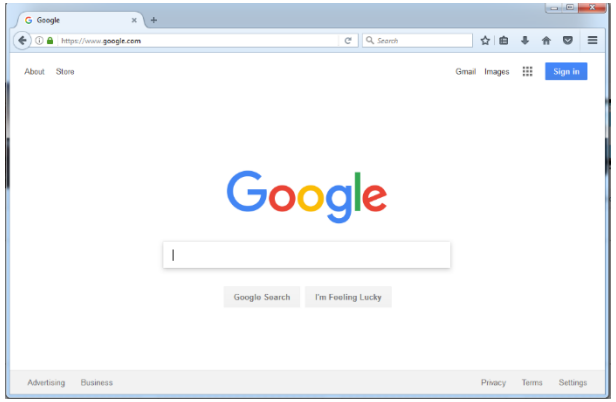
System Updates and Repos

- yum (CentOS), apt-get (other Linux)
- rpm (Redhat Package Manager)

Download Files or Apps

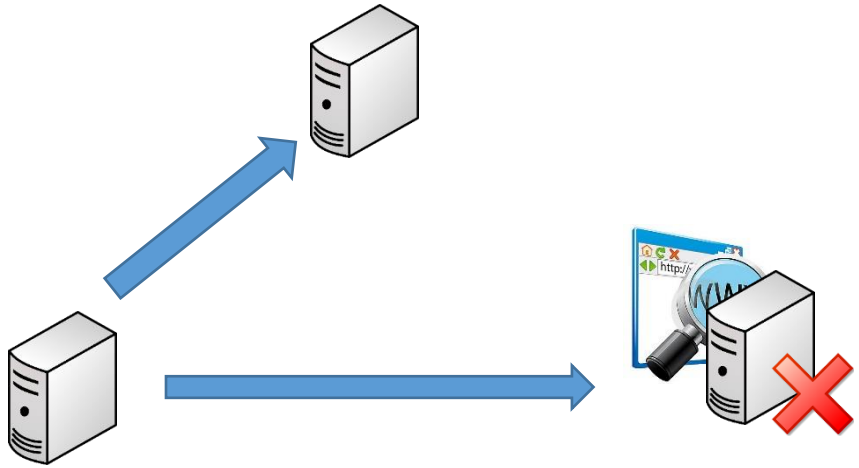
- Example of Windows browser



- Linux = **wget**

- Example in Linux:

wget http://website.com/filename



- **Why???**

Most of the servers in corporate environment do **NOT** have internet access

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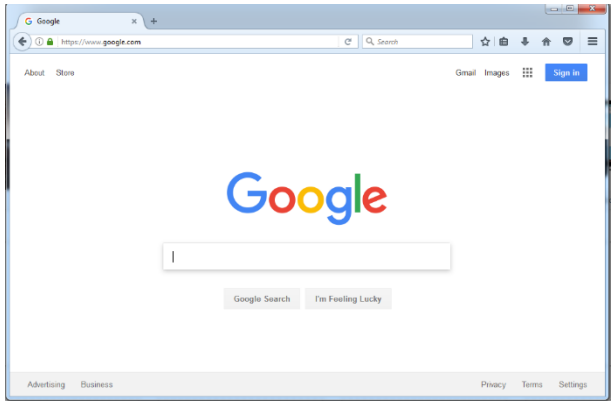
curl and ping Commands

- Example of Windows browser



- Linux = **curl**
- **Linux = ping**

- Example in Linux:

```
curl http://website.com/filename
curl -O http://website.com/filename

ping www.google.com
```

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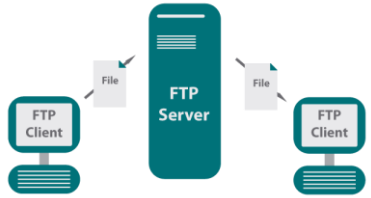
FTP – File Transfer Protocol

- The File Transfer Protocol is a standard network protocol used for the transfer of computer files between a client and server on a computer network. FTP is built on a client-server model architecture using separate control and data connections between the client and the server. *(Wikipedia)*



- Protocol = Set of rules used by computers to communicate

- Default FTP Port = 21

- For this lecture we need 2 Linux machines
  - **`Client = MyFirstLinuxVM`**
  - **`Server = LinuxCentOS7`**

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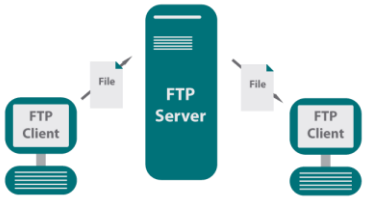
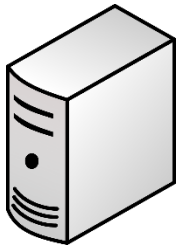
FTP – File Transfer Protocol



Client = A



FTP

Server = B

ftpd = 21

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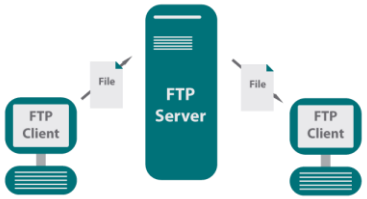
FTP – File Transfer Protocol

- **Install and Configure FTP on the remote server**
  - **# Become root**
  - **# rpm -qa | grep ftp**
  - **# ping www.google.com**
  - **# yum install vsftpd**
  - **# vi /etc/vsftpd/vsftpd.conf** ***(make a copy first)***



  - Find the following lines and make the changes as shown below:
  - ## Disable anonymous login ##
    - ***anonymous_enable=NO***

  - ## Uncomment ##
    - ***ascii_upload_enable=YES***
    - ***ascii_download_enable=YES***

  - ## Uncomment - Enter your Welcome message - This is optional ##
    - ***ftpd_banner=Welcome to UNIXMEN FTP service.***

  - ## Add at the end of this file ##
    - ***use_localtime=YES***

  - **# systemctl start vsftpd**
  - **# systemctl enable vsftpd**
  - **# systemctl stop firewalld**
  - **# systemctl disable firewalld**
  - **# useradd iafzal** *(if the user does not exist).*

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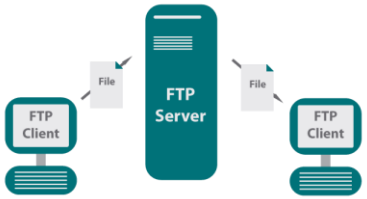
FTP – File Transfer Protocol



- **Install FTP client on the client server**
  - `# Become root`
  - `# yum install ftp`
  - `# su – iafzal`
  - `$ touch kruger`

  - **Commands to transfer file to the FTP server:**
  - `ftp 192.168.1.x`
  - `Enter username and password`
  - `bi`
  - `hash`
  - `put kruger`
  - `bye.`

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SCP – Secure Copy Protocol

- The Secure Copy Protocol or “SCP” helps to transfer computer files securely from a local to a remote host. It is somewhat similar to the File Transfer Protocol “FTP”, but it adds security and authentication
- Protocol = Set of rules used by computers to communicate
- Default SCP Port = 22 (same as SSH)
- For this lecture we need 2 Linux machines
  - **`Client = MyFirstLinuxVM`**
  - **`Server = LinuxCentOS7`**

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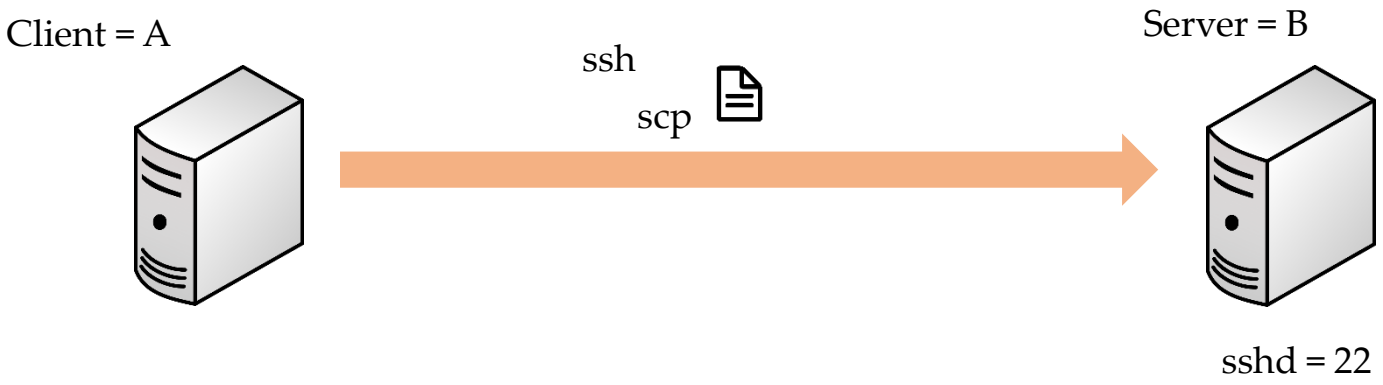
SCP – Secure Copy



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SCP – Secure Copy

- **SCP commands to transfer file to the remote server:**
  - `Login as yourself (iafzal)`
  - `touch jack`
  - `scp jack iafzal@192.168.1.x:/home/iafzal`
  - `Enter username and password`

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rsync – Remote Synchronization

- **rsync** is a utility for efficiently transferring and synchronizing files within the same computer or to a remote computer by comparing the modification times and sizes of files

- rsync is a lot faster than ftp or scp
- This utility is mostly used to backup the files and directories from one server to another
- Default rsync Port = 22 (same as SSH)
- For this lecture we need 2 Linux machines
  - **`Client = MyFirstLinuxVM`**
  - **`Server = LinuxCentOS7`**

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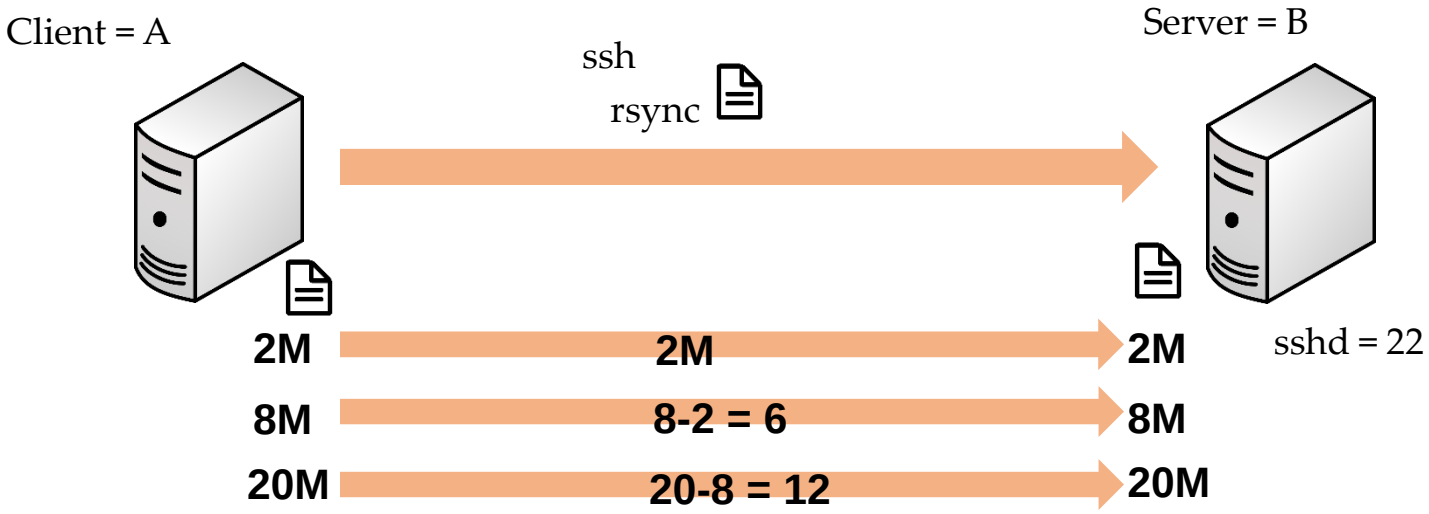
rsync – Remote Synchronization



