Operating System and Computer Networks ITS 66304

May 2023 – Semester 2

Laboratory 1: Network Topology **Thursday, May 18, 2023**

Design a following network in Cisco Packet Tracer and write its advantages and disadvantages

Necessary Equipment: PC's, Hub, Switch, Repeater and Connecting Wires.

(Linear) Bus Topology:

All nodes in the network are connected directly to a central main cable (aka backbone) running through the network. Not popular in modern networking, dealing with large data amounts. Temporary setup.

Advantages

- Easy to connect nodes to network
- Less cabling compared to other topologies
- Small and Cheaper installation
- Failure of a single device does not affect the rest of the network.

Disadvantages

- The whole network fails if the backbone cable is broken
- Terminators must be installed at each end of the backbone
- One backbone increases chances of data collision
- As the number of devices increases, the network performance can slow down.
- It is challenging to identify and troubleshoot problems in the network.
- It has limited scalability, as adding new devices to the network is challenging.

Design

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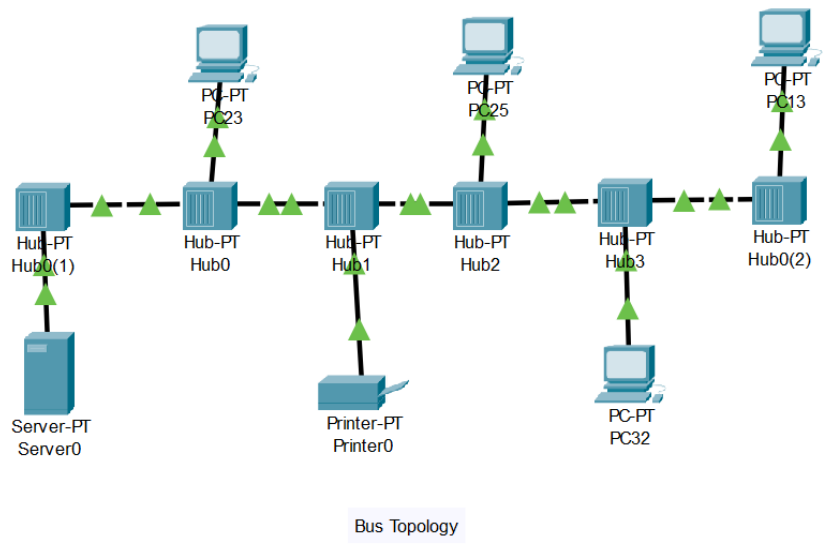

Bus Topology

Star Topology

Hubs can either be active or passive, with active hubs containing repeaters and passive hubs being classified as non-intelligent nodes. They are also found in home networks, especially those that are wireless.

Advantages

- the data flow is centralized through the hub, reducing collisions and congestion on the network. This results in increased network performance and fast data transmission.
- it is easy to identify and isolate network problems, which makes it easy to troubleshoot and fix network issues.
- Adding new devices to the network can quickly expand, making it a flexible that can grow and adapt to changing network requirements.
- higher performance as a message is passed on to its intended node only

Disadvantages

- If the hub or switch (central point of communication) fails, the entire network can be affected. relies heavily on the hub or switch
- requires more cabling and equipment than other network topologies, more expensive to install and maintain.
- As the number grows, the number of cables required can become unwieldy. limit the scalability of the network.
- setting up and configuring the cabling for an extensive network can be problematic. Proper planning and installation of cabling is crucial for ensuring network efficiency and effectiveness.

Design

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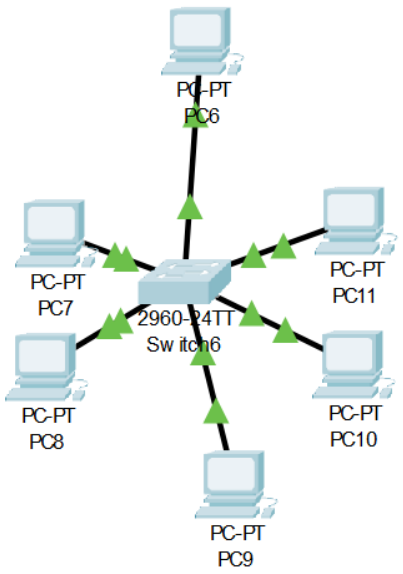

Star Topology

Ring Topology

The devices are interconnected in a circular or ring-like pattern, which forms a closed loop. data is transmitted in one direction around the circle, with each device on the network reading and passing on the data until it reaches its destination.

Advantages

- provides redundancy, meaning that transmitting data through the other devices in the loop is possible if one device fails
- each device has an equal opportunity to transmit data, helps to balance network traffic. reduces the risk of congestion and ensures equal bandwidth.
- data travels in one direction around the loop, no need for collision detection or retransmission of data.
- can easily scale up or down by removing or adding devices from the loop. This makes it a flexible option for networks that need to grow or shrink over time.
- data can only travel in one direction around the loop. more challenging for hackers to intercept data or inject malicious code into the network.

Disadvantages

- the failure of a single device can disrupt the entire network. when a device fails to transmit data or the cable connecting breaks.
- limited in its support number. device must connect to the loop, determine the network's size.

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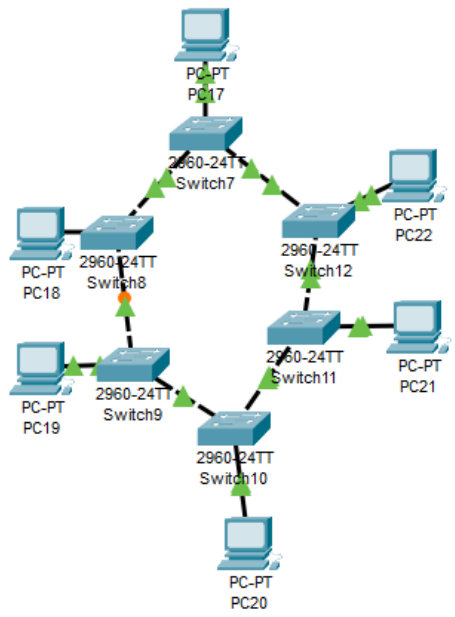
- challenging to locate the source of the problem. in a circular loop, making it hard to pinpoint where the failure occurred.
- devices to the loop can also result in slow performance Data must travel through each device in the circle before reaching its destination.

Design



Ring Topology

Mesh Topology

Network channels connect each node to all the other nodes. a point-to-point connection, supports two data transmission techniques: routing and flooding. The routing technique equips the nodes with routing logic, such as selecting the shortest distance path to the destination node or avoiding routes with broken connections. the flooding technique involves broadcasting the data to all network nodes, eliminating the need for the routing logic. While this technique enhances the network's robustness, it may also generate unwanted network traffic and result in a heavy load on the network.

Advantages

- provides redundancy and multiple paths for data to travel between devices, one link fails, data can be rerouted, ensuring that the network remains operational
- accommodate new devices without disrupting the existing network. without affecting performance
- provides network design and topology flexibility. to suit the specific needs, connected in a full or partial configuration.
- provides a high level of security, making it difficult for attackers to intercept or disrupt the network.

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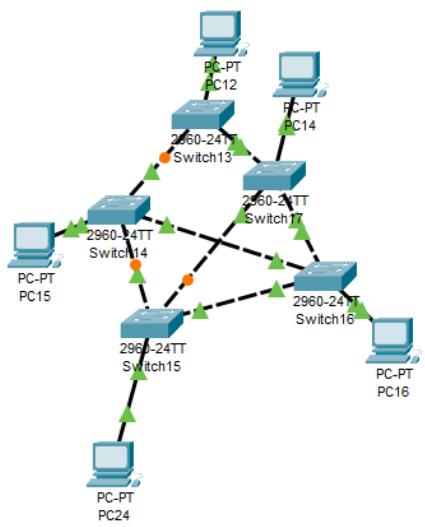
Disadvantages

- expensive. must connect every device in the network to multiple other devices. cabling, hardware, and infrastructure.
- complex to implement and manage, Users should use routing protocols and algorithms to drive traffic flow between devices. Failure detection and recovery mechanisms to ensure the network remains operational despite node failures.
- data travel through multiple nodes to reach destination, increasing latency and affecting network performance. problematic in applications with critical low latency, such as real-time communication or online gaming.
- In wireless, devices must transmit and receive data over the air, which can consume significant amounts of power. It can be a problem in applications with limited battery life, such as IoT sensors.

Design



Mesh Topology

Hybrid Topology

combining two or more different network topologies. Combines advantages of each topology to create a more robust and flexible network infrastructure.

Advantages

- allows adding new network segments, making it easier to scale up or down as per the organization’s needs.
- offers greater flexibility in network design, user can customize different segments to meet specific requirements.
- better redundancy and fault tolerance. one segment fails, network continue functioning through another segment.
- cost-effective because organizations can use existing infrastructure and add new technology only where necessary.

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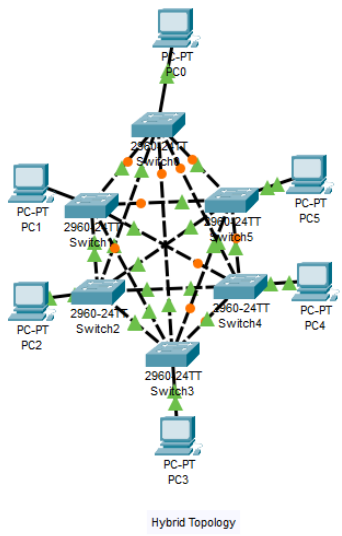
- can provide faster data transfer speeds, improved performance, and lower latency by selecting the most suitable topology for each network segment.

Disadvantages

- more complex, requires knowledge and expertise to design,
- requires regular maintenance to ensure all network segments function correctly.
- time-consuming and costly if an organization lacks in-house IT expertise.
- more vulnerable to security threats, combining different segments with different security protocols and configurations, creating potential weaknesses that hackers can exploit.
- various technologies and protocols, making it challenging to ensure their compatibility. It can result in communication issues and performance problems.

Design



Hybrid Topology

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Laboratory 2: Basic Network Configuration Command Thursday, June 8, 2023

Design a LAN network to study basic network command and Network configuration commands. (ping, tracert and nslookup)

Necessary Equipment's:

Router (1841), Switch (2960-24PT), 2 PCs and 2 Printers, Copper Crossover wires

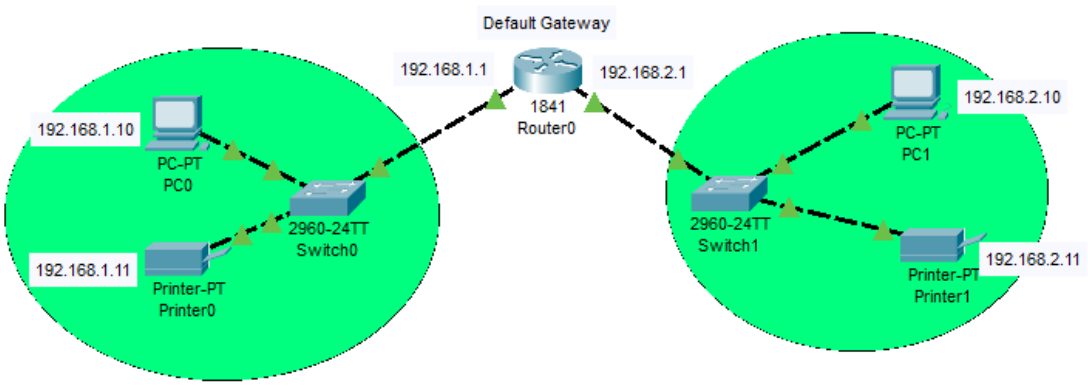

Figure 1.Basic LAN network

IPv4 Configuration:

IP Addresses: to end devices

PC0	192.168.1.10	PC1	192.168.2.10
Printer0	192.168.1.11	Printer1	192.168.2.11

Default Gateway: to router

PC0 & Printer0	192.168.1.1	PC1 & Printer1	192.168.2.1

Subnet Masks: 255.255.255.0 (Class C)

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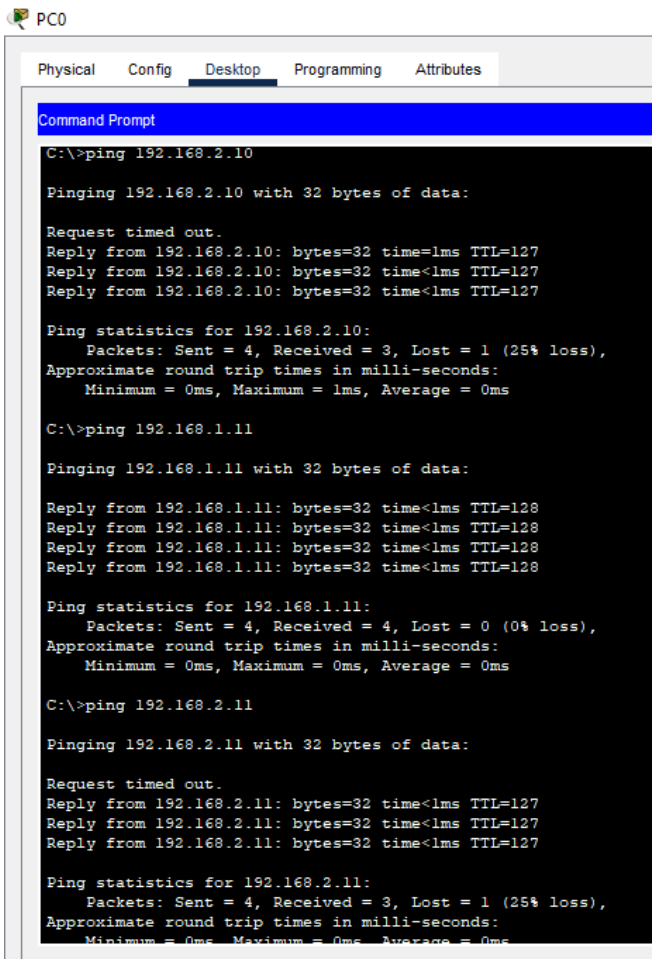
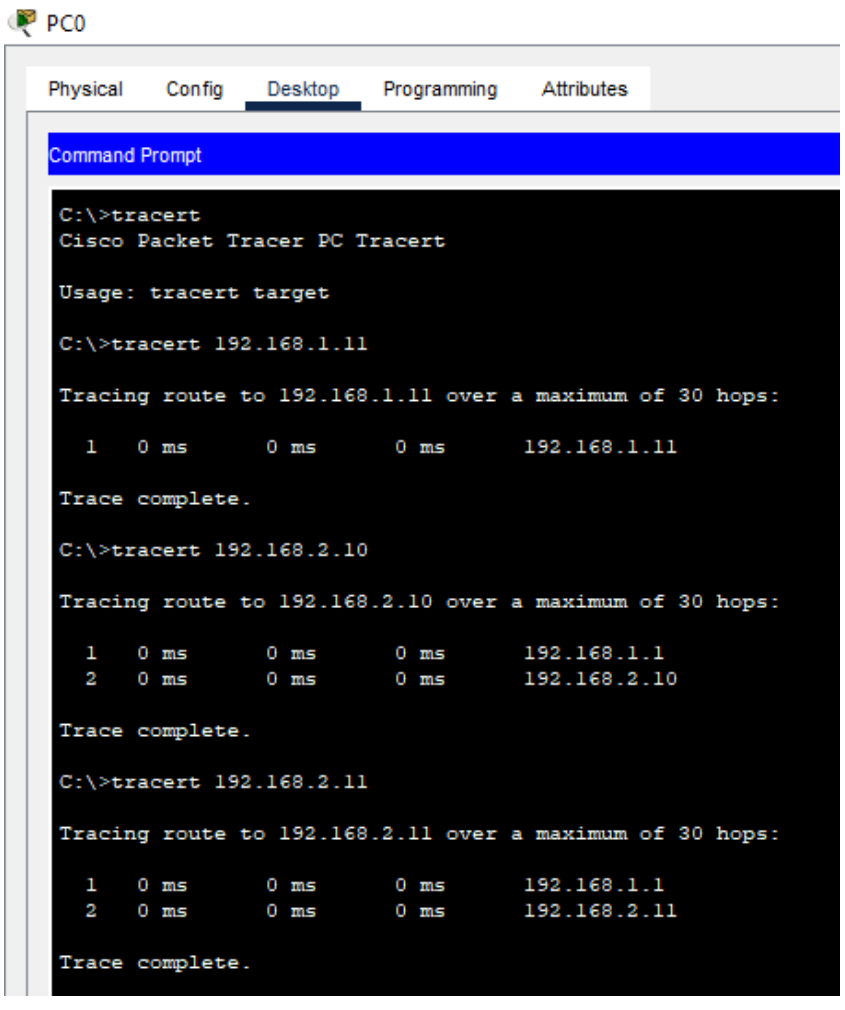
Ping: Allows the user to send a signal to another device and check if its active and will respond back to the sender aka echo request and respond. To check internet connectivity issue



tracert: let the user see all steps a packet takes to the destination aka hops tracing to a specific route it hits to an intended servers



nslookup: fetch the DNS record for a given domain name or ip address stored in a DNS server allowing us to query the record to gather information's

```
C:\WINDOWS\system32>nslookup
Default Server:  192.168.1.1
Address:  192.168.1.1

> www.google.com
Server:  192.168.1.1
Address:  192.168.1.1

Non-authoritative answer:
Name:    www.google.com
Addresses:  2404:6800:4007:804::2004
          142.250.67.36

> www.youtube.com
Server:  192.168.1.1
Address:  192.168.1.1

Non-authoritative answer:
Name:    www.youtube.com
Addresses:  2404:6800:4007:821::200e
          2404:6800:4007:82d::200e
          2404:6800:4007:809::200e
          2404:6800:4007:820::200e
          142.250.193.174
          142.250.205.238
          172.217.31.206
          172.217.160.142
          142.250.71.14
          142.250.76.46
          142.250.195.78
          142.250.195.110
          142.250.195.142
          142.250.195.174
          142.250.182.78
          142.250.182.110
          142.250.182.142
          142.250.183.238
          142.250.193.110
          142.250.193.142
```

```
> www.twitter.com
Server:  192.168.1.1
Address:  192.168.1.1

Non-authoritative answer:
Name:    www.twitter.com
Addresses:  104.244.42.129
          104.244.42.65
          104.244.42.1
          104.244.42.193

> www.instagram.com
Server:  192.168.1.1
Address:  192.168.1.1

Non-authoritative answer:
Name:    z-p42-instagram.c10r.instagram.com
Addresses:  2a03:2880:f22f:e5:face:b00c:0:4420
          157.240.16.174
Aliases:  www.instagram.com
          geo-p42.instagram.com

> www.facebook.com
Server:  192.168.1.1
Address:  192.168.1.1

Non-authoritative answer:
Name:    star-mini.c10r.facebook.com
Addresses:  2a03:2880:f12f:83:face:b00c:0:25de
          157.240.16.35
Aliases:  www.facebook.com
```

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Laboratory 3: Initial Switch and Router Configurations Thursday, June 15, 2023

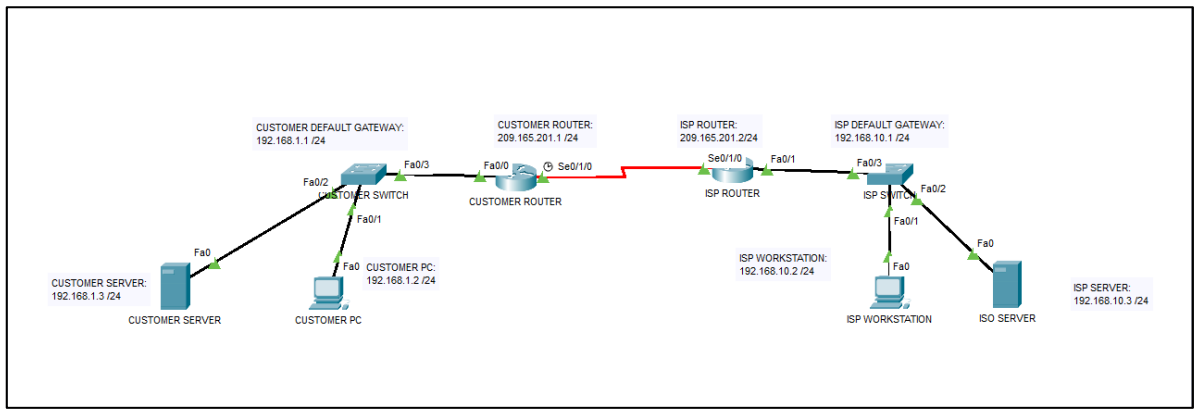
Design and Configure 2 different networks as Customer Network and ISP Network. Also mention the Router and Switch Name, Host Name, Interface Description, Banner, Both Console and Secret Password in Both Networks.

Note: Use the IP addresses as in the figure or you can use another IPs also. All the networking devices should communicate with each other.

Necessary Equipment's

2× 1841 Router's, 2× 2960-24TT Switches, 2× PC-PT's, 2× Server-PT's, 2× Connecting Cable Wires (Copper Straight Through, Serial, Console)

For Customer Network:	For ISP Network:
Router Name: Customer Router Host Name: Customer Router Password: Cisco123 Secret: Cisco@123 Switch Name: Customer Switch Host Name: Customer Switch Password: cisco123 Secret: cisco@123	Router Name: ISP Router Host Name: ISPRouter-SujalRT Password: rtsujal Secret: rt@sujal Switch Name: ISP Switch Host Name: ISPSwitch-SujalRT Password: sujalrt Secret: rtsujal@



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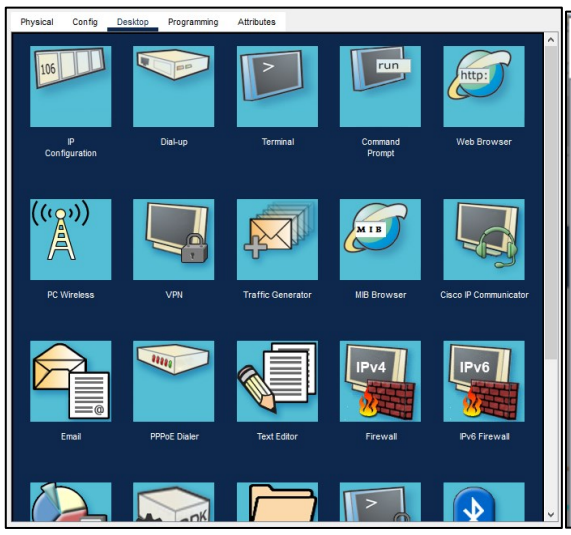
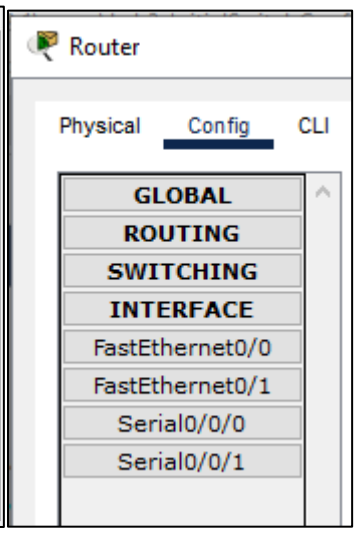
Procedure:

- Took 2 PC's, 2 switches, 2 server's, 2 router's
- Divided one of each device (network and end-user) to ISP and Customer sides
- Used copper straight through cable to connect end-user devices like pc and server to switch on both sides as well as switches to router
- Used serial cable to connect two routers, and console cable to connect pc directly to routers
- Managed the interfaces in the devices such as copper fast ethernet and serial ports.
- Manually entered the Static IP Addresses to each device on both networks
- Using IP Configuration on Desktop (GUI) PC and Server, Interface on Config Tab for Routers.
- Class C Private IPv4 on Customer Network (192.168.x.x) and Class C Public IPv4 on ISP Network
- Routers are connected with Class C PUBLIC IPv4 (209.165.20.x)
- Check internal connections and move on to IOS CLI of Switches and Routers.