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rsync – Remote Synchronization

- **Basic syntax of rsync command**
  - `# rsync options source destination`

- **Install rsync in your Linux machine** *(check if it already exists)*
  - `# yum install rsync` *(On CentOS/Redhat based systems)*
  - `# apt-get install rsync` *(On Ubuntu/Debian based systems)*

- **rsync a file on a local machine**
  - `$ tar cvf backup.tar .` *(tar the entire home directory (/home/iafzal)*
  - `$ mkdir /tmp/backups`
  - `$ rsync -zvh backup.tar /tmp/backups/`

- **rsync a directory on a local machine**
  - `$ rsync -azvh /home/iafzal /tmp/backups/`

- **rsync a file to a remote machine**
  - `$ mkdir /tmp/backups` *(create /tmp/backups dir on remote server)*
  - `$ rsync -avz backup.tar iafzal@192.168.1.x:/tmp/backups`

- **rsync a file from a remote machine**
  - `$ touch serverfile`
  - `$ rsync -avzh iafzal@192.168.1.x:/home/iafzal/serverfile /tmp/backups`

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System Upgrade/Patch Management

- Two type of upgrades
  - Major version = 5, 6, 7
  - Minor version = 7.3 to 7.4

Major version = yum command 

Minor version = yum update 

Example:

```
yum update -y
```

yum update vs. upgrade

upgrade = delete packages 

update = preserve 

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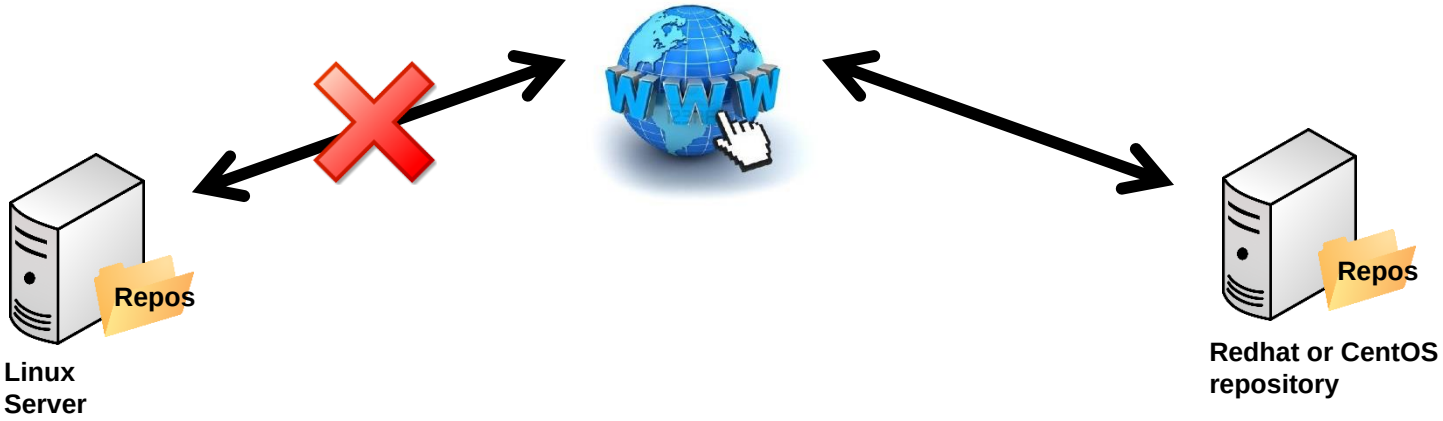
Create Local Repository from DVD

- What is local repository?



- Command
  `createrepo`

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Advance Package Management

- Installing packages
- Upgrading
- Deleting
- View package details information
- Identify source or location information
- Packages configuration files

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Rollback Updates and Patches

- Virtual machine
- Physical machine

- Rollback a package or patch
  - **`yum install <package-name>`**
  - **`yum history undo <id>`**

- Rollback an update
  - Downgrading a system to minor version (ex: RHEL7.1 to RHEL7.0) is not recommended as this might leave the system in undesired or unstable state

  - **`yum update`**= Update will preserve them
  - **`yum upgrade`** = Upgrade will delete obsolete packages
  - **`yum history undo <id>`**

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SSH and Telnet

- Telnet = Un-secured connection between computers
- SSH = Secured

- Two type of packages for most of the services
  - Client package
  - Server package

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DNS = Domain Name System

- Purpose?

  Hostname to IP (A Record)

  IP to Hostname (PTR Record)

  Hostname to Hostname (CNAME Record)

- Files

  /etc/named.conf

  /var/named

- Service

  systemctl restart named

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Download, Install and Configure DNS

- Create a snapshot of your virtual machine
- Setup:
  - Master DNS
  - Secondary or Slave DNS
  - Client

- Domain Name = lab.local
- IP address = My local IP address on enp0s3

- Install DNS package
  - `yum install bind bind-utils -y`
- Configure DNS **(Summary)**
  - `Modify /etc/named.conf`
  - `Create two zone files (forward.lab and reverse.lab)`
  - `Modify DNS file permissions and start the service`

- Revert back to snapshot

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Hostname/IP Lookup

- Commands used for DNS lookup
  - **`nslookup`**
  - **`dig`**

NTP

- **Purpose?**

  Time synchronization

- **File**

  /etc/ntp.conf

- **Service**

  systemctl restart ntpd

- **Command**

  ntpq

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chronyd

- Purpose? = Time synchronization
- Package name = chronyd
- Configuration file = /etc/chronyd.conf
- Log file = /var/log/chrony
- Service = systemctl start/restart chronyd
- Program command = chronyd.

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New System Utility Command (`timedatectl`)

- The **`timedatectl`** command is a new utility for RHEL/CentOS 7/8 based distributions, which comes as a part of the systemd system and service manager
- It is a replacement for old traditional **`date`** command
- The **`timedatectl`** command shows/change date, time, and timezone
- It synchronizes the time with NTP server as well
  - You can either use **`chronyd`** or **`ntpd`** and make the ntp setting in **`timedatectl`** as **`yes`**
  - Or you can use **`systemd-timesyncd`** daemon to synchronize time which is a replacement for ntpd and chronyd

Please note:

Redhat/CentOS does not provide this daemon in its standard repo. You will have to download it separately.

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New System Utility Command `(timedatectl)`

Lab exercise:

- To check time status
  - **`timedatectl`**
- To view all available time zones
  - **`timedatectl list-timezones`**
- To set the time zone
  - **`timedatectl set-timezone "America/New_York"`**
- To set date
  - **`timedatectl set-time YYYY-MM-DD`**
- To set date and time
  - **`timedatectl set-time '2015-11-20 16:14:50'`**
- To start automatic time synchronization with a remote NTP server
  - **`timedatectl set-ntp true.`**

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Sendmail - OLD

- **Purpose?**

  Send and receive emails

- **Files**

  /etc/mail/sendmail.mc

  /etc/mail/sendmail.cf

  /etc/mail

- **Service**

  systemctl restart sendmail

- **Command**

  mail –s “subject line” email@mydomain.com

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Sendmail

- **Sendmail** is a program in Linux operating systems that allows systems administrator to send email from the Linux system

- It uses SMTP (Simple Mail Transfer Protocol)
- SMTP port = 25

- It attempts to deliver the mail to the intended recipient immediately and, if the recipient is not present, it queues messages for later delivery.

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Sendmail

- Sendmail installation and configuration
  - **# su –** *(Login as root)*
  - **# rpm –qa | grep sendmail** *(verify if it is already installed)*
  - **# yum install sendmail sendmail-cf**
  - **# vi /etc/mail/sendmail.mc**
  - **# systemctl start sendmail**
  - **# systemctl enable sendmail**
  - **# systemctl stop firewalld**
  - **# systemctl disable firewalld**

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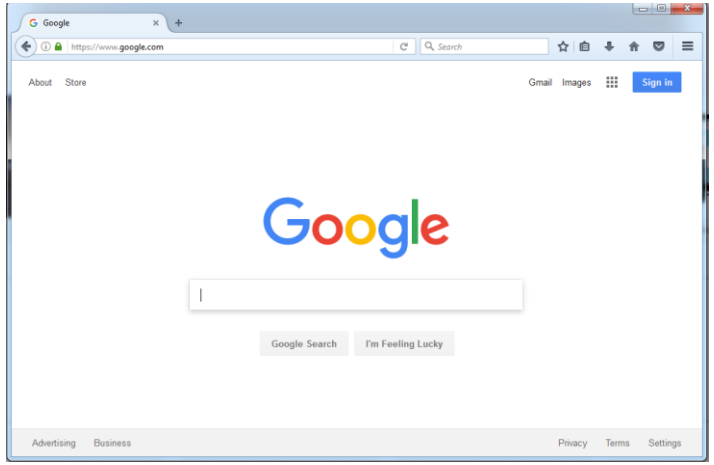
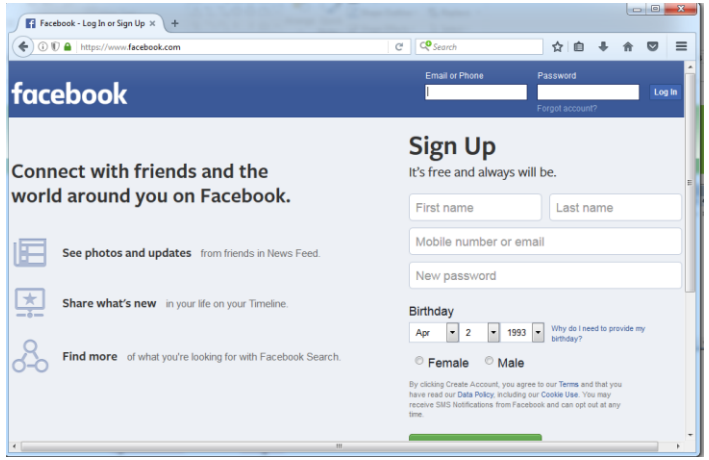
Web Server (httpd)

- Purpose = Serve webpages





- Service or Package name = **`httpd`**
- Files = **`/etc/httpd/conf/httpd.conf`**
  = **`/var/www/html/index.html`**
- Log Files = **`/var/log/httpd/`**
- Service

```
systemctl restart httpd
systemctl enable httpd
```