Table

Customer Network:

Device	Port Interface	Cable	IP
Customer PC Customer Switch	Fa0 Fa0/1	Copper Straight-Through	192.168.1.2/24
Local Server	Fa0	Copper Straight-Through	192.168.1.3/24

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Customer Switch	Fa0/2		
Customer Switch Customer Router	Fa0/24 Fa0/0	Copper Straight-Through	192.168.1.1/24 (Default Gateway)

ISP Network:

Device	Port Interface	Cable	IP
ISP Workstation ISP Switch	Fa0 Fa0/1	Copper Straight-Through	192.168.10.2/24
ISP Server ISP Switch	Fa0 Fa0/2	Copper Straight-Through	192.168.10.3/24
ISP Switch ISP Router	Fa0/24 Fa0/0	Copper Straight-Through	192.168.10.1/24 (Default Gateway)

Router:

Device	Port Interface	Cable	IP
ISP Router Customer Router	Se0/0/0 Se0/0/0	Serial DCE Serial DTE	209.165.201.2 209.165.201.1

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IOS CLI

Customer Switch

```
Switch>enable

Switch#configure terminal

Switch(config)#hostname CustomerSwitch

CustomerSwitch(config)#banner motd $ !!! ONLY
AUTHORIZED USERS ARE ALLOWED !!! $

CustomerSwitch(config)#line con 0

CustomerSwitch(config-line)#password cisco123

CustomerSwitch(config-line)#login

CustomerSwitch(config-line)#exit

CustomerSwitch(config)#enable secret cisco@123

CustomerSwitch(config)#exit

CustomerSwitch#copy run startup-config
```

Customer Switch

```
Router>enable

Router#show running-config

Router#show startup-config

Router#configure terminal

Router(config)#hostname CustomerRouter

CustomerRouter(config)#banner motd $ !!! ONLY
AUTHORIZED USERS ARE ALLOWED !!! $

CustomerRouter(config)#lin con 0

CustomerRouter(config-line)#password Cisco123
```

```
CustomerRouter(config-line)#login

CustomerRouter(config-line)#exit

CustomerRouter(config)#enable secret Cisco@123

CustomerRouter(config)#exit

CustomerRouter#exit
```

ISP Switch

```
Switch>enable

Switch#configure terminal

Switch(config)#hostname ISPSwitch-SujalRT

ISPSwitch-SujalRT (config)#banner motd $ !!! UNAUTHORIZED
ACCESS IS PROHIBITED !!! $

ISPSwitch-SujalRT (config)#line con 0

ISPSwitch-SujalRT (config-line)#password sujalrt

ISPSwitch-SujalRT (config-line)#login

ISPSwitch-SujalRT (config-line)#exit

ISPSwitch-SujalRT (config)#enable secret rtsujal@

ISPSwitch-SujalRT (config)#exit

ISPSwitch-SujalRT#exit

ISPSwitch-SujalRT#copy run startup-config
```

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ISP Router

```
Router>enable

Router#show running-config

Router#show startup-config

Router#configure terminal

Router(config)#hostname ISPRouter-SujalRT

ISPRouter-SujalRT(config)#banner motd $ !!! UNAUTHORIZED
ACCESS IS PROHIBITED !!! $

ISPRouter-SujalRT (config)#line con 0

ISPRouter-SujalRT (config-line)#password rtsujal

ISPRouter-SujalRT (config-line)#login

ISPRouter-SujalRT (config-line)#exit

ISPRouter-SujalRT (config)#enable secret rt@sujal

ISPRouter-SujalRT (config)#exit

ISPRouter-SujalRT#exit
```

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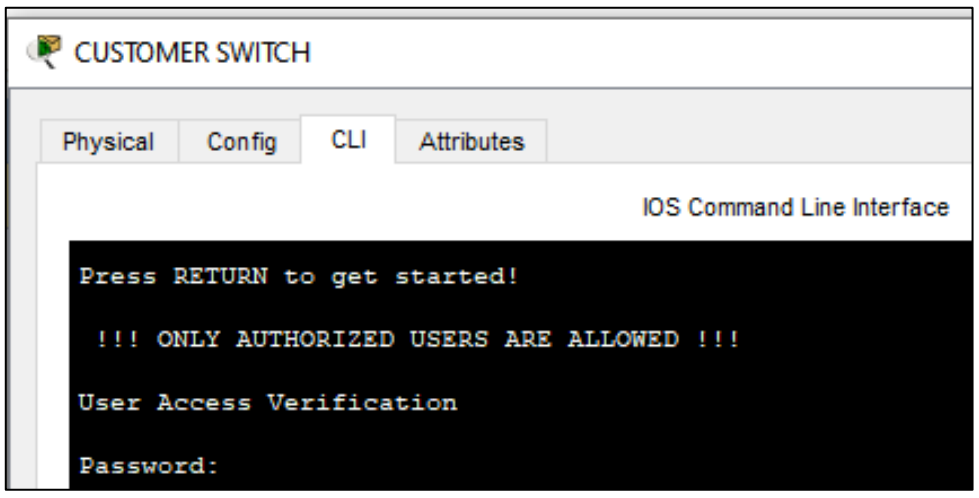

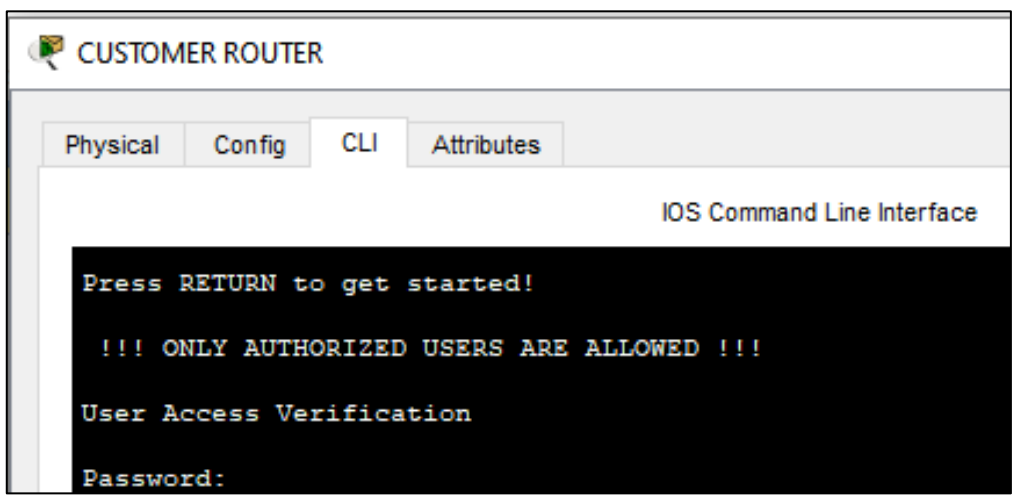

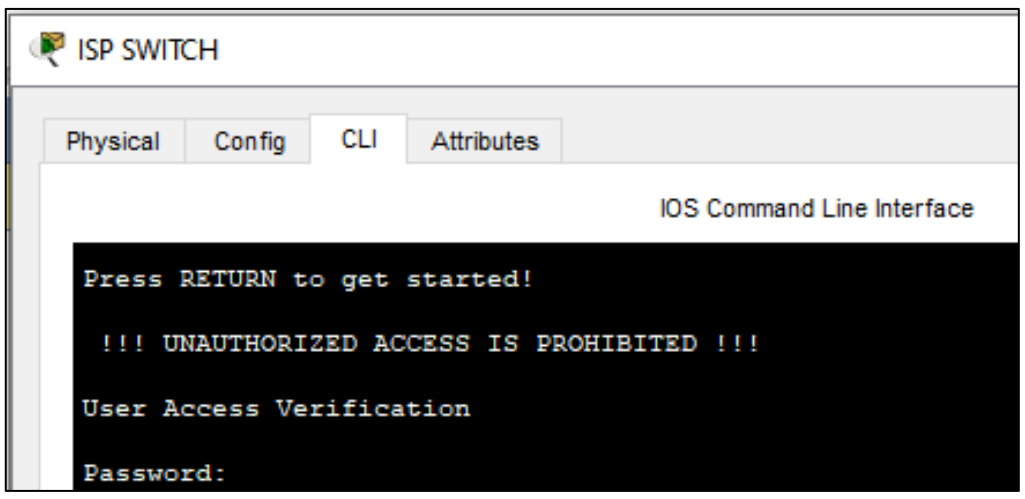

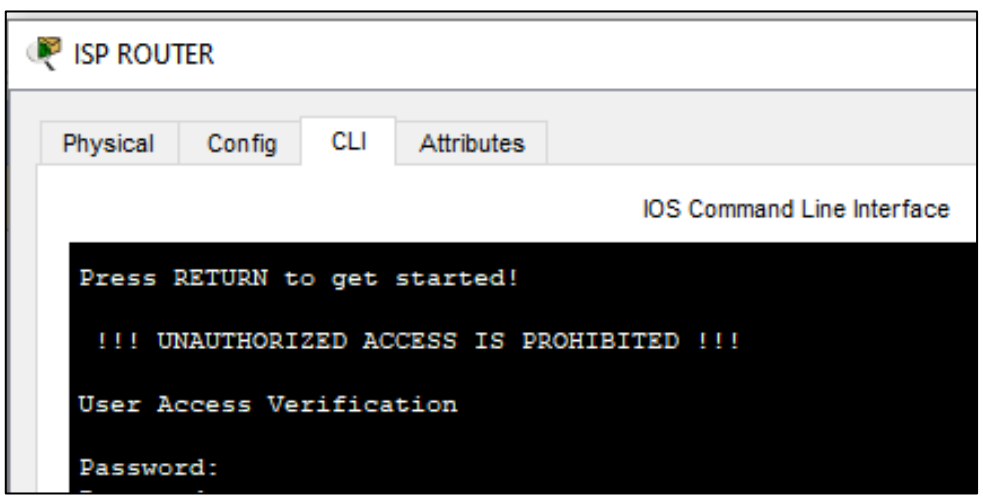

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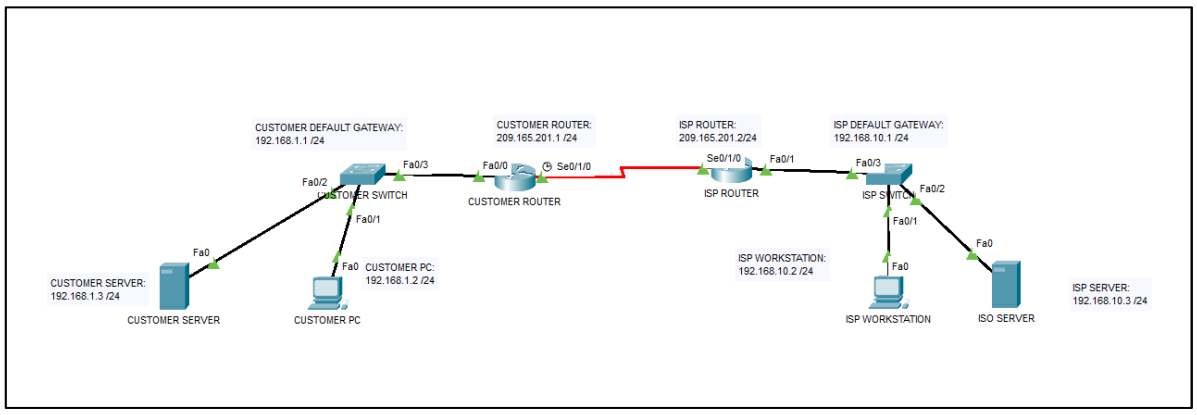
Laboratory 4: LAN & MAN Communication Thursday, June 15, 2023

Design a MAN network with two different LAN network and PCs of one network able to share data to another network.

Necessary Equipment's

2× 1841 Router's, 2× 2960-24TT Switches, 2× PC-PT's, 2× Server-PT's, 2× Connecting Cable Wires (Copper Straight Through, Serial DTE, Console)



Procedure:

- Took 2 PC's, 2 switches, 2 server's, 2 router's
- Divided one of each device (network and end-user) to ISP and Customer sides
- Used copper straight through cable to connect end-user devices like pc and server to switch on both sides as well as switches to router
- Used serial cable to connect two routers, and console cable to connect pc directly to routers
- Managed the interfaces in the devices such as copper fast ethernet and serial ports.
- Manually entered the Static IP Addresses to each device on both networks
- Using IP Configuration on Desktop (GUI) PC and Server, Interface on Config Tab for Routers.
- Class C Private IPv4 on Customer Network (192.168.x.x) and Class C Public IPv4 on ISP Network
- Routers are connected with Class C PUBLIC IPv4 (209.165.20.x)
- Then servers are opened and then the services were configured.

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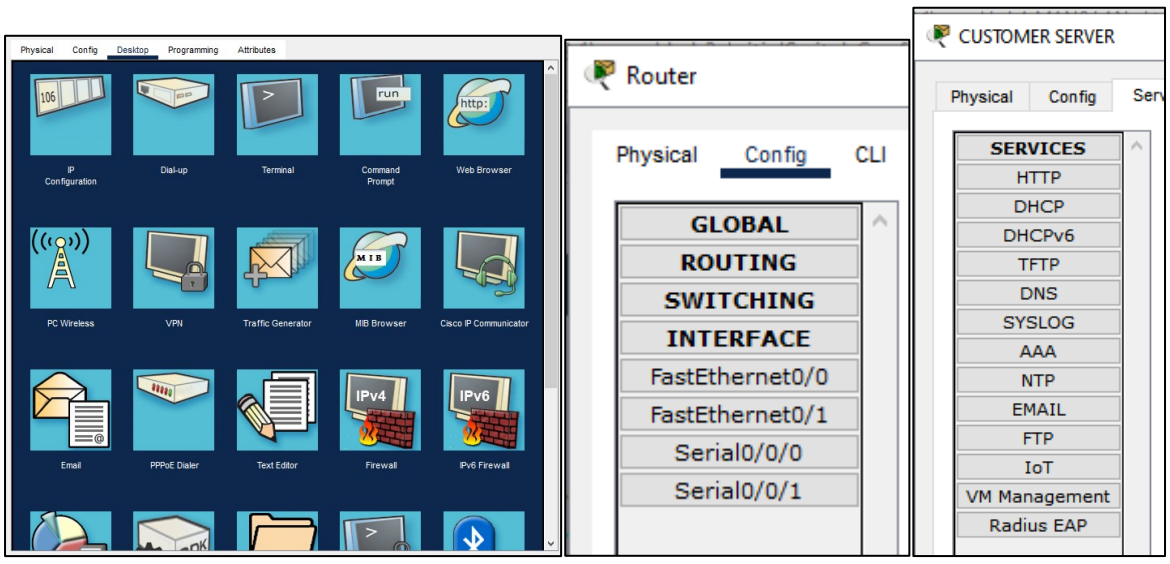

Table

Customer Network:

Device	Port Interface	Cable	IP
Customer PC Customer Switch	Fa0 Fa0/1	Copper Straight-Through	192.168.1.2/24
Local Server Customer Switch	Fa0 Fa0/2	Copper Straight-Through	192.168.1.3/24
Customer Switch Customer Router	Fa0/24 Fa0/0	Copper Straight-Through	192.168.1.1/24 (Default Gateway)

ISP Network:

Device	Port Interface	Cable	IP
ISP Workstation ISP Switch	Fa0 Fa0/1	Copper Straight-Through	192.168.10.2/24
ISP Server ISP Switch	Fa0 Fa0/2	Copper Straight-Through	192.168.10.3/24
ISP Switch ISP Router	Fa0/24 Fa0/0	Copper Straight-Through	192.168.10.1/24 (Default Gateway)

Router:

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Device	Port Interface	Cable	IP
ISP Router	Se0/0/0	Serial DCE	10.10.10.10/8
Customer Router	Se0/0/0	Serial DTE	

PDU

PDU List Window

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num
	Successful	CUSTOMER PC	CUSTOMER SERVER	ICMP		0.000	N	0
	Successful	CUSTOMER PC	CUSTOMER ROUTER	ICMP		0.000	N	1
	Successful	CUSTOMER SERVER	CUSTOMER ROUTER	ICMP		0.000	N	2
	Successful	ISP WORKSTATION	ISO SERVER	ICMP		0.000	N	3
	Successful	ISP WORKSTATION	ISP ROUTER	ICMP		0.000	N	4
	Successful	ISO SERVER	ISP ROUTER	ICMP		0.000	N	5
	Successful	CUSTOMER PC	ISP WORKSTATION	ICMP		0.000	N	6
	Successful	CUSTOMER PC	ISO SERVER	ICMP		0.000	N	7
	Successful	CUSTOMER SERVER	ISP WORKSTATION	ICMP		0.000	N	8
	Successful	CUSTOMER SERVER	ISO SERVER	ICMP		0.000	N	9
	Successful	ISP WORKSTATION	CUSTOMER PC	ICMP		0.000	N	10
	Successful	ISP WORKSTATION	CUSTOMER SERVER	ICMP		0.000	N	11
	Successful	ISO SERVER	CUSTOMER PC	ICMP		0.000	N	12
	Successful	ISO SERVER	CUSTOMER SERVER	ICMP		0.000	N	13

PING

```
C:\>ping 192.168.10.2

Pinging 192.168.10.2 with 32 bytes of data:

Request timed out.
Reply from 192.168.10.2: bytes=32 time=1ms TTL=126
Reply from 192.168.10.2: bytes=32 time=20ms TTL=126
Reply from 192.168.10.2: bytes=32 time=18ms TTL=126

Ping statistics for 192.168.10.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 20ms, Average = 13ms

C:\>ping 192.168.10.3

Pinging 192.168.10.3 with 32 bytes of data:

Request timed out.
Reply from 192.168.10.3: bytes=32 time=1ms TTL=126
Reply from 192.168.10.3: bytes=32 time=1ms TTL=126
Reply from 192.168.10.3: bytes=32 time=1ms TTL=126

Ping statistics for 192.168.10.3:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 1ms, Average = 1ms
```

FTP

FTP

Service On Off

User Setup

Username Password

Write Read Delete Rename List

	Username	Password	Permission
1	cisco	cisco	RWDNL
2	sujalrt	sujal@r&t$	RWDNL

Add Save Remove

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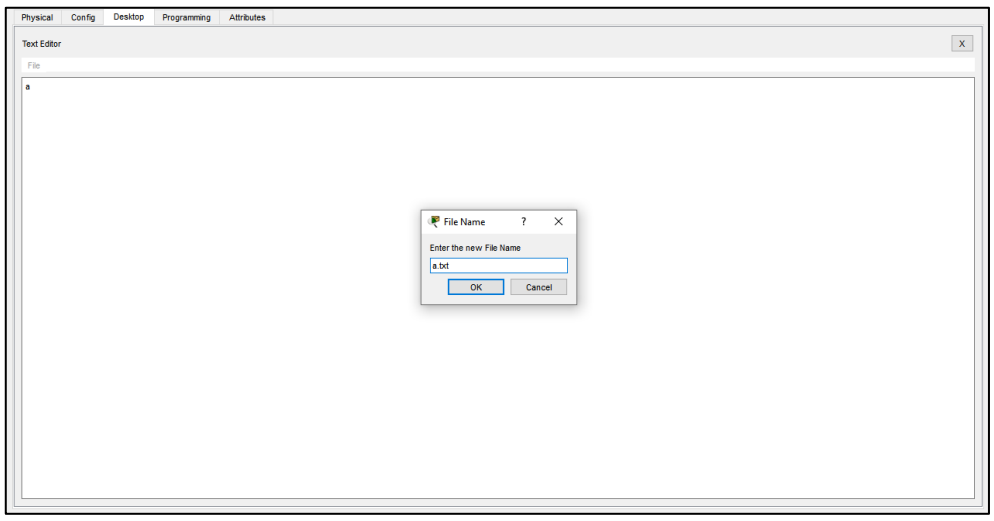

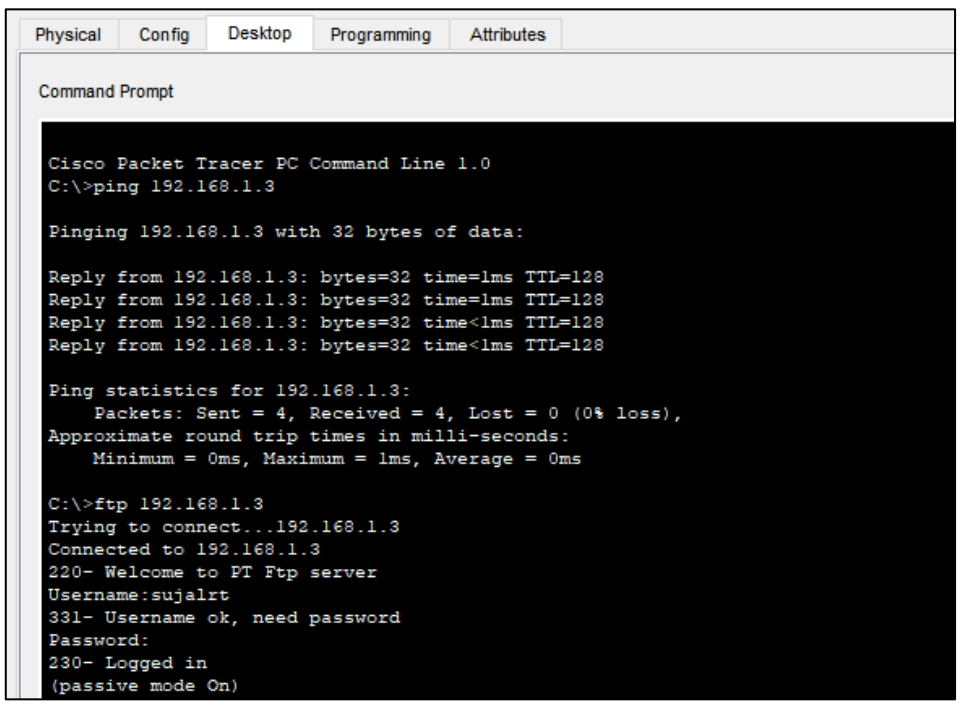

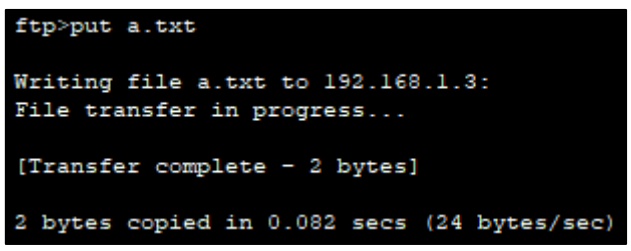

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```
ftp>dir

Listing /ftp directory from 192.168.1.3:
0    : a.txt                                        2
1    : asa842-k8.bin                                5571584
2    : asa923-k8.bin                                30468096
3    : c1841-advipservicesk9-mz.124-15.T1.bin       33591768
4    : c1841-ipbase-mz.123-14.T7.bin                13832032
5    : c1841-ipbasek9-mz.124-12.bin                 16599160
6    : c1900-universalk9-mz.SPA.155-3.M4a.bin       33591768
7    : c2600-advipservicesk9-mz.124-15.T1.bin       33591768
8    : c2600-i-mz.122-28.bin                        5571584
9    : c2600-ipbasek9-mz.124-8.bin                  13169700
10   : c2800nm-advipservicesk9-mz.124-15.T1.bin     50938004
11   : c2800nm-advipservicesk9-mz.151-4.M4.bin      33591768
12   : c2800nm-ipbase-mz.123-14.T7.bin              5571584
13   : c2800nm-ipbasek9-mz.124-8.bin                15522644
14   : c2900-universalk9-mz.SPA.155-3.M4a.bin       33591768
15   : c2950-i6q412-mz.121-22.EA4.bin               3058048
16   : c2950-i6q412-mz.121-22.EA8.bin               3117390
17   : c2960-lanbase-mz.122-25.FX.bin               4414921
18   : c2960-lanbase-mz.122-25.SEE1.bin             4670455
19   : c2960-lanbasek9-mz.150-2.SE4.bin             4670455
20   : c3560-advipservicesk9-mz.122-37.SE1.bin      8662192
21   : c3560-advipservicesk9-mz.122-46.SE.bin       10713279
22   : c800-universalk9-mz.SPA.152-4.M4.bin         33591768
23   : c800-universalk9-mz.SPA.154-3.M6a.bin        83029236
24   : cat3k_caa-universalk9.16.03.02.SPA.bin       505532849
25   : cgr1000-universalk9-mz.SPA.154-2.CG          159487552
26   : cgr1000-universalk9-mz.SPA.156-3.CG          184530138
27   : ir800-universalk9-bundle.SPA.156-3.M.bin     160968869
28   : ir800-universalk9-mz.SPA.155-3.M             61750062
29   : ir800-universalk9-mz.SPA.156-3.M             63753767
30   : ir800_yocto-1.7.2.tar                        2877440
31   : ir800_yocto-1.7.2_python-2.7.3.tar           6912000
32   : pt1000-i-mz.122-28.bin                       5571584
33   : pt3000-i6q4l2-mz.121-22.EA4.bin              3117390
```

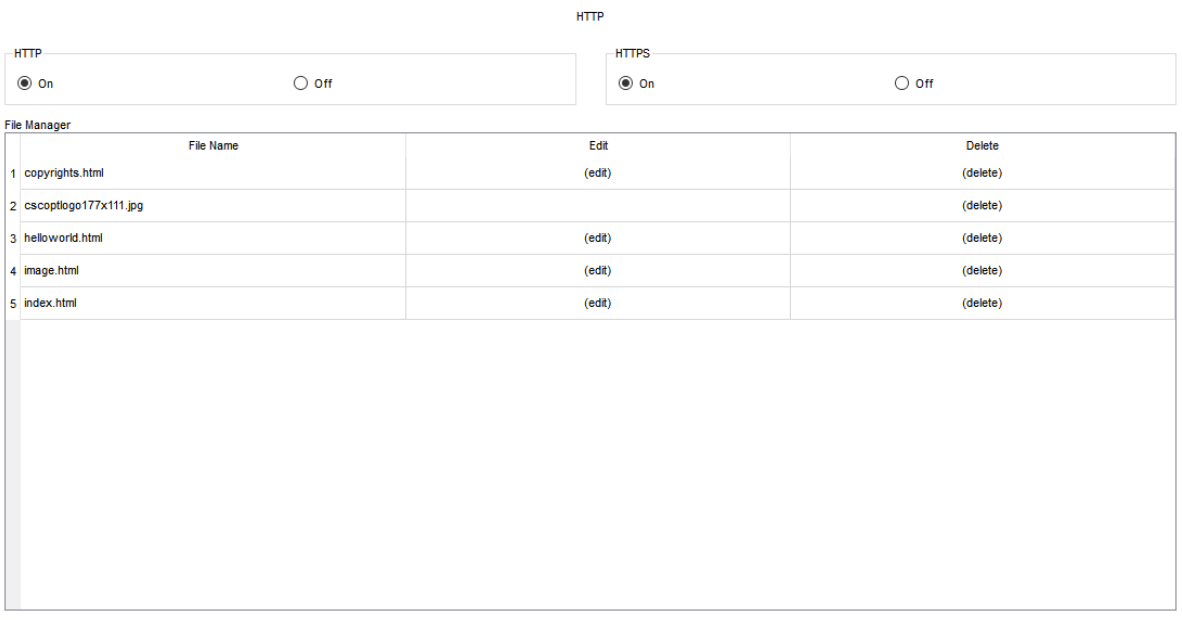
```
ftp>get a.txt

Reading file a.txt from 192.168.1.3:
File transfer in progress...