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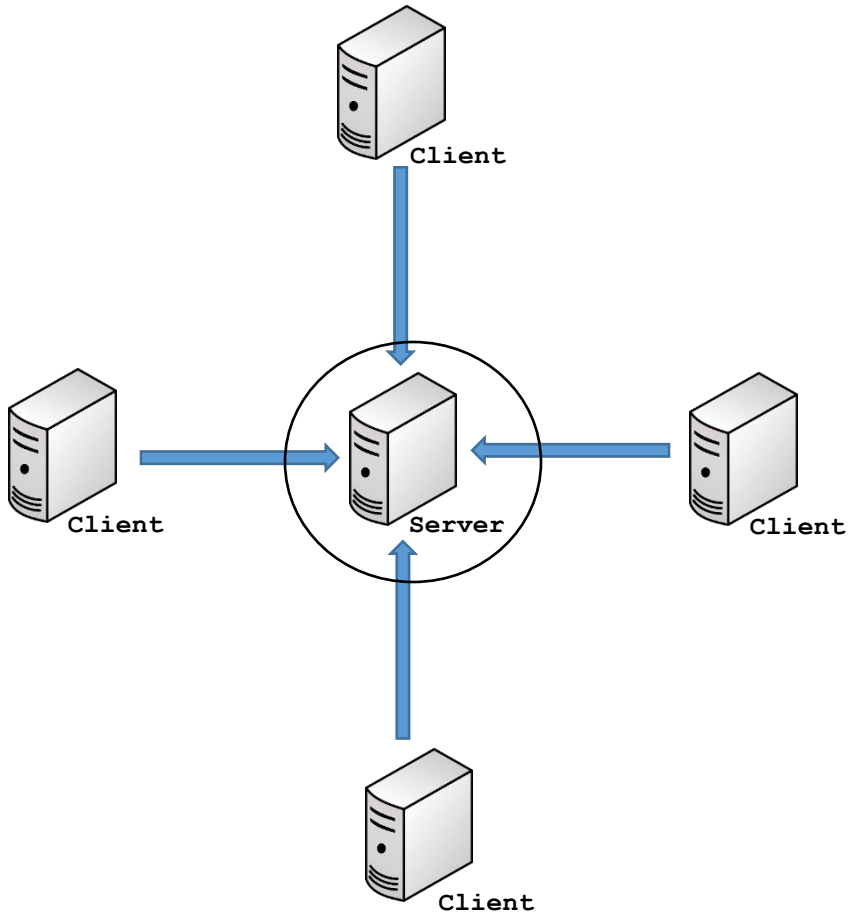
Central Logger (rsyslog)

- Purpose = Generate logs or collect logs from other servers
- Service or package name = **`rsyslog`**
- Configuration file= **`/etc/syslog.conf`**
- Service

```
systemctl restart rsyslog
systemctl enable rsyslog
```



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Linux OS Hardening

- User Account
- Remove un-wanted packages
- Stop un-used Services
- Check on Listening Ports
- Secure SSH Configuration
- Enable Firewall (iptables/firewalld)
- Enable SELinux
- Change Listening Services Port Numbers
- Keep your OS up to date (security patching)

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OpenLDAP Installation

- What is OpenLDAP?
- OpenLDAP Service
  - `slapd`
- Start or stop the service
  - `systemctl start slapd`
  - `systemctl enable slapd`
- Configuration Files
  - `/etc/openldap/slapd.d`

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Trace Network Traffic (traceroute)

- The traceroute command is used in Linux to map the journey that a packet of information undertakes from its source to its destination. One use for traceroute is to locate when data loss occurs throughout a network, which could signify a node that's down.
- Because each hop in the record reflects a new server or router between the originating PC and the intended target, reviewing the results of a traceroute scan also lets you identify slow points that may adversely affect your network traffic.

- Example

```
# traceroute www.google.com
```

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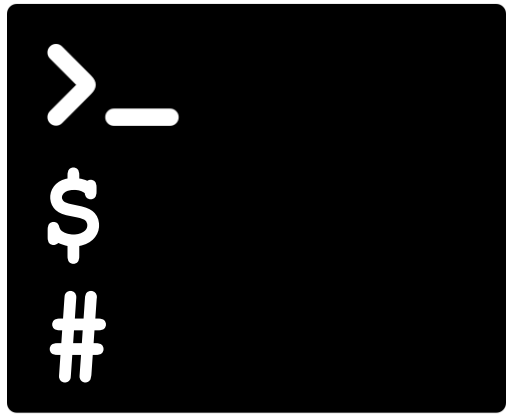
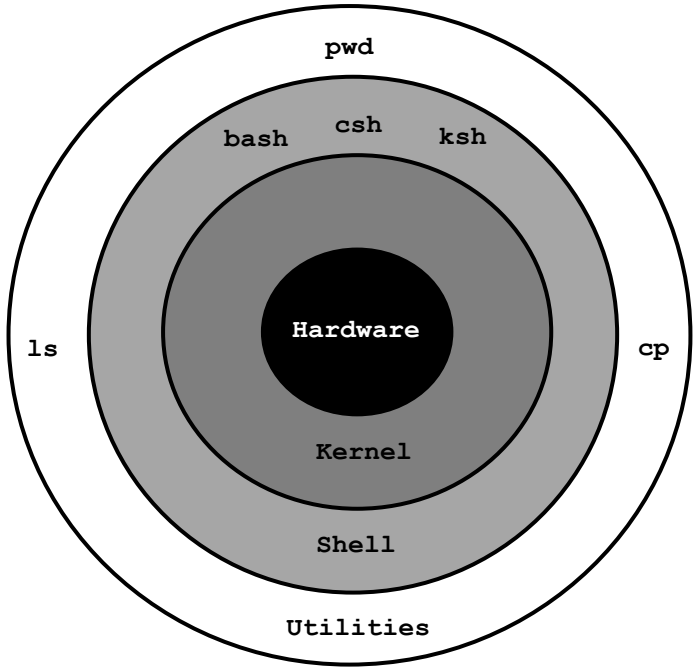
Configure and Secure SSH

- **SSH**
  - SSH stands for secure shell

provides you with an interface to the Linux system. It takes in your commands and translate them to kernel to manage hardware





- Open SSH is a package/software
- Its service daemon is sshd
- SSH port # 22

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Configure and Secure SSH

- SSH itself is secure, meaning communication through SSH is always encrypted, but there should be some additional configuration can be done to make it more secure
- Following are the most common configuration an administrator should take to secure SSH

✓ **Configure Idle Timeout Interval**

Avoid having an unattended SSH session, you can set an Idle timeout interval

- Become root
- Edit your **`/etc/ssh/sshd_config`** file and add the following line:
- **`ClientAliveInterval 600`**
- **`ClientAliveCountMax 0`**
- **`# systemctl restart sshd`**

The idle timeout interval you are setting is in seconds (600 secs = 10 minutes). Once the interval has passed, the idle user will be automatically logged out

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Configure and Secure SSH

- ✓ **Disable root login**

  Disabling root login should be one of the measures you should take when setting up the system for the first time. It disable any user to login to the system with root account

  - Become root
  - Edit your **`/etc/ssh/sshd_config`** file and replace PermitRootLogin yes to no
  - **`PermitRootLogin no`**
  - **`# systemctl restart sshd`**

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Configure and Secure SSH

✓ **Disable Empty Passwords**

You need to prevent remote logins from accounts with empty passwords for added security.

- Become root
- Edit your **`/etc/ssh/sshd_config`** file and remove # from the following line
- **`PermitEmptyPasswords no`**
- **`# systemctl restart sshd`**

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Configure and Secure SSH

✓ **Limit Users' SSH Access**

To provide another layer of security, you should limit your SSH logins to only certain users who need remote access

- Become root
- Edit your **`/etc/ssh/sshd_config`** file and add
- **`AllowUsers user1 user2`**
- **`# systemctl restart sshd`**

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Configure and Secure SSH

✓ **Use a different port**

By default SSH port runs on 22. Most hackers looking for any open SSH servers will look for port 22 and changing can make the system much more secure

- Become root
- Edit your **`/etc/ssh/sshd_config`** file and remove # from the following line and change the port number
- **`Port 22`**
- **`# systemctl restart sshd`**

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Configure and Secure SSH

- ✓ **SSH-Keys - Access Remote Server without Password**

Watch the next video

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Configure and Secure SSH

Access Remote Server without Password (SSH-Keys)

- Two reasons to access a remote machine
  - Repetitive logins
  - Automation through scripts

- Keys are generated at user level
  - iafzal
  - root

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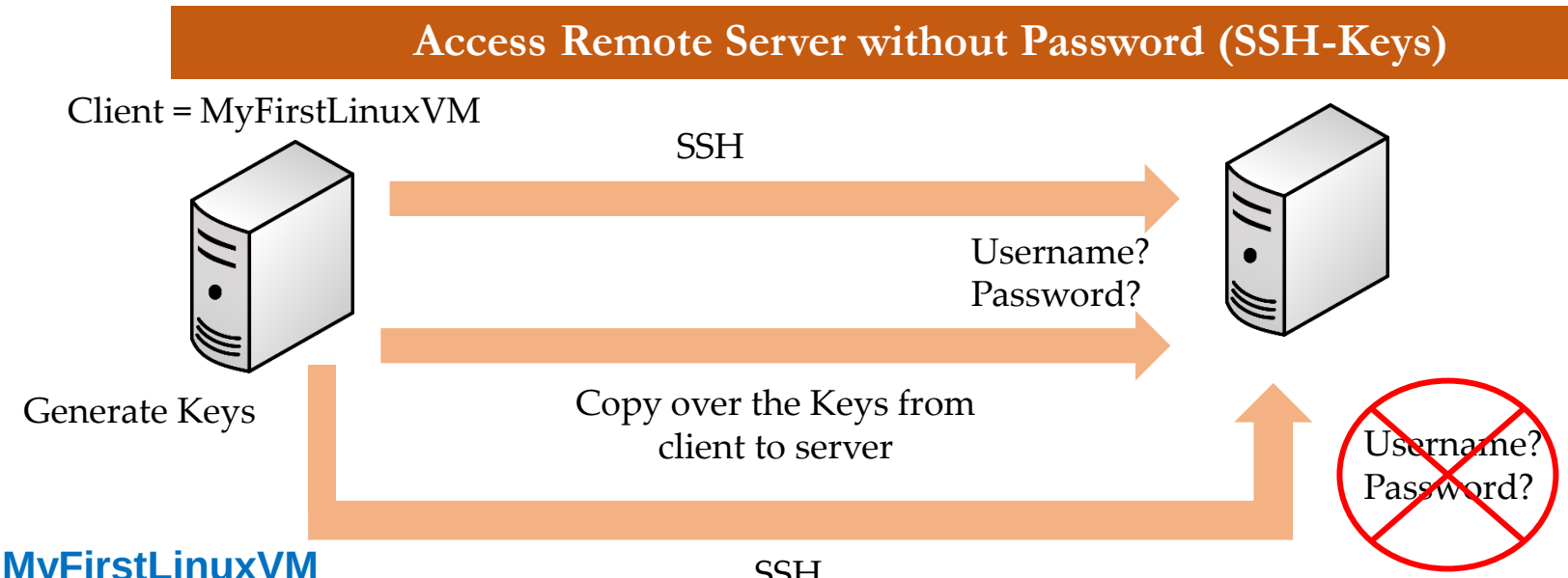
Configure and Secure SSH



Client = MyFirstLinuxVM

Step 1 — Generate the Key

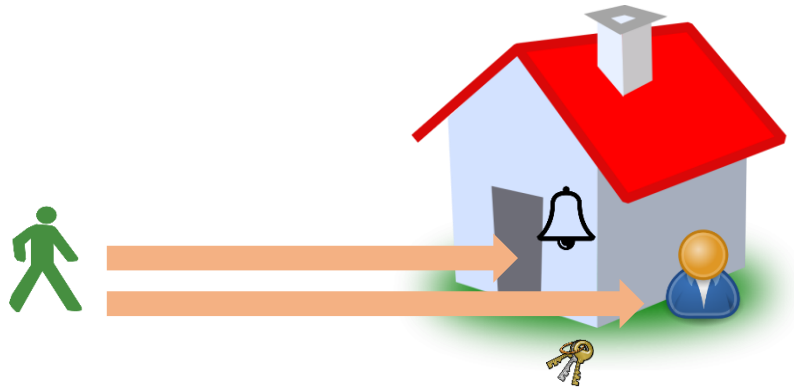
```
# ssh-keygen
```

Step 2 — Copy the Key to the server

```
# ssh-copy-id root@192.168.1.x
```

Step 3 — Login from client to server

```
# ssh root@192.168.1.x
# ssh -l root 192.168.1.x
```



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SSH without a Password

- SSH is a secure way to login from host A to host B
- Repetitive tasks require login without a password

What we will learn…

- How to generate SSH keys on the server
- Add SSH keys to the client
- Verify by logging through SSH.