[Transfer complete - 2 bytes]

2 bytes copied in 0.001 secs (2000 bytes/sec)
ftp>
```

HTTP



DNS

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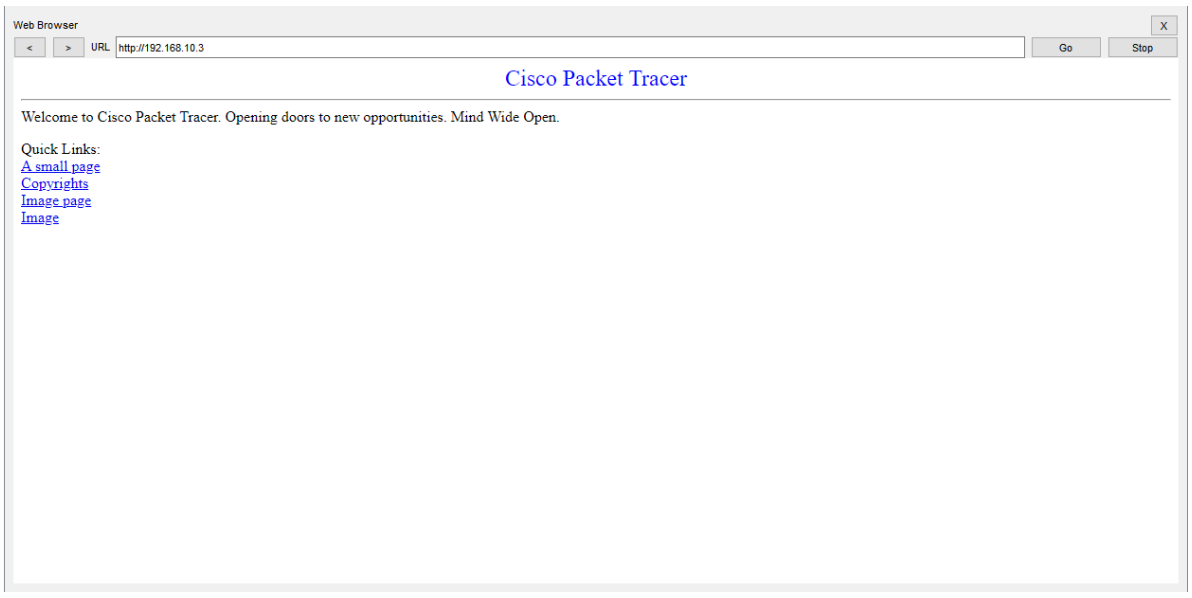
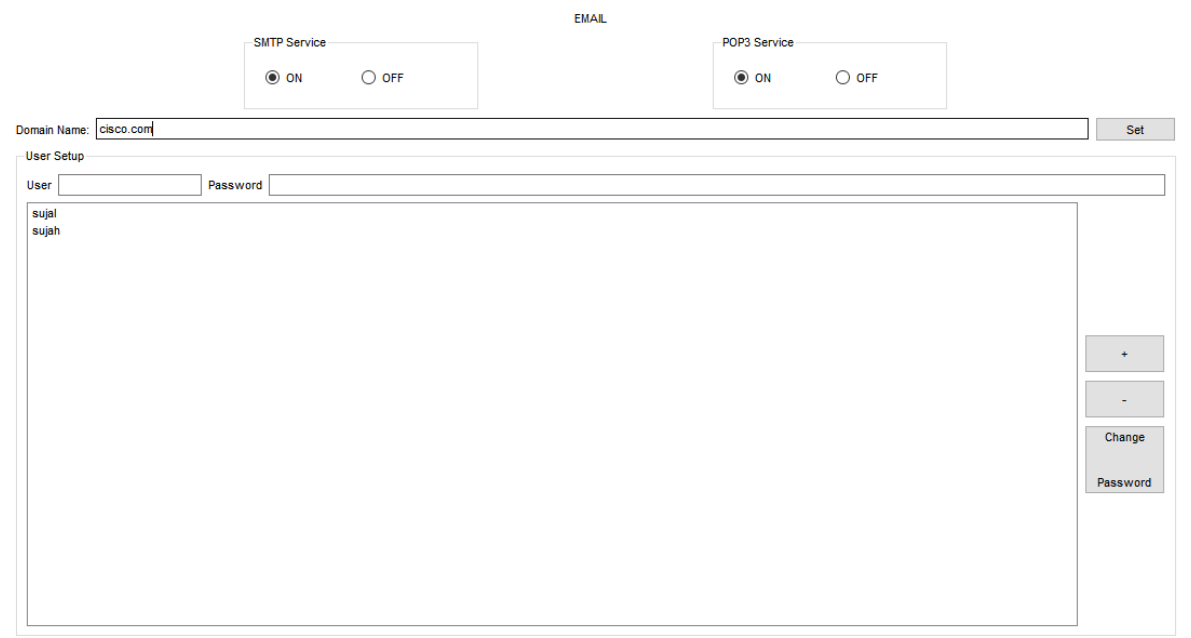
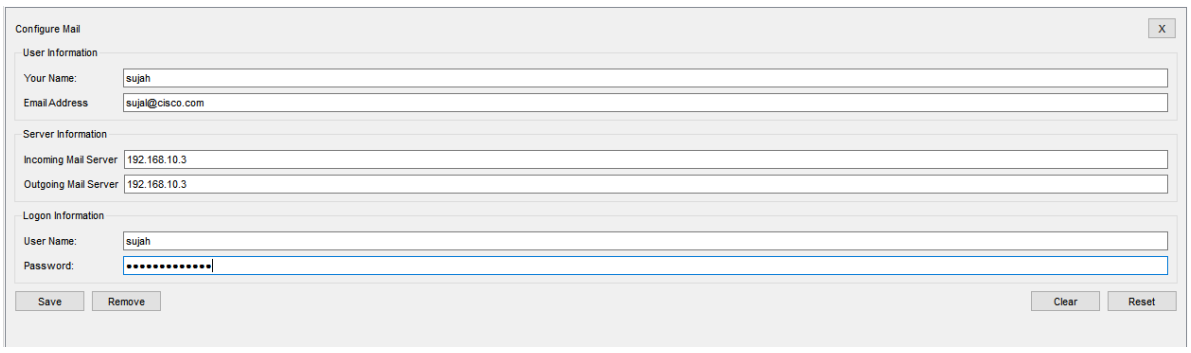
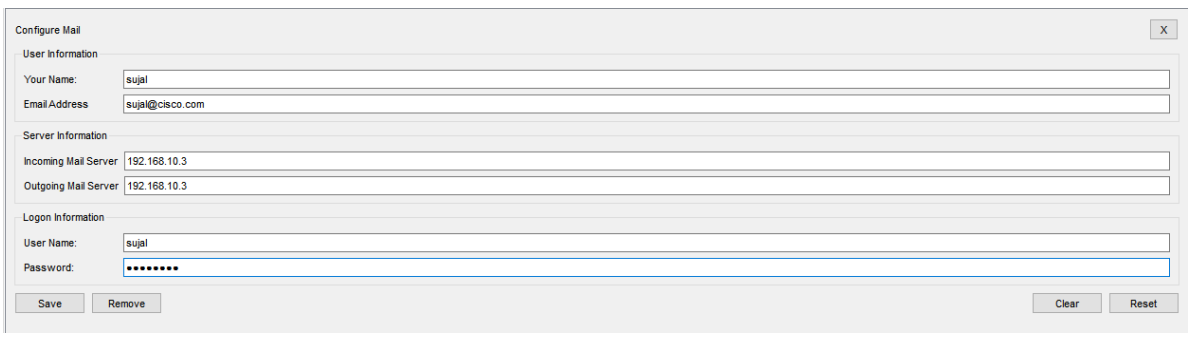


EMAIL







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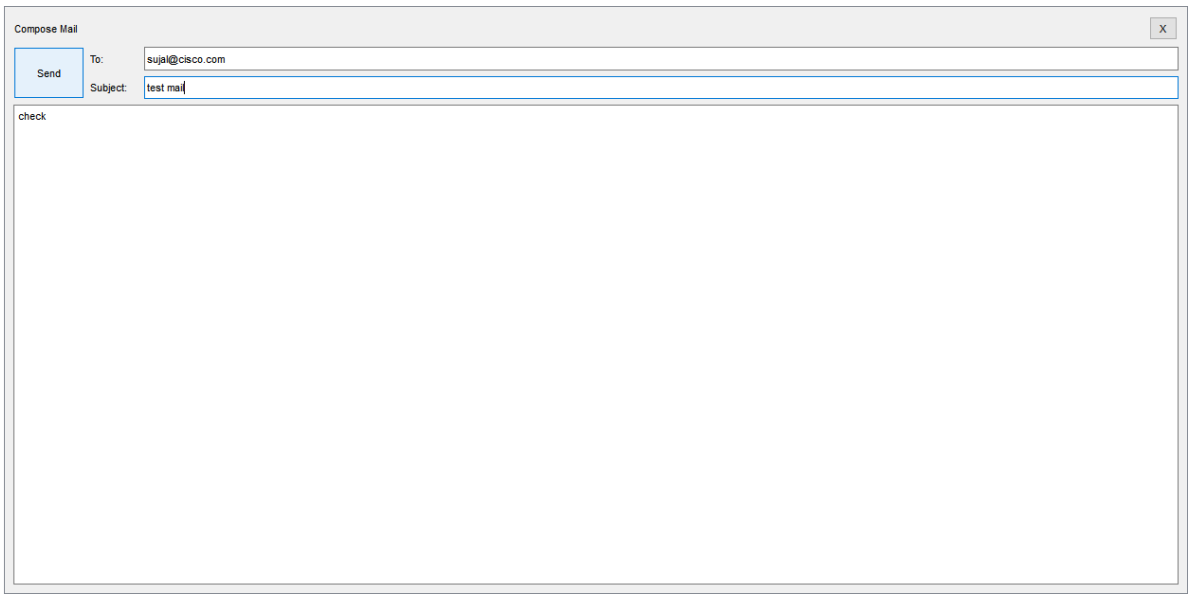

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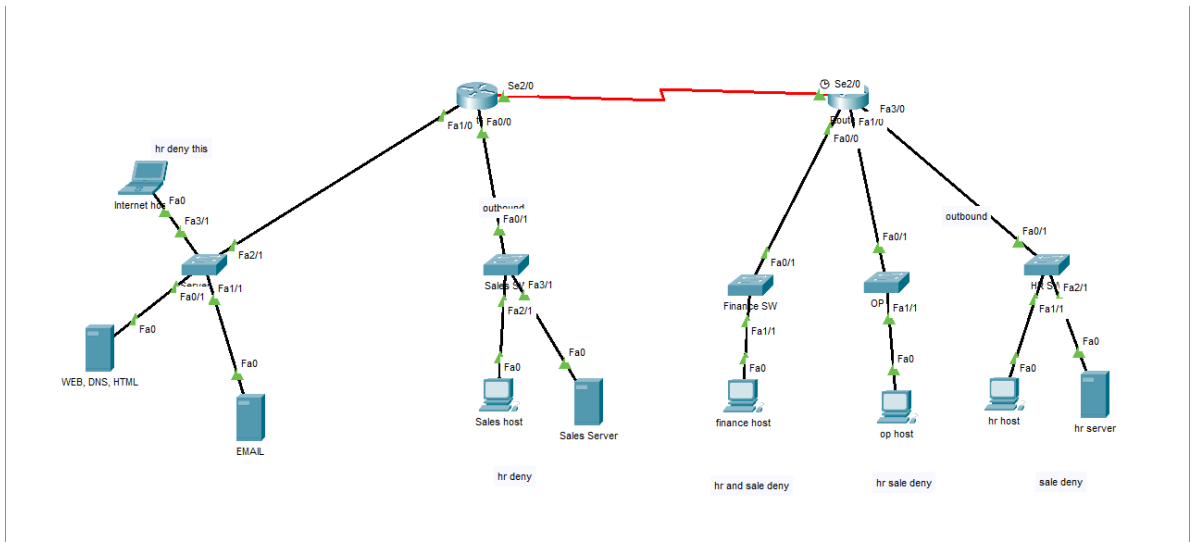
Laboratory 5: WEB/DNS & ACL Friday, July 28, 2023

Design a network where one should be able to access Web server (192.168.0.1) using the browser. Also, following access control criteria should be fulfilled.

- Internet Host should be able to ping any device in the network, except HR1 or HR server.
- Internet Host should be able to access Web server (192.168.0.3) using the browser.
- Internet Host should not be able to access either the HR server (192.168.40.1) or Sales server (192.168.10.2) using the browser.
- HR2 should be able to access HR server (192.168.40.1) using ping or the browser.
- RandD2 should not be able to access HR server (192.168.40.1) using ping or the browser.

Necessary Equipment's

Router's and 5 Switch's, Cluster (made by 2 Routers), PC's and 4 Server's 20, Connecting Wires (Copper Straight-Through, Copper Cross-Over and Serial DTE)



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device	name	int	ip	cable
Server switch	Web, http, dns Server	Fa0 Fa0/1	192.168.0.1/24	Straight through
Server switch	ftp, email server	Fa0 Fa1/1	192.168.0.2/24	Straight thorugh
Switch router	Server Sales server	Fa2/1 Fa1/0	192.168.0.254/24	Straight through
Pc switch	Sales sales	Fa0 Fa2/1	192.168.1.1/24	Straight through
Server switch	Sales sales	Fa0 Fa3/1	192.168.1.2/24	Straight thorugh
Switch router	Sales Sales server	Fa0/1 Fa0/0	192.168.1.254/24	Straight through
Pc switch	Finance host finance	Fa0 Fa1/1	192.168.2.1/24	Straight through
Pc switch	Op op	Fa0 Fa1/1	192.168.3.1/24	Straight thorugh
Pc switch	Hr Hr	Fa0 Fa1/1	192.168.4.1/24	Straight through
Server switch	Hr hr	Fa0 Fa2/1	192.168.4.2/24	Straight through
Switch router	Fin Fin	Fa0/1 Fa0/0	192.168.2.254/24	Straight through

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Switch router	Op Op	Fa0/1 Fa1/0	192.168.3.254/24	Straight through
Switch router	Hr hr	Fa0/1 Fa3/0	192.168.4.254/24	Straight through
Router router	Rtr1 Rtr2	Se2/0 Se2/0	192.168.5.1/30 192.168.5.2/30	serial

Iso cli

Interface