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Access Remote Server without Password (SSH-Keys)

- Two reasons to access a remote machine
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  - Automation through scripts

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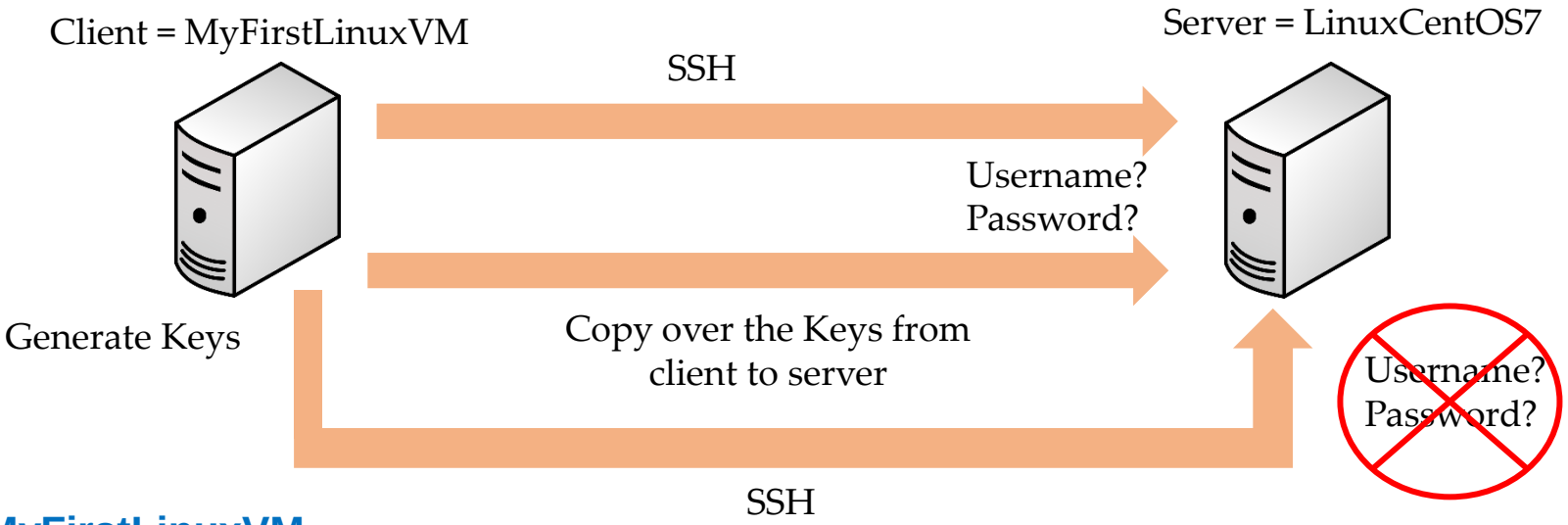
Access Remote Server without Password (SSH-Keys)



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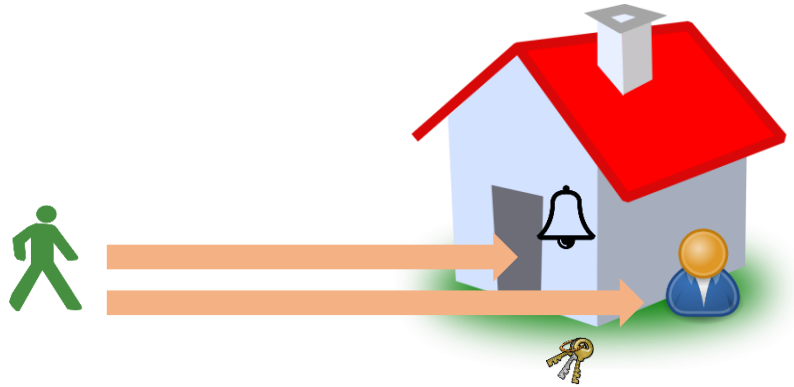

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Cockpit

- Cockpit is a server administration tool sponsored by Red Hat, focused on providing a modern-looking and user-friendly interface to manage and administer servers
- Cockpit is the easy-to-use, integrated, glanceable, and open web-based interface for your servers
- The application is available in most of the Linux distributions such as, CentOS, Redhat, Ubuntu and Fedora
- It is installed in Redhat 8 by default and it is optional in version 7
- It can monitor system resources, add or remove accounts, monitor system usage, shut down the system and perform quite a few other tasks all through a very accessible web connection

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Install, Configure and Manage Cockpit

- Check for network connectivity
  - **`ping www.google.com`**
- Install cockpit package as root
  - **`yum/dnf install cockpit -y`** *(For RH or CentOS)*
  - **`apt-get install cockpit`** *(For Ubuntu)*
- Start and enable the service
  - **`systemctl start|enable cockpit`**
- Check the status of the service
  - **`systemctl status cockpit`**
- Access the web-interface
  - **`https://192.168.1.x:9090`**

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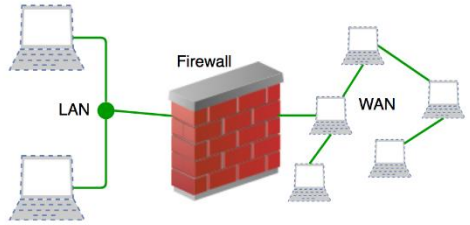
Introduction to Firewall

- What is Firewall
  - A wall that prevents the spread of fire
  - When data moves in and out of a server its packet information is tested against the firewall rules to see if it should be allowed or not
  - In simple words, a firewall is like a watchman, a bouncer, or a shield that has a set of rules given and based on that rule they decide who can enter and leave
  - There are 2 type of firewalls in IT
    - Software = Runs on operating system
    - Hardware = A dedicated appliance with firewall software



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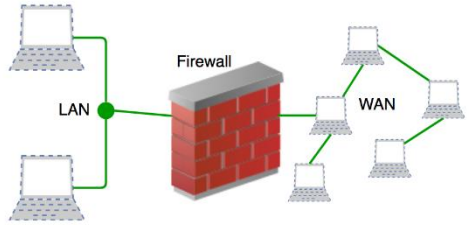
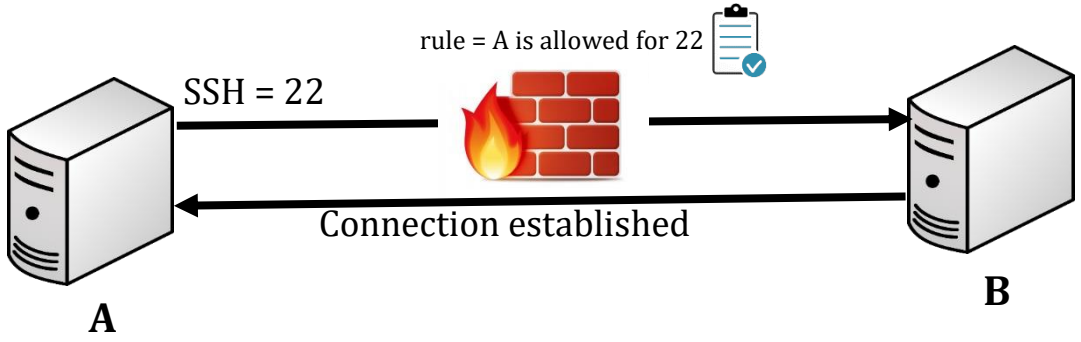
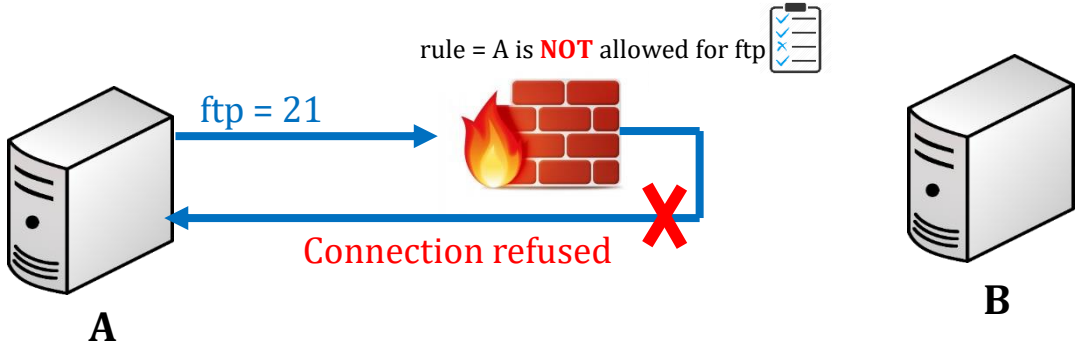
Introduction to Firewall







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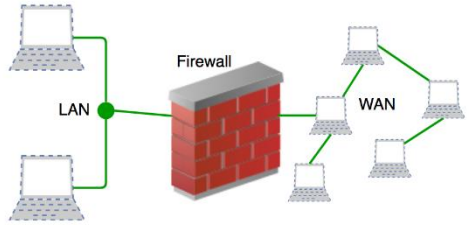
Firewall *(iptables – tables, chains and targets)*

- There are 2 tools to manage firewall in most of the Linux distributions
  - iptables = For older Linux versions but still widely used
  - firewalld = For newer versions like 7 and up



- You can run one or the other
  - In this lecture we will work with **iptables** to manage firewall

  - Before working with iptables make sure firewalld is not running and disable it
    - **`service OR systemctl stop firewalld`** = To stop the service
    - **`systemctl disable firewalld`** = To prevent from starting at boot time
    - **`systemctl mask firewalld`** = To prevent it from running by other programs

  - Now check if you have iptables-services package installed
    - **`rpm –qa | grep iptables-services`**
    - **`yum install iptables-services -`** *If not installed then*

  - Start the service
    - **`systemctl start iptables`**
    - **`systemctl enable iptables`**

  - To check the iptables rules
    - **`iptables –L`**

  - To flush iptables.
    - **`iptables -F`**

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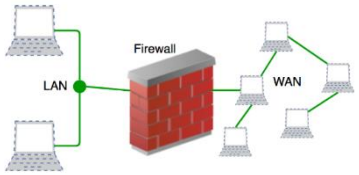
Firewall *(iptables – tables, chains and targets)*



- The function of iptables tool is packet filtering
- The packet filtering mechanism is organized into three different kinds of structures: **tables,** **chains** and **targets**

1. **`tables`** = table is something that allows you to process packets in specific ways. There are 4 different types of tables, **filter**, mangle, nat and raw

2. **`chains`** = The chains are attached to tables, These chains allow you to inspect traffic at various points. There are 3 main chains used in iptables
   - INPUT = incoming traffic
   - FORWARD = going to a router, from one device to another
   - OUTPUT = outgoing traffic
     - chains allow you to filter traffic by adding rules to them
     - Rule = if traffic is coming from `192.168.1.35` then go to defined target

3. **`targets`** = target decides the fate of a packet, such as allowing or rejecting it. There are 3 different type of targets
   - ACCEPT = connection accepted
   - REJECT = Send reject response
   - DROP = drop connection without sending any response