```
Router>enable

Router#configure terminal

Router(config)#interface FastEthernet0/0

Router(config-if)#no shutdown

Router(config-if)#ip address 192.168.1.254 255.255.255.0

Router(config-if)#exit

Router(config)#interface FastEthernet1/0

Router(config-if)#no shutdown

Router(config-if)#ip address 192.168.0.254 255.255.255.0

Router(config-if)#exit

Router(config)#interface Serial2/0

Router(config-if)#no shutdown

Router(config-if)#ip address 192.168.5.1 255.255.255.252

Router(config-if)#exit
```

```
Router>enable

Router#configure terminal

Router(config)#interface FastEthernet0/0

Router(config-if)#no shutdown

Router(config-if)#ip address 192.168.2.254 255.255.255.0

Router(config-if)#exit

Router(config)#interface FastEthernet1/0

Router(config-if)#ip address 192.168.3.254 255.255.255.0

Router(config-if)#no shutdown

Router(config-if)#exit

Router(config)#interface Serial2/0

Router(config-if)#no shutdown

Router(config-if)#ip address 192.168.5.2 255.255.255.252

Router(config-if)#exit

Router(config)#interface FastEthernet3/0

Router(config-if)#no shutdown

Router(config-if)#ip address 192.168.4.254 255.255.255.0

Router(config-if)#exit
```

Routing protocal

```
Router(config)#router rip

Router(config-router)#network 192.168.0.0

Router(config-router)#network 192.168.1.0

Router(config-router)#network 192.168.2.0
```

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```
Router(config-router)#network 192.168.3.0

Router(config-router)#network 192.168.4.0

Router(config-router)#network 192.168.5.0

Router(config-router)#end

Router#configure terminal

Router(config)#ip route 192.168.2.0 255.255.255.0 192.168.5.2

Router(config)#ip route 192.168.3.0 255.255.255.0 192.168.5.2

Router(config)#ip route 192.168.4.0 255.255.255.0 192.168.5.2

Router(config)#ip route 192.168.1.0 255.255.255.0 192.168.5.2

Router(config)#ip route 192.168.0.0 255.255.255.0 192.168.5.2



Router(config)#router rip

Router(config-router)#network 192.168.0.0

Router(config-router)#network 192.168.1.0

Router(config-router)#network 192.168.2.0

Router(config-router)#network 192.168.3.0

Router(config-router)#network 192.168.4.0

Router(config-router)#network 192.168.5.0

Router(config-router)#end

Router#configure terminal

Router(config)#ip route 192.168.2.0 255.255.255.0 192.168.5.1

Router(config)#ip route 192.168.3.0 255.255.255.0 192.168.5.1

Router(config)#ip route 192.168.4.0 255.255.255.0 192.168.5.1
```

```
Router(config)#ip route 192.168.1.0 255.255.255.0 192.168.5.1

Router(config)#ip route 192.168.0.0 255.255.255.0 192.168.5.1
```

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ACL

Create the access list (standard or extended)

Apply to interface (inbound or outbound)

Standard acl (1-99) – closest to the destination, Denies or permits source ip address

Extended acl (100-199) – closest to the source, denies or permit source or destination p address, port (service)

```
Router>en

Router#conf t

Router(config)#hostname R2

R2(config)#access-list 1 deny 192.168.0.3 0.0.0.0

R2(config)#access-list 1 permit any

R2(config)#int fa3/0

R2(config-if)#ip access-group 1 out
```

```
Router>en

Router#conf t

Router(config)#hostname R1

R1(config)#access-list 3 deny 192.168.0.3 0.0.0.0

R1(config)#access-list 3 permit any

R1(config)#int fa0/0

R1(config-if)#ip access-group 3 out
```

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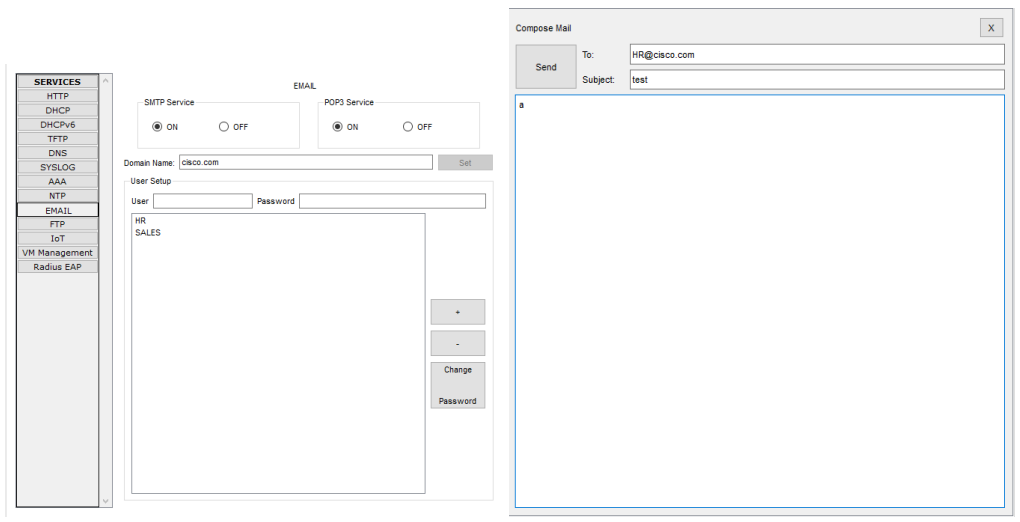
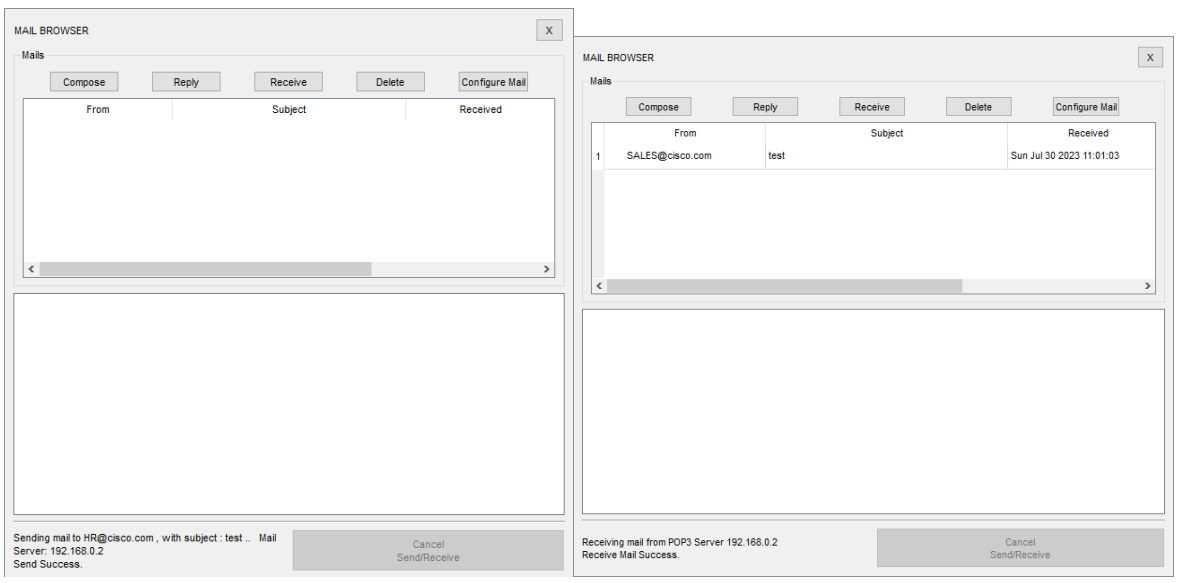
Before and after acl

```
Cisco Packet Tracer PC Command Line 1.0
C:\>192.168.4.2
Invalid Command.

C:\>ping 192.168.4.2

Pinging 192.168.4.2 with 32 bytes of data:

Reply from 192.168.5.2: Destination host unreachable.
Reply from 192.168.5.2: Destination host unreachable.
Reply from 192.168.5.2: Destination host unreachable.
Reply from 192.168.5.2: Destination host unreachable.

Ping statistics for 192.168.4.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>ping 192.168.1.1

Pinging 192.168.1.1 with 32 bytes of data:

Reply from 192.168.1.1: bytes=32 time<1ms TTL=127
Reply from 192.168.1.1: bytes=32 time<1ms TTL=127
Reply from 192.168.1.1: bytes=32 time<1ms TTL=127
Reply from 192.168.1.1: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.1.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

```
C:\>ping 192.168.2.1

Pinging 192.168.2.1 with 32 bytes of data:

Request timed out.
Reply from 192.168.2.1: bytes=32 time=5ms TTL=126
Reply from 192.168.2.1: bytes=32 time=1ms TTL=126
Reply from 192.168.2.1: bytes=32 time=1ms TTL=126

Ping statistics for 192.168.2.1:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 5ms, Average = 2ms

C:\>ping 192.168.2.2

Pinging 192.168.2.2 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 192.168.2.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Showing working if server