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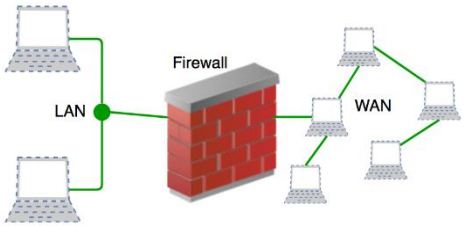
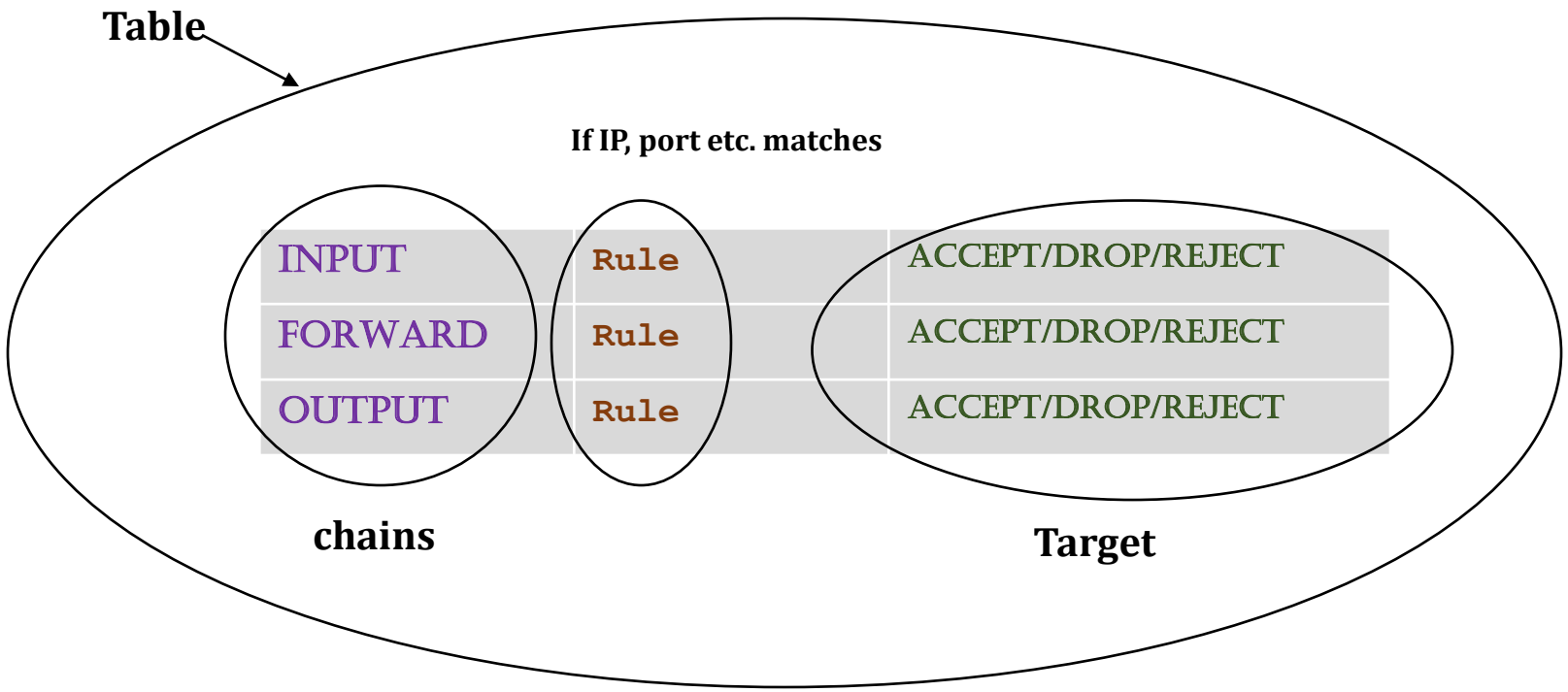
Firewall *(iptables – tables, chains and targets)*

Let's draw it out:





- To check the iptables rules
  - `iptables -L`

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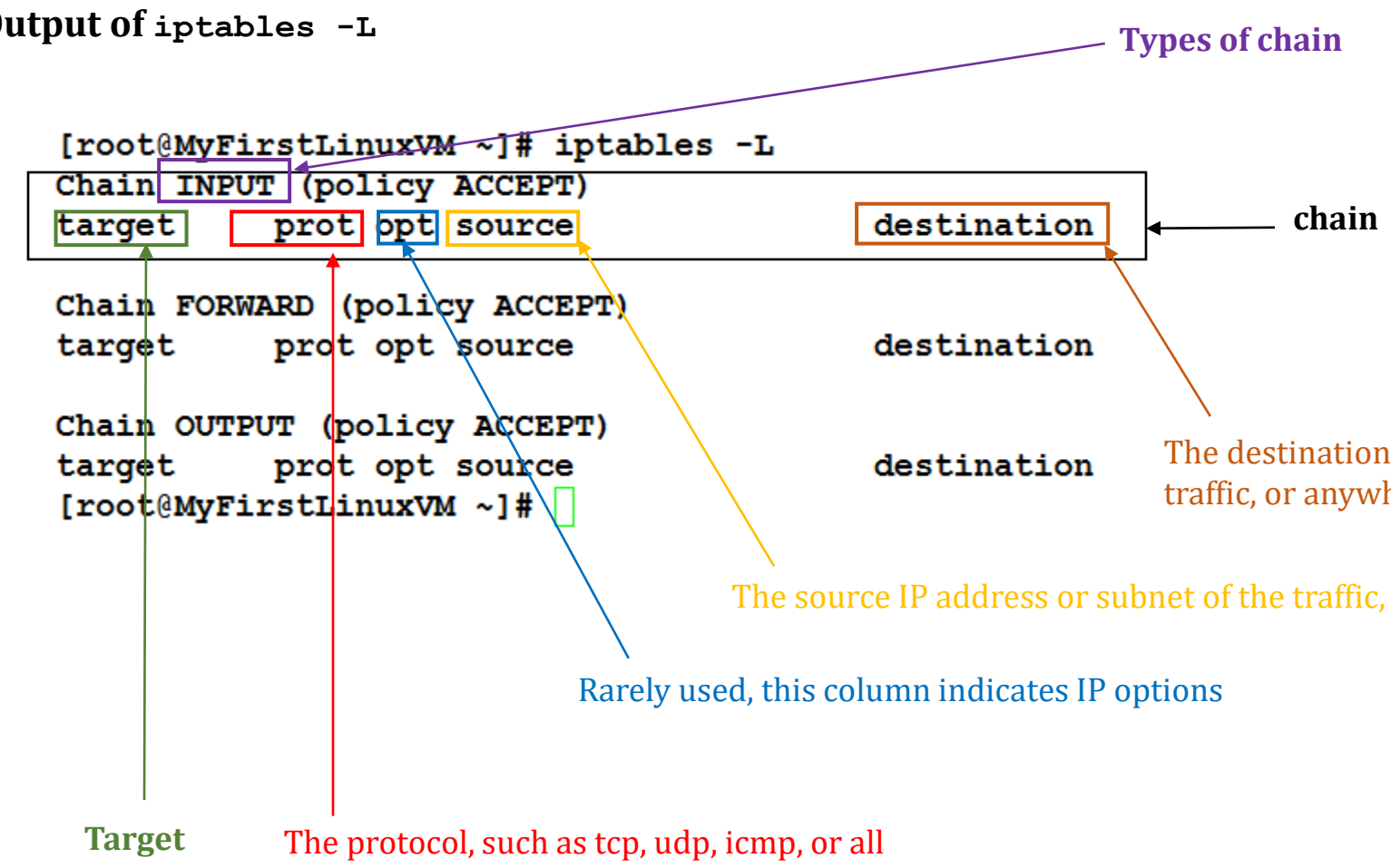
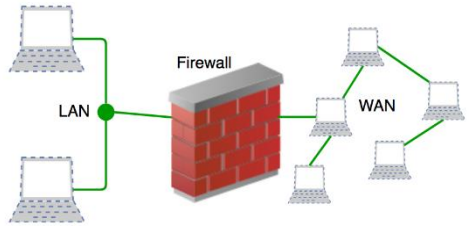
Firewall *(iptables – tables, chains and targets)*

Output of `iptables -L`





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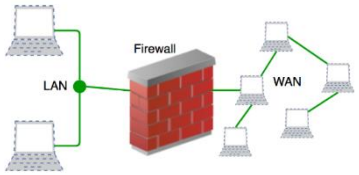
Firewall *(iptables – practical examples)*



- Drop all traffic coming from a specific IP (192.168.0.25)
  - `iptables –A INPUT –s 192.168.0.25 –j DROP`
- Drop all traffic coming from a range of IPs (192.168.0.0)
  - `iptables –A INPUT –s 192.168.0.0/24 –j DROP`
- List all rules in a table by line numbers
  - `iptables –L --line-numbers`
- Delete a specific rule by line number
  - `iptables –D INPUT 1`
- To flush the entire chain
  - `iptables –F`
- To block a specific protocol with rejection (e.g. ICMP)
  - `iptables -A INPUT -p icmp -j REJECT`
- To block a specific protocol without rejection (e.g. ICMP)
  - `iptables -A INPUT -p icmp -j DROP`
- To block a specific port # (e.g. http port 80)
  - `iptables -A INPUT -p tcp --dport 80 -j DROP`

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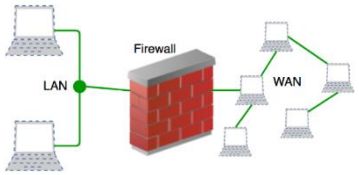
Linux Firewall *(iptables – practical examples)*

Practical:



- Block connection to a network interface
  - **`iptables -A INPUT -i enps03 -s 192.168.0.25 -j DROP`**
- Drop all traffic going to www.facebook.com
  - **`host -t a www.facebook.com` = find IP address**
  - **`iptables –A OUTPUT –d 31.13.71.36 –j DROP`**
- Block all outgoing traffic to a network range
  - **`iptables –A OUTPUT –d 31.13.71.0/24 –j DROP`**
- Block all incoming traffic except SSH
  - **`iptables -A INPUT -p tcp --dport 22 -j ACCEPT`**
  - **`iptables -P INPUT DROP`**
- After making all the changes save the iptables. Again make sure firewalld is not running
  - **`iptables-save`** = The file is save in /etc/sysconfig/iptables
- iptables saved file can also be restored
  - **`iptables-restore /LOCATION/FILENAME`**
- By default everything is logged in
  - **`/var/log/messages`**

- IMPORTANT: The iptables read the rules in sequence
  - DROP first then it will drop all without going to the next one
  - So make sure to ACCEPT first with –I option instead of -A

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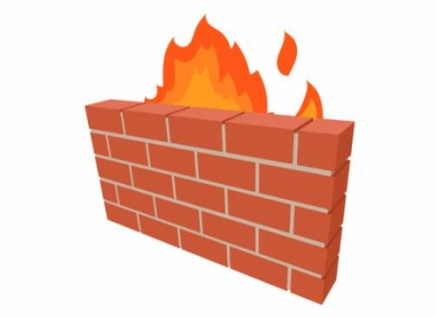
Firewall *(firewalld)*



- Firewalld works the same way as iptables but of course it has it own commands
  - **`firewall-cmd`**
- It has a few pre-defined service rules that are very easy to turn on and off
  - **`Services such as: NFS, NTP, HTTPD etc.`**
- Firewalld also has the following:
  - **`Table`**
  - **`Chains`**
  - **`Rules`**
  - **`Targets`**

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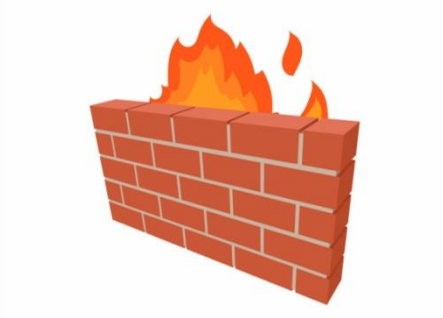
Firewall *(firewalld)*



- You can run one or the other
  - iptables or firewalld

- Make sure iptables is stopped, disabled and mask
  - **`systemctl stop iptables`**
  - **`systemctl disable iptables`**
  - **`systemctl mask iptables`**

- Now check if filewalld package is installed
  - **`rpm –qa | grep firewalld`**

- Start firewalld
  - **`systemctl start/enable firewalld`**

- Check the rule of firewalld
  - **`firewall-cmd --list-all`**

- Get the listing of all services firewalld is aware of:
  - **`firewall-cmd --get-services`**

- To make firewalld re-read the configuration added
  - **`firewall-cmd --reload`**

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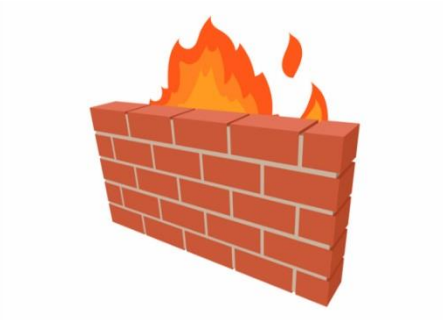
Firewall *(firewalld – Practical Examples)*



- The firewalld has multiple zone, to get a list of all zones
  - **`firewall-cmd --get-zones`**
- To get a list of active zones
  - **`firewall-cmd --get-active-zones`**
- To get firewall rules for public zone
  - **`firewall-cmd --zone=public --list-all`**

    OR
  - **`firewall-cmd --list-all`**
- All services are pre-defined by firewalld. What if you want to add a 3rd party service
  - **`/usr/lib/firewalld/services/allservices.xml`**
  - **`Simply cp any .xml file and change the service and port number`**

```
[root@MyFirstLinuxVM services]# cat test.xml
<?xml version="1.0" encoding="utf-8"?>
<service>
  <short>SSH</short>
  <description>To login</description>
  <port protocol="tcp" port="22"/>
</service>
[root@MyFirstLinuxVM services]#
```

Version of XML

Service

Service

Port

Description

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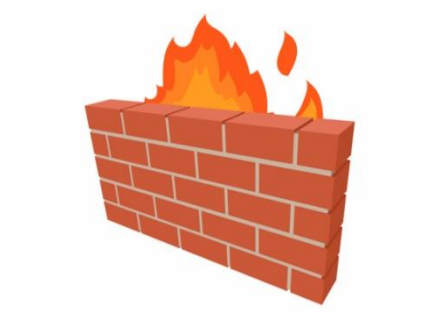
Firewall *(firewalld – Practical Examples)*



- To add a service (http)
  - **`firewall-cmd --add-service=http`**
- To remove a service
  - **`firewall-cmd --remove-service=http`**
- To reload the firewalld configuration
  - **`firewall-cmd --reload`**
- To add or remove a service permanently
  - **`firewall-cmd --add-service=http --permanent`**
  - **`firewall-cmd --remove-service=http --permanent`**
- To add a service that is not pre-defined by firewalld
  - **`/usr/lib/firewalld/services/allservices.xml`**
  - **`Simply cp any .xml file sap.xml and change the service and port number (32)`**
  - **`systemctl restart firewalld`**
  - **`firewall-cmd --get-services`** **`(to verify new service)`**
  - **`Firewall-cmd --add-service=sap`**

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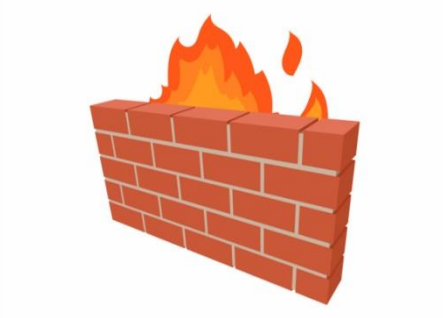
Firewall *(firewalld – Practical Examples)*



- To add a port
  - **`firewall-cmd --add-port=1110/tcp`**
- To remove a port
  - **`firewall-cmd --remove-port=1110/tcp`**
- To reject incoming traffic from an IP address
  - **`firewall-cmd --add-rich-rule='rule family="ipv4" source address="192.168.0.25" reject'`**
- To block and unblock ICMP incoming traffic
  - **`firewall-cmd --add-icmp-block-inversion`**
  - **`firewall-cmd --remove-icmp-block-inversion`**
- To block outgoing traffic to a specific website/IP address
  - **`host -t a www.facebook.com = find IP address`**
  - **`firewall-cmd --direct --add-rule ipv4 filter OUTPUT 0 -d 31.13.71.36 -j DROP`**

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www.utclisolutions.com

Tune System Performance

Linux system comes fined tunned by default when you install, however there are a few tweaks that can be done based on system performance and application requirements

In this lesson we will learn…

- Optimize system performance by selecting a tuning profile managed by the **`tuned`** daemon
- Prioritize or de-prioritize specific processes with the **`nice`** and **`renice`** commands

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Tune System Performance

What is tuned?

- Tuned pronounced as tune-d
- **Tune** is for system tuning and **d** is for daemon
- It is **systemd** service that is used to tune Linux system performance
- It is installed in CentOS/Redhat version 7 and 8 by default
- **tuned** package name is **tuned**
- The **tuned** service comes with pre-defined profiles and settings *(List of profile will be discussed in the next page)*
- Based on selected profile the **tuned** service automictically adjust system to get the best performance. E.g. **tuned** will adjust networking if you are downloading a large file or it will adjust IO settings if it detects high storage read/write
- The tuned daemon applies system settings when the service starts or upon selection of a new tuning profile.

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Tune System Performance (`tuned` profiles)

Tuned profile	Purpose
balanced	deal for systems that require a compromise between power saving and performance
desktop	Derived from the balanced profile. Provides faster response of interactive applications
Throughput-performance	Tunes the system for maximum throughput
Latency-performance	Ideal for server systems that require low latency at the expense of power consumption
network-latency	Derived from the latency-performance profile. It enables additional network tuning parameters to provide low network latency
Network-throughput	Derived from the throughput-performance profile. Additional network tuning parameters are applied for maximum network throughput
powersave	Tunes the system for maximum power saving
oracle	Optimized for Oracle database loads based on the throughput-performance profile
virtual-guest	Tunes the system for maximum performance if it runs on a virtual machine
virtual-host	Tunes the system for maximum performance if it acts as a host for virtual machines

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Tune System Performance

- Check if tuned package has been installed
  `rpm -qa | grep tuned`
- Install tuned package if NOT installed already
  `yum install tuned`
- Check **`tuned`** service status
  `systemctl status|enable|start tuned`
  `systemctl enable tuned` *(To enable at boot time)*
- Command to change setting for tuned daemon
  `tuned-adm`
- To check which profile is active
  `tuned-adm active`
- To list available profiles
  `tuned-adm list`.

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Tune System Performance

- To change to desired profile

  `tuned-adm profile profile-name`

- Check for tuned recommendation

  `tuned-adm recommend`

- Turn off tuned setting daemon

  `tuned-adm off`

- Change profile through web console

  Login to https://192.168.1.x:9090

  Overview → Configuration → Performance profile

By: Imran Afzal
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Tune System Performance (nice/renince)

- Another way of keeping your system fine-tuned is by prioritizing processes through **`nice`** and **`renice`** command
- If a server has 1 CPU then it can execute **1** computation/process at a time as they come in *(first come first served)* while other processes must wait
- With **`nice`** and **`renice`** commands we can make the system to give preference to certain processes than others
- This priority can be set at 40 different levels
- The nice level values range from -20 (highest priority) to 19 (lowest priority) and by default, processes inherit their nice level from their parent, which is usually 0.

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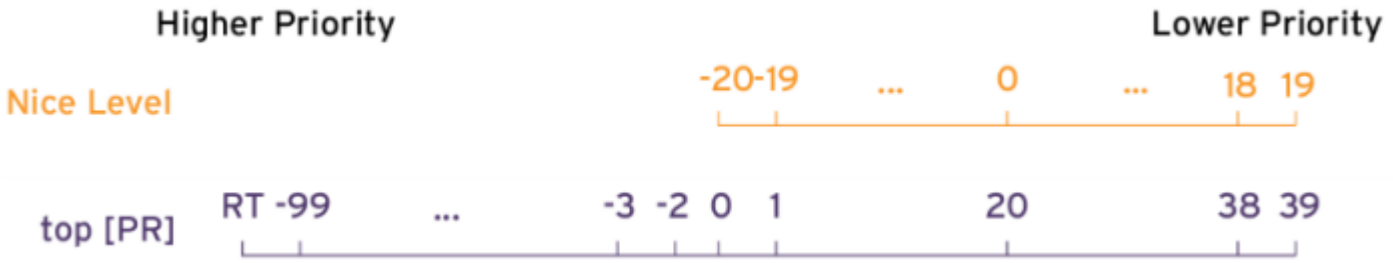
Tune System Performance (nice/renince)

- To check process priority

```
top
```



Nice value is a user-space and priority PR is the process's actual priority that use by Linux kernel. In Linux system priorities are 0 to 139 in which 0 to 99 for real time and 100 to 139 for users

- Process priority can be viewed through ps command as well with the right options

```
$ ps axo pid,comm,nice,cls --sort=-nice
```

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Tune System Performance (nice/renince)

- To set the process priority

```
nice –n # process-name
e.g. nice –n -15 top
```

- To change the process priority

```
renice –n # process-name
e.g. renice –n 12 PID.
```

By: Imran Afzal
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Run Containers

What is a Container?

- The term container and the concept came from the shipping container

- These containers are shipped from city to city and country to country
- No matter which part of the world you go to, you will find these containers with the exact same measurements… **YOU KNOW WHY???**
- Because around the world all docks, trucks, ships and warehouses are built to easily transport and store them

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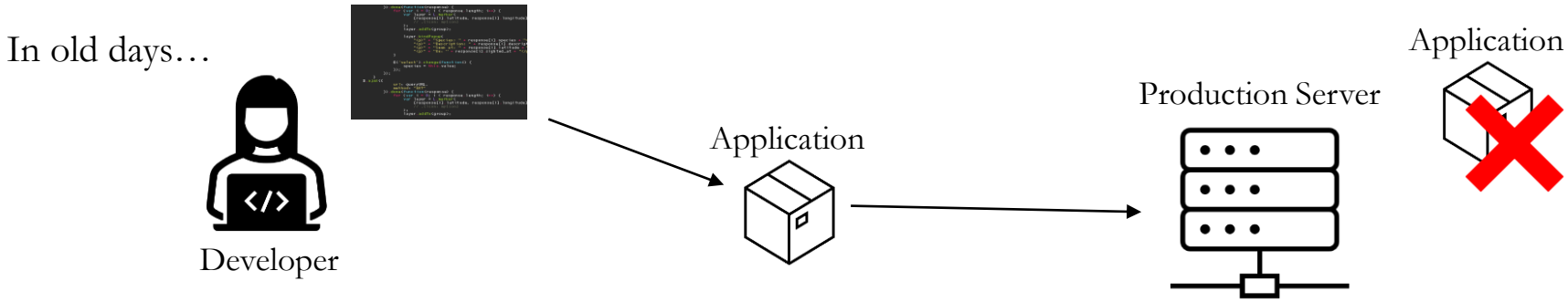
Run Containers

What is a Container?