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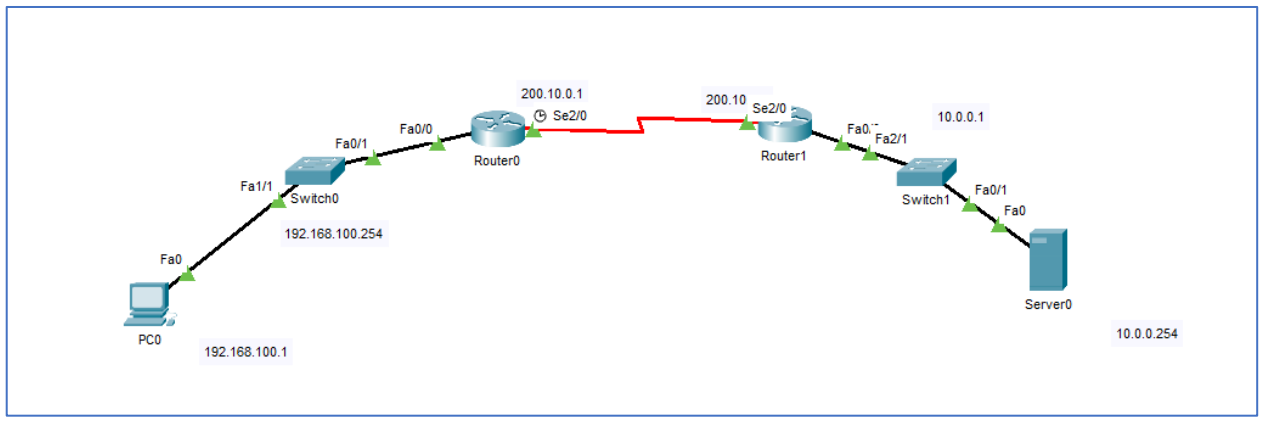
Laboratory 6: Network and Port Address Translation Friday, July 28, 2023

Design a network to send an HTTP request from an inside host to an outside web server to examine NAT (Network Address Translation). While designing the topology, we should be able to browse the Servers using URL addresses of Servers. Also, observe static and dynamic routing.

Necessary Equipment's

Routers and Switch's, PC's and Server's (HTTP and DNS Servers), Connecting Wires (Copper Straight-Through and Serial DTE)




```
Router>enable

Router#configure terminal

Router(config)#interface FastEthernet0/0

Router(config-if)#no shutdown

Router(config-if)#ip address 192.168.100.254 255.255.255.0

Router(config-if)#exit

Router(config)#interface Serial2/0

Router(config-if)#no shutdown

Router(config-if)#ip address 200.10.0.1 255.255.255.0

Router(config-if)#clock rate 64000



Router>enable

Router#configure terminal
```

```
Router(config)#interface Serial2/0

Router(config-if)#no shutdown

Router(config-if)#ip address 200.10.0.2 255.255.255.0

Router(config-if)#exit

Router(config)#interface FastEthernet0/0

Router(config-if)#ip address 10.0.0.1 255.0.0.0

Router(config-if)#no shutdown

Router(config-if)#ip route 0.0.0.0 0.0.0.0 s2/0



Router(config)#ip nat inside source static 10.0.0.254 200.10.0.2

Router(config)#int s2/0

Router(config-if)#ip nat outside

Router(config-if)#int fa0/0

Router(config-if)#ip nat inside



Router>en

Router#conf t

Router(config)#access-list 1 permit 192.168.100.0 0.0.0.255

Router(config)#ip nat inside source list 1 interface s2/0 overload

Router(config)#int se2/0

Router(config-if)#ip nat outside

Router(config-if)#int fa0/0

Router(config-if)#ip nat inside
```

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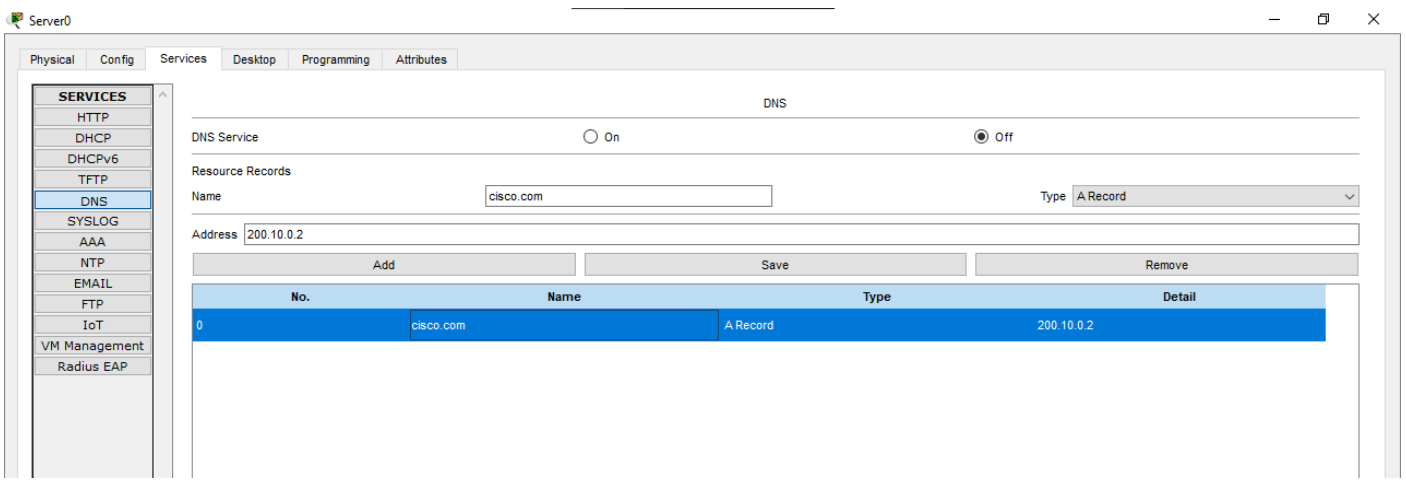
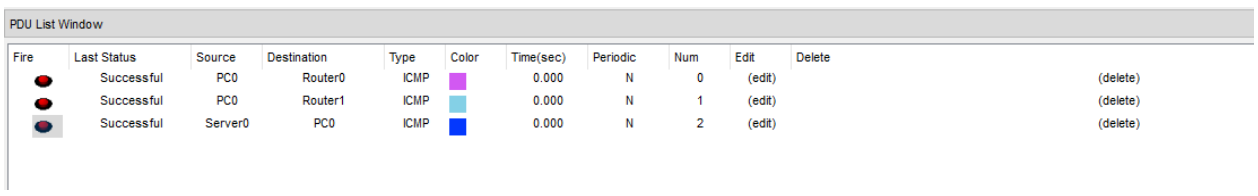
```
Router#copy run start
```

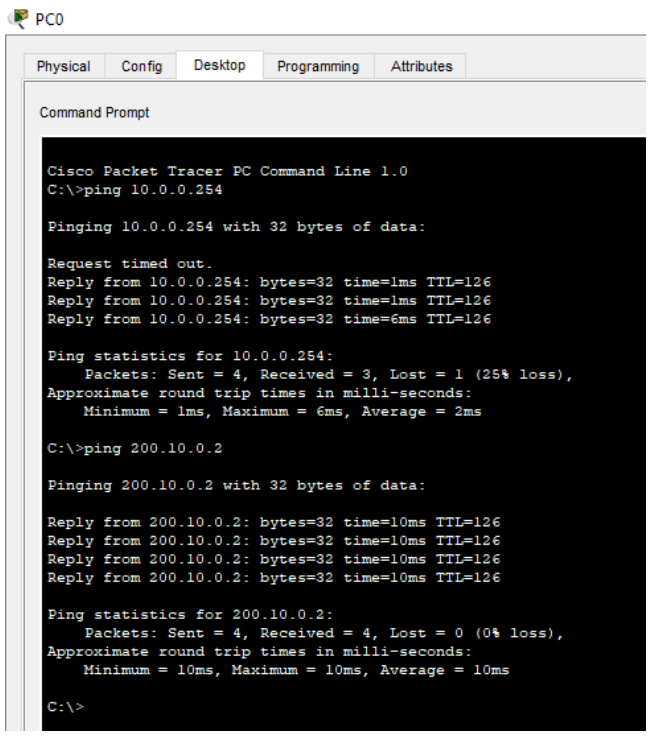
Dns



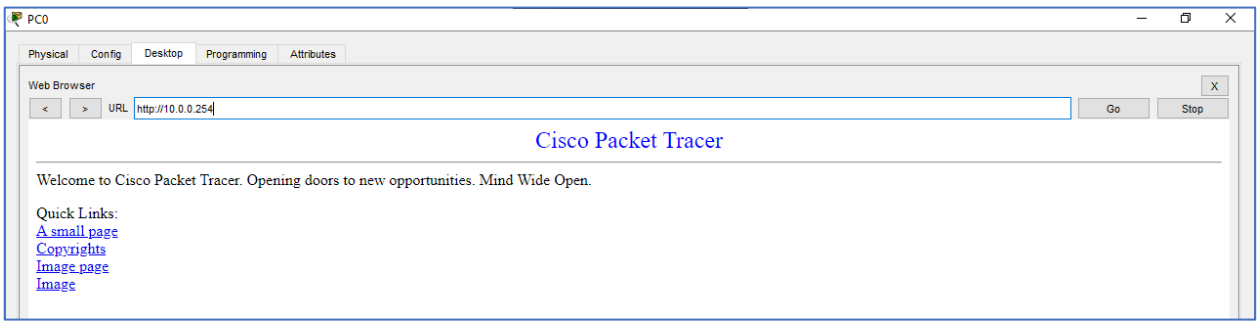
pdu



Before and after nat



Static nat



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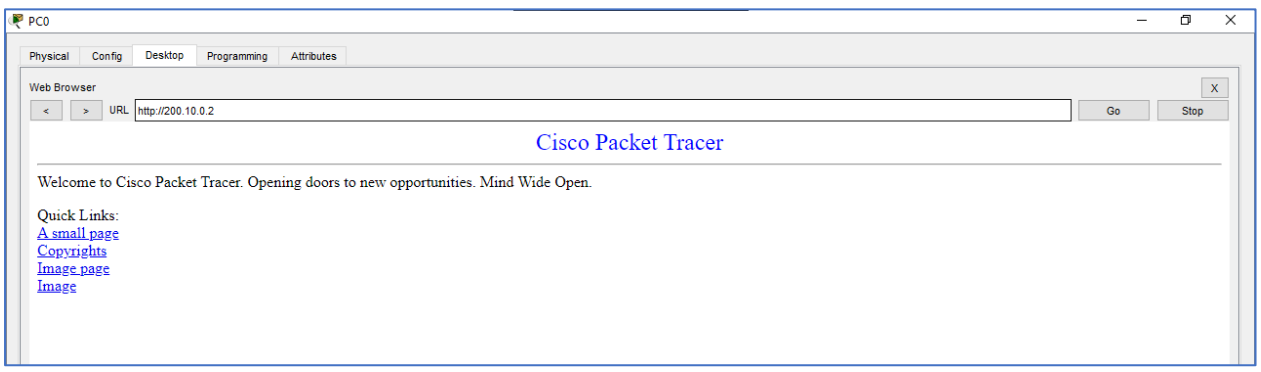
Hide lan



Translation check

```
Router#show ip nat translations
Pro  Inside global     Inside local       Outside local      Outside global
---  200.10.0.2        10.0.0.254         ---                ---
tcp 200.10.0.2:80      10.0.0.254:80      192.168.100.1:1027 192.168.100.1:1027
```