Now when we are talking about containers in IT we are fulfilling somewhat similar purpose



- Then came the container technology which allowed developers or programmer to test and build applications on any computer just by putting it in a container *(bundled in with the software code, libraries and configuration files)* and then run on another computer regardless of its architecture
- You can move the application anywhere without moving its OS just like moving the actual physical container anywhere that would fit on any dockyard, truck, ship or warehouse
- An OS can run single or multiple containers at the same time

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Run Containers

What is a Container?

Now when we are talking about containers in IT we are fulfilling somewhat similar purpose

Please Note:

Container technology is mostly used by developers or programmers who write codes to build applications

As a system administrator your job is to install, configure and manage them.

container anywhere that would fit on any dockyard, truck, ship or warehouse

- An OS can run single or multiple containers at the same time

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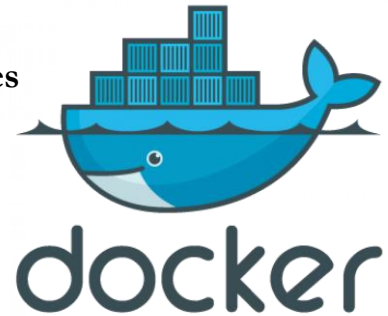
Run Containers

What are the Container Software?

Developed by:
Solomon Hykes



Released on:
March 20th 2013

- Docker is the software used to create and manage containers
- Just like any other package, docker can be installed on your Linux system and its service or daemon can be controlled through native Linux service management tool

Developed by:
Red Hat

Released on:
August 2018

podman

- Podman is an alternative to docker
- Docker is not supported in RHEL 8
- It is daemon less, open source, Linux-native tool designed to develop, manage, and run containers.

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Run Containers

Getting Familiar with Redhat Container Technology

Red Hat provides a set of command-line tools that can operate without a container engine, these include:

- **podman** - for directly managing pods and container images (run, stop, start, ps, attach, etc.)
- **buildah** - for building, pushing, and signing container images
- **skopeo** - for copying, inspecting, deleting, and signing images
- **runc** - for providing container run and build features to podman and buildah
- **crun** - an optional runtime that can be configured and gives greater flexibility, control, and security for rootless containers.

Getting Familiar with podman Container Technology

When you hear about containers then you should know the following terms as well

- **images** – containers can be created through images and containers can be converted to images
- **pods** – Group of containers deployed together on the host. In the podman logo there are 3 seals grouped together as a pod.

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Run Containers

Building, Running and Managing Containers

To install podman

- **`yum/dnf install podman -y`**
- **`yum install docker -y`** *(For dockers)*

Creating alias to docker

- **`alias docker=podman`**

Check podman version

- **`podman -v`**

Getting help

- **`podman --help or man podman`**

Check podman environment and registry/repository information

- **`podman info`** *(If you are trying to load a container image, then it will look at the local machine and then go through each registry by the order listed)*

To search a specific image in repository.

- **`podman search httpd`**

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Run Containers

Building, Running and Managing Containers

To list any previously downloaded podman images

- **`podman images`**

To download available images

- **`podman pull docker.io/library/httpd`**
- **`podman images`** *(Check downloaded image status)*

To list podman running containers

- **`podman ps`**

To run a downloaded httpd containers

- **`podman run -dt -p 8080:80/tcp docker.io/library/httpd`**
  `(d=detach, t=get the tty shell, p=port)`
- **`podman ps`** **`or`** ***Check httpd through web browser***

To view podman logs.

- **`podman logs –l`**

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Run Containers

Building, Running and Managing Containers

To stop a running container

- **`podman stop con-name`** *(con-name from podman ps command)*
- **`podman ps`** *(To list running containers)*

To run a multiple containers of httpd by changing the port #

- **`podman run -dt -p 8081:80/tcp docker.io/library/httpd`**
- **`podman run -dt -p 8082:80/tcp docker.io/library/httpd`**
- **`podman ps`**

To stop and start a previously running container

- **`podman stop|start con-name`**

To create a new container from the downloaded image

- **`podman create --name httpd-con docker.io/library/httpd`**

To start the newly created container.

- **`podman start httpd-con`**

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Run Containers

Building, Running and Managing Containers

Manage containers through systemd

- First you have to generate a unit file
  - **`podman generate systemd --new --files --name httpd-con`**
- Copy it systemd directory
  - **`cp /root/container-httpd.service /etc/systemd/system`**
- Enable the service
  - **`systemctl enable container-httpd-con.service`**
- Start the service.
  - **`systemctl start container-httpd-con.service`**

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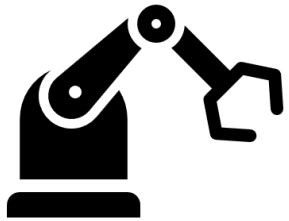
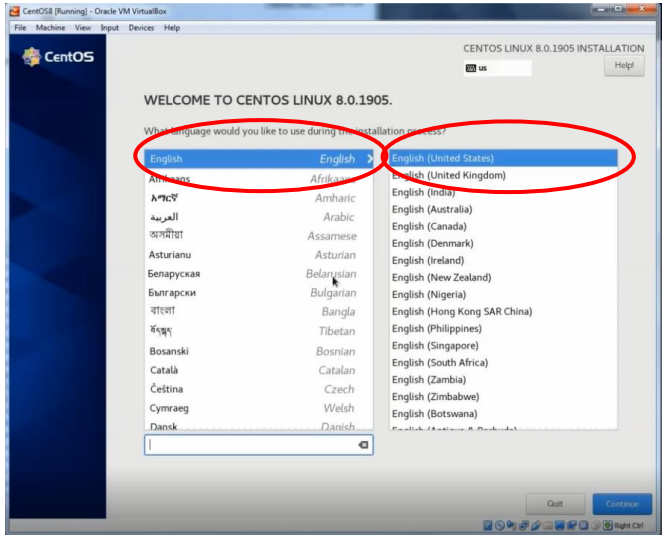
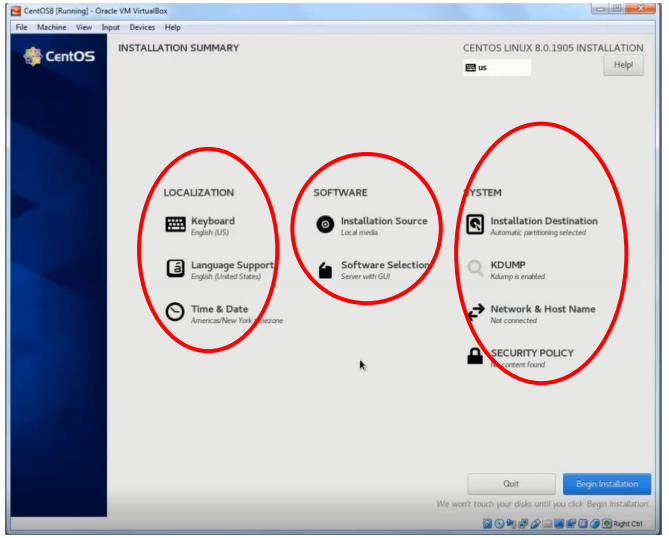
Kickstart (Automate Linux Installation)



- Kickstart is a method to automate the Linux installation without the need for any intervention from the user

- With the help of kickstart you can automate questions that are asked during the installation. e.g.
  - Language and time zone
  - How the drives should be partitioned
  - Which packages should be installed etc.





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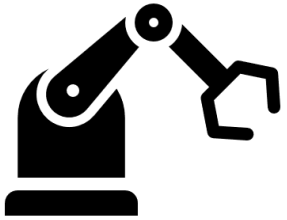
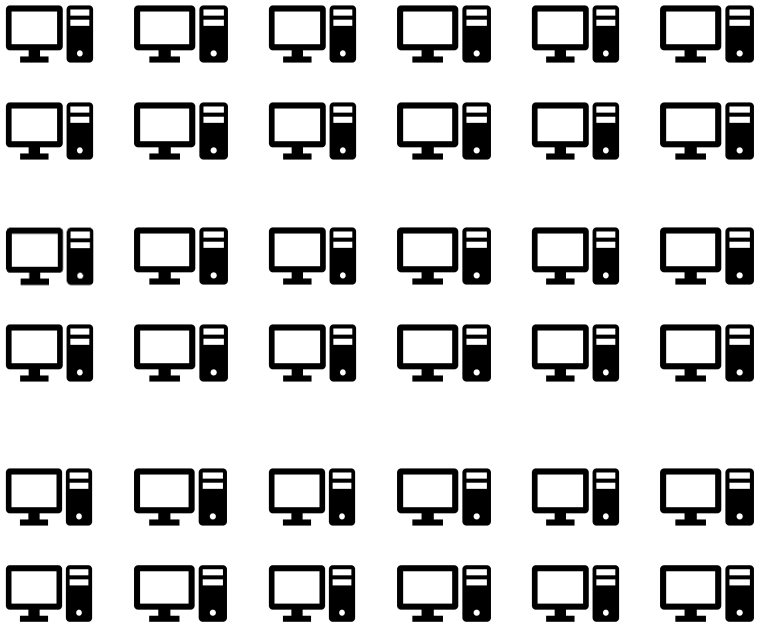
Kickstart (Automate Linux Installation)

- Purpose?





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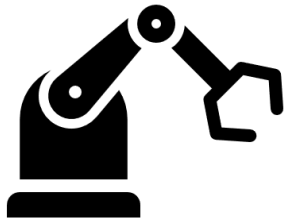
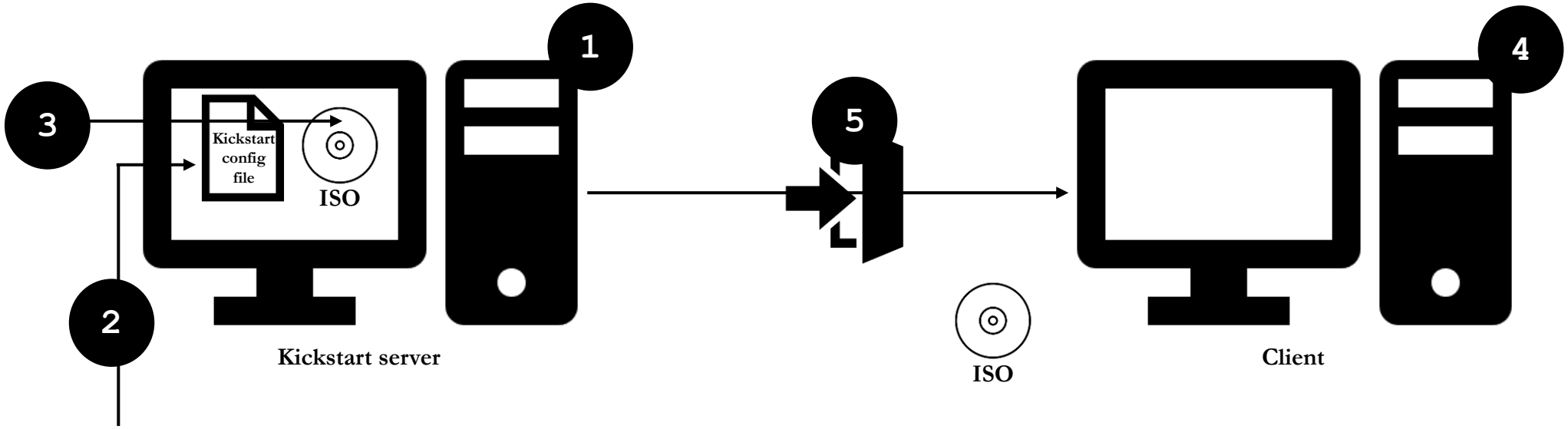
Kickstart (Automate Linux Installation)



- To use Kickstart, you must:
  1. Choose a Kickstart server and create/edit a Kickstart file
  2. Make the Kickstart file available on a network location
  3. Make the installation source available
  4. Make boot media available for client which will be used to begin the installation
  5. Start the Kickstart installation



Network = NFS, FTP, HTTP, or HTTPS

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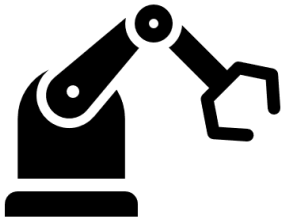
Kickstart (Automate Linux Installation)



- CentOS/Redhat 7
  - Kickstart program can be downloaded which allows you to define parameters through the GUI
    - **`yum install system-config-kickstart`**
  - Or you can use the installation kickstart file which was created during the first installation (**`anaconda-ks.cfg`**)

- CentOS/Redhat 8
  - There is no GUI available to edit the file

- Why changed?
  - Most systems are virtual and templates can be used
  - Automation software are in used such as Anisble.

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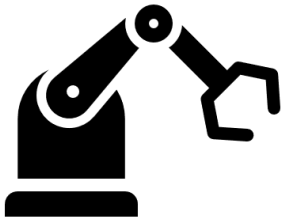
Kickstart (Automate Linux Installation)

- **Step by step procedure for Kickstart**



1. Identify the server

2. Take a snapshot of the server

3. Install kickstart configurator (for version 7)
   - **`yum install system-config-kickstart`**

4. Start the kickstart file configurator and define parameters **OR** use the **`/root/anaconda-ks.cfg`**
   - **`system-config-kickstart`** (To start the configurator)
   - We will use anaconda installation kickstart file and change the hostname only

5. Make sure httpd package is installed, if not then install the package and start the httpd service
   - **`rpm -qa | grep http`**
   - **`yum/dnf install httpd`**
   - **`systemctl start httpd`**
   - **`systemctl enable httpd.`**

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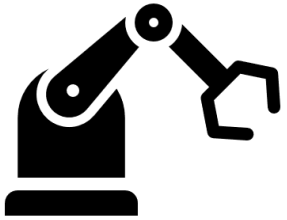
Kickstart (Automate Linux Installation)

6. Copy kickstart file to httpd directory and change the permissions
   - `cp /root/anaconda-ks.cfg /var/www/html`
   - `chmod a+r /var/www/html/anaconda-ks.cfg`
   - `systemctl stop|disable firewalld`
   - `Check file through browser on another PC http://192.168.1.x/anaconda-ks.cfg`



7. Create a new VM and attach the CentOS iso image

8. Change the network adapter to Bridged adapter

9. Hit Esc

10. `boot: linux ks=http://192.168.1.x/anaconda-ks.cfg`
    `For NFS →  boot: linux inst.ks=nfs:192.168.1.x:/rhel8`

11. Wait and enjoy the automated installation

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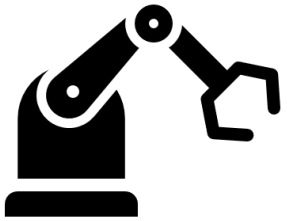
Kickstart (Automate Linux Installation)

Kickstart for clients with static IP



```
boot: linux ks=http://server.example.com/ks.cfg ksdevice=eth0 IP:192.168.1.50
netmask=255.255.255.0 gateway=192.168.1.1
```

Where:

`ksdevice` = is the network adapter of the client

`IP` = IP you are assigning to the client

`netmask` = Subnet mask for the client

`gateway` = Gateway IP address for the client

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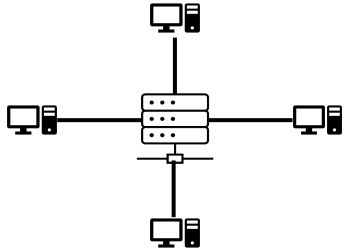
DHCP

In this video I will show you how to setup DHCP server conceptually because if you want to setup DHCP server on your Linux machine then you will have to re-configure your router/modem in your home which can route DHCP traffic to your new DHCP server.
Reconfiguring router/modem will make all your devices at home lose the network connectivity



- DHCP stands for Dynamic Host Configuration Protocol
- In order to communicate over the network, a computer needs to have an IP address
- DHCP server is responsible to automatically assign IP addresses to servers, laptops, desktops, and other devices on the network

- Wait a second…
  - Right now in our home how IPs are assigned to our devices?
    - Answer → The router or gateway given to you by your ISP provider
  - How IPs are assigned in corporate world?
    - Answer → Dedicated routers run DHCP service to assign IPs on the network

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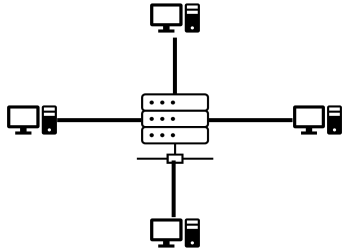
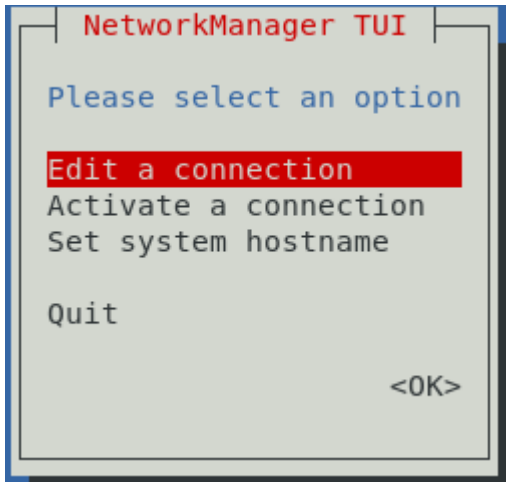
DHCP

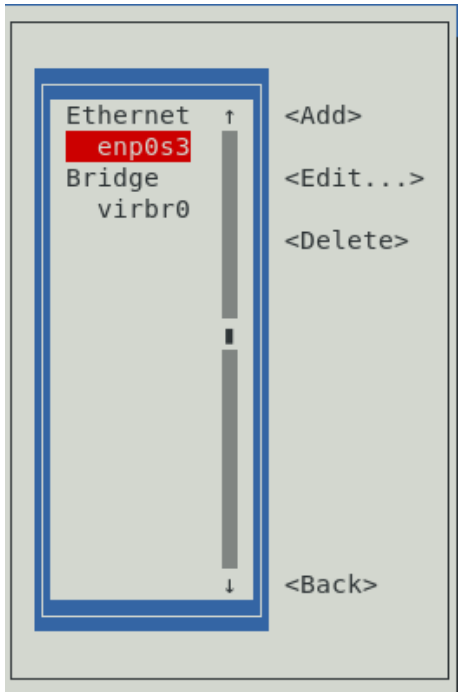


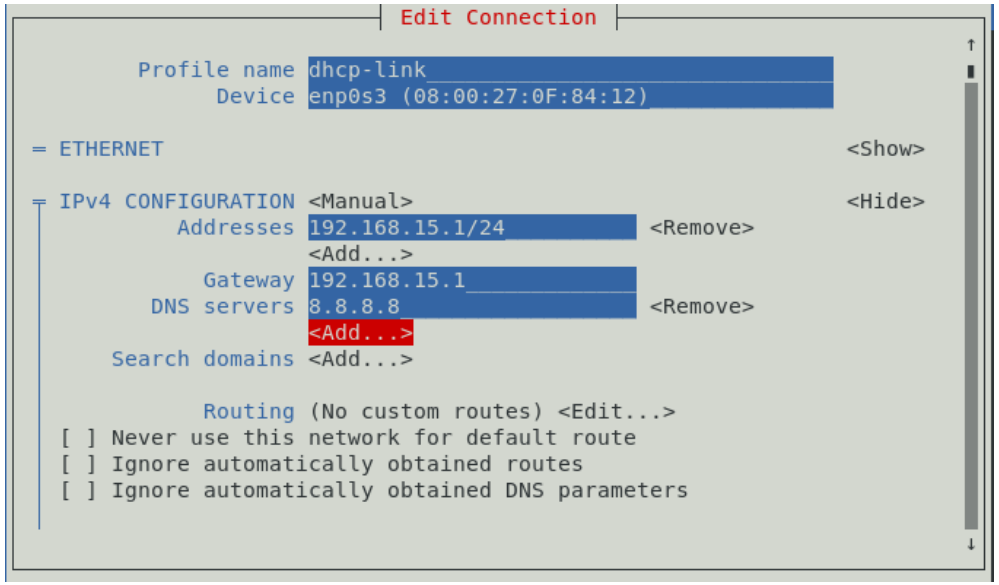
Step by steps instructions

- Pick a server to be your DHCP and take a snapshot

- Assign a static IP to the DHCP server
  - **`vi /etc/sysconfig/network/enp0s3`**
  - Or simply run **`nmtui`** command to use GUI based network tool







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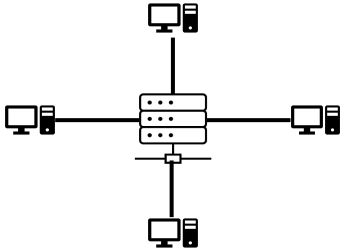
DHCP



- Install dhcp server package
  - **`yum install dhcp`** (version 7)
  - **`dnf install dhcp-server`** (version 8)

- Edit the configuration file with desired parameters
  - **`vi /etc/dhcp/dhcp.conf`**
  - **`cp /usr/share/doc/dhcp-x.x.x/dhcpd.conf.example /etc/dhcp/dhcpd.conf`**

```
#
# DHCP Server Configuration file.
#   see /usr/share/doc/dhcp-server/dhcpd.conf.example
#   see dhcpd.conf(5) man page
#
default-lease-time 600;
max-lease-time 7200;

ddns-update-style none;
authoritative;

subnet 192.168.15.0 netmask 255.255.255.0 {
        range 192.168.15.50 192.168.15.200;
        option routers 192.168.15.1;
        option subnet-mask 255.255.255.0;
        option domain-name-servers 8.8.8.8, 8.8.4.4;
}
~
~
~
```

- The DHCP server will reserve the IP address for at least 10 minutes
- The DHCP server will reserve the IP address for a max of 2 hours
- Defines the subnet range of 256 addresses
- Defines the DHCP range assignment of 150 addresses
- Routers defines the default gateway
- Defines the default subnet mask that will be assigned to each host
- Defines the DNS nameservers which will be assigned to each host.

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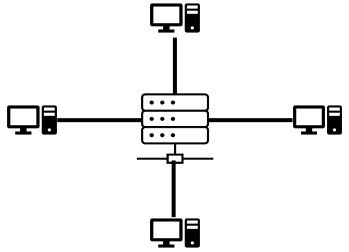
DHCP



- Start dhcpd service
  - **`systemctl start dhcpd`**
  - **`systemctl enable dhcp`**
- Disable **`firewalld`** or allow dhcp port over firewall
  - **`systemctl stop firewalld`**
  - **`OR`**
  - **`firewall-cmd --add-service=dhcp –permanent`**
  - **`firewall-cmd –reload`**
- Switch DHCP service from your router/modem to your new DHCP server
  - **`Login to your ISP provided router`**
  - **`Disable dhcp and enable forwarding to the new dhcp server.`**

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