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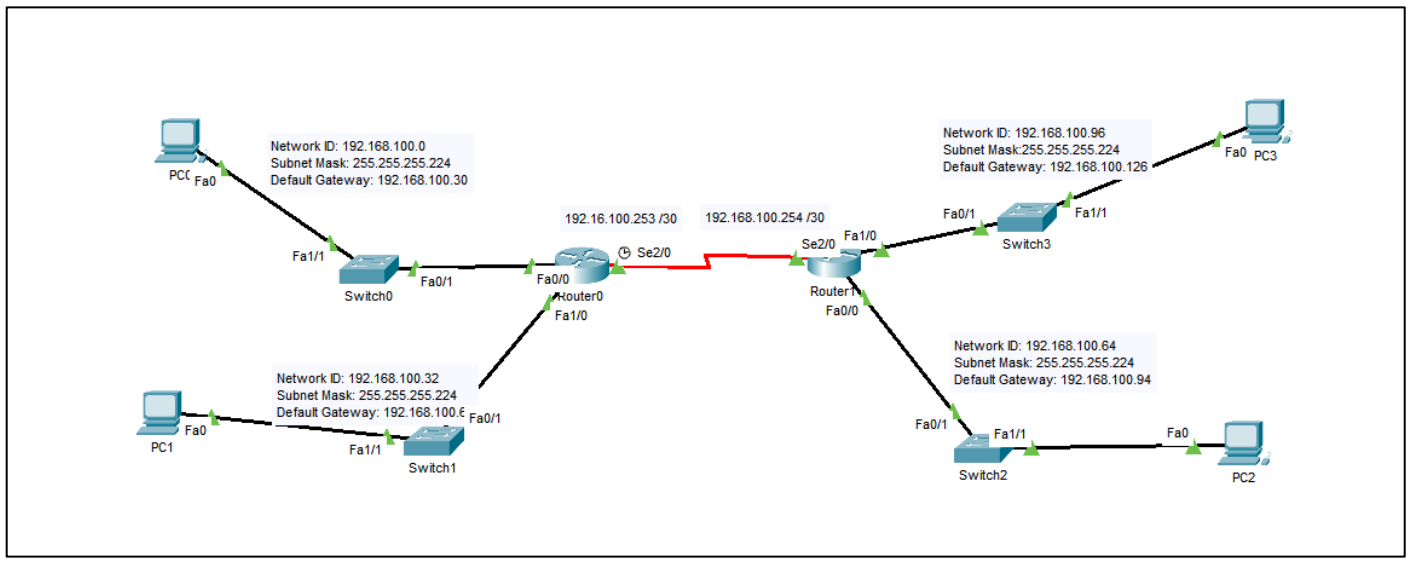
Laboratory 10: Acquired Network Subnet LAN Connectivity Sunday, 23 July, 2023

Design an IP addressing scheme and assign IP Addresses to Network Devices and Verify Connectivity in below network. Given the network address of 192.168.100.0/24 to subnet and provide the IP addressing for the network shown in the topology. Each LAN in the network requires enough space for, at least, 25 addresses for end devices, the switch and the router. The connection between R1 to R2 will require an IP address for each end of the link.



Before Subnet:

Short IP Address:	192.168.100.0 /24
Binary ID:	11000000101010000110010000000000
IP Class:	C
CIDR Notation:	/24
IP Type:	Private
Subnet Mask:	255.255.255.0
Binary Subnet Mask:	11111111.11111111.11111111.00000000
Network Address:	192.168.100.0
Usable Host IP Range:	192.168.100.1 - 192.168.100.254
Broadcast Address:	192.168.100.255
Total Number of Hosts:	256
Number of Usable Hosts:	254

Wildcard Mask:	0.0.0.255

After Subnet:

For Each LAN

Short IP Address:	192.168.100.0 /27
Binary ID:	11000000101010000110010000000000
Total Number of Hosts:	32
Number of Usable Hosts:	30
Subnet Mask:	255.255.255.224
Binary Subnet Mask:	11111111.11111111.11111111.11100000
Wildcard Mask:	0.0.0.31

All 8 of the Possible /27 Networks for 192.168.100.0

Network Address	Usable Host Range	Broadcast Address:
192.168.100.0	192.168.100.1 - 192.168.100.30	192.168.100.31
192.168.100.32	192.168.100.33 - 192.168.100.62	192.168.100.63
192.168.100.64	192.168.100.65 - 192.168.100.94	192.168.100.95
192.168.100.96	192.168.100.97 - 192.168.100.126	192.168.100.127
192.168.100.128	192.168.100.129 - 192.168.100.158	192.168.100.159
192.168.100.160	192.168.100.161 - 192.168.100.190	192.168.100.191
192.168.100.192	192.168.100.193 - 192.168.100.222	192.168.100.223
192.168.100.224	192.168.100.225 - 192.168.100.254	192.168.100.255

For Router

Choosing from Last Segment of previous subnet

Short IP Address:	192.168.100.* /30

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Binary ID:	11000000101010000110010000000000
Total Number of Hosts:	4
Number of Usable Hosts:	2
Subnet Mask:	255.255.255.252
Binary Subnet Mask:	11111111.11111111.11111111.11111100
Wildcard Mask:	0.0.0.3

All 1 of 64 of the Possible /30 Networks for 192.168.100.*

Network Address	Usable Host Range	Broadcast Address:
192.168.100.252	192.168.100.25 3 - 192.168.100.254	192.168.100.255

```
Device Name: Router0
Device Model: Router-PT
Hostname: Router

Port              Link   IP Address         IPv6 Address                              MAC Address
FastEthernet0/0   Up     192.168.100.30/27  <not set>                                 00D0.97AB.EA53
FastEthernet1/0   Up     192.168.100.62/27  <not set>                                 0006.2AD6.BE1B
Serial2/0         Up     192.168.100.253/30 <not set>                                 <not set>
Serial3/0         Down   <not set>          <not set>                                 <not set>
FastEthernet4/0   Down   <not set>          <not set>                                 0002.4A91.B2B7
FastEthernet5/0   Down   <not set>          <not set>                                 0007.EC65.0C82

Physical Location: Intercity > Home City > Corporate Office > Main Wiring Closet > Rack > Router0
```

```
Device Name: Router1
Device Model: Router-PT
Hostname: Router

Port              Link   IP Address         IPv6 Address                              MAC Address
FastEthernet0/0   Up     192.168.100.94/27  <not set>                                 0002.4AAA.AD79
FastEthernet1/0   Up     192.168.100.126/27 <not set>                                 0060.2F76.937B
Serial2/0         Up     192.168.100.254/30 <not set>                                 <not set>
Serial3/0         Down   <not set>          <not set>                                 <not set>
FastEthernet4/0   Down   <not set>          <not set>                                 0001.97E1.D078
FastEthernet5/0   Down   <not set>          <not set>                                 0060.4785.7B39

Physical Location: Intercity > Home City > Corporate Office > Main Wiring Closet > Rack > Router1
```

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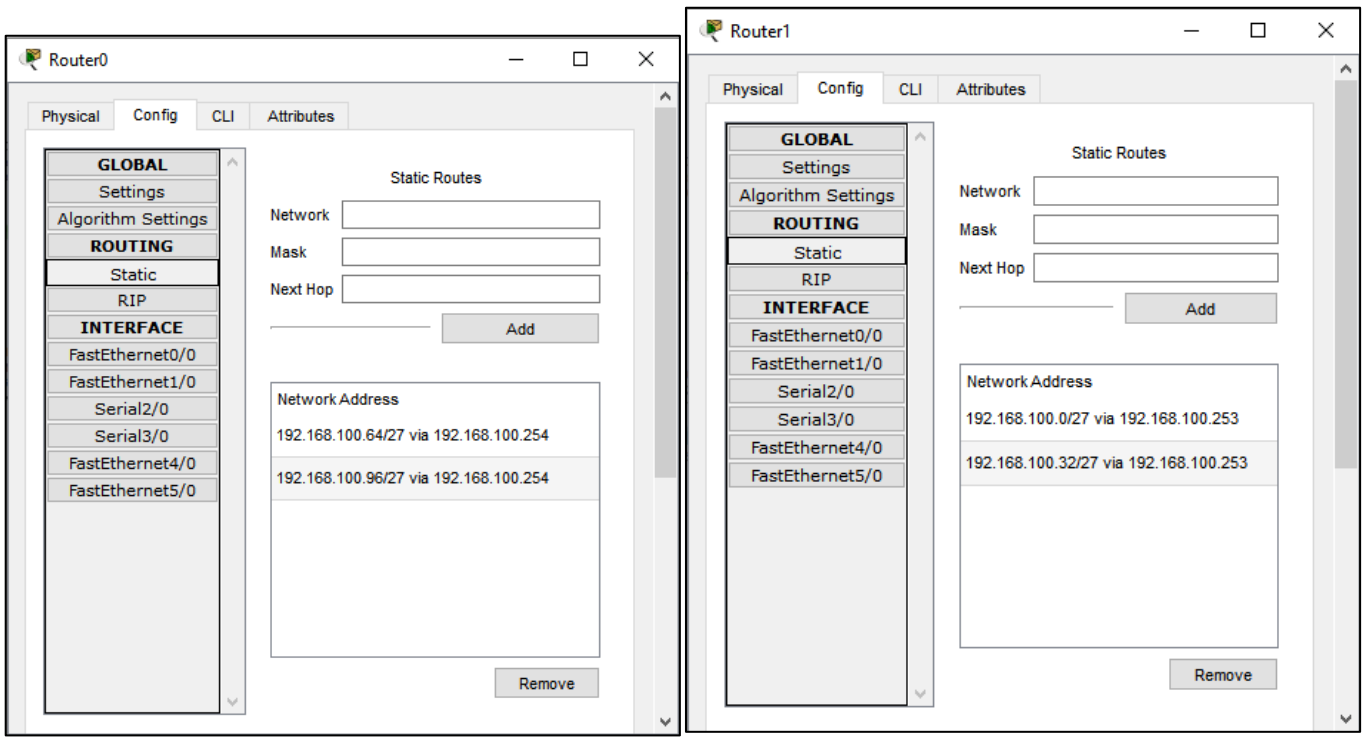

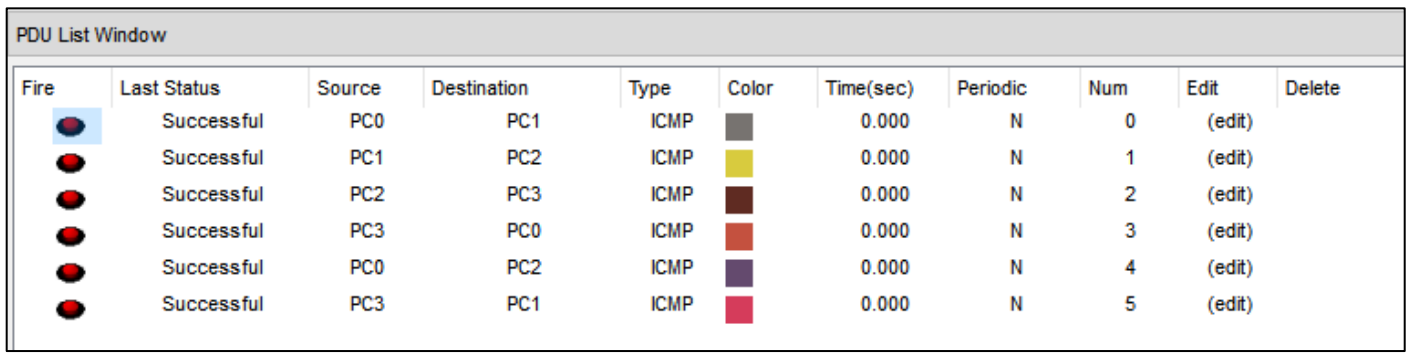

PDU List Window

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC0	PC1	ICMP		0.000	N	0	(edit)	
	Successful	PC1	PC2	ICMP		0.000	N	1	(edit)	
	Successful	PC2	PC3	ICMP		0.000	N	2	(edit)	
	Successful	PC3	PC0	ICMP		0.000	N	3	(edit)	
	Successful	PC0	PC2	ICMP		0.000	N	4	(edit)	
	Successful	PC3	PC1	ICMP		0.000	N	5	(edit)	

Router ISO CLI

```
Router0

Router>enable

Router#configure terminal

Router(config)#interface FastEthernet0/0

Router(config-if)#ip address 192.168.100.30 255.255.255.224

Router(config-if)#no shutdown

Router(config-if)#exit

Router(config)#interface FastEthernet1/0

Router(config-if)#ip address 192.168.100.62 255.255.255.224

Router(config-if)#no shutdown

Router(config-if)#exit
```

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```
Router(config)#interface Serial2/0
Router(config-if)#no shutdown
Router(config-if)#ip address 192.168.100.253 255.255.255.252
Router(config-if)#exit
Router(config)#ip route 192.168.100.64 255.255.255.224 192.168.100.254
Router(config)#ip route 192.168.100.96 255.255.255.224 192.168.100.254
```

Router1

```
Router>enable
Router#configure terminal
Router(config)#interface FastEthernet0/0
Router(config-if)#ip address 192.168.100.94 255.255.255.224
Router(config-if)#no shutdown
Router(config-if)#exit
Router(config)#interface FastEthernet1/0
Router(config-if)#ip address 192.168.100.126 255.255.255.224
Router(config-if)#no shutdown
Router(config-if)#exit
Router(config)#interface Serial2/0
Router(config-if)#ip address 192.168.100.254 255.255.255.252
Router(config-if)#no shutdown
Router(config-if)#exit
Router(config)#ip route 192.168.100.0 255.255.255.224 192.168.100.253
Router(config)#ip route 192.168.100.32 255.255.255.224 192.168.100.253
```

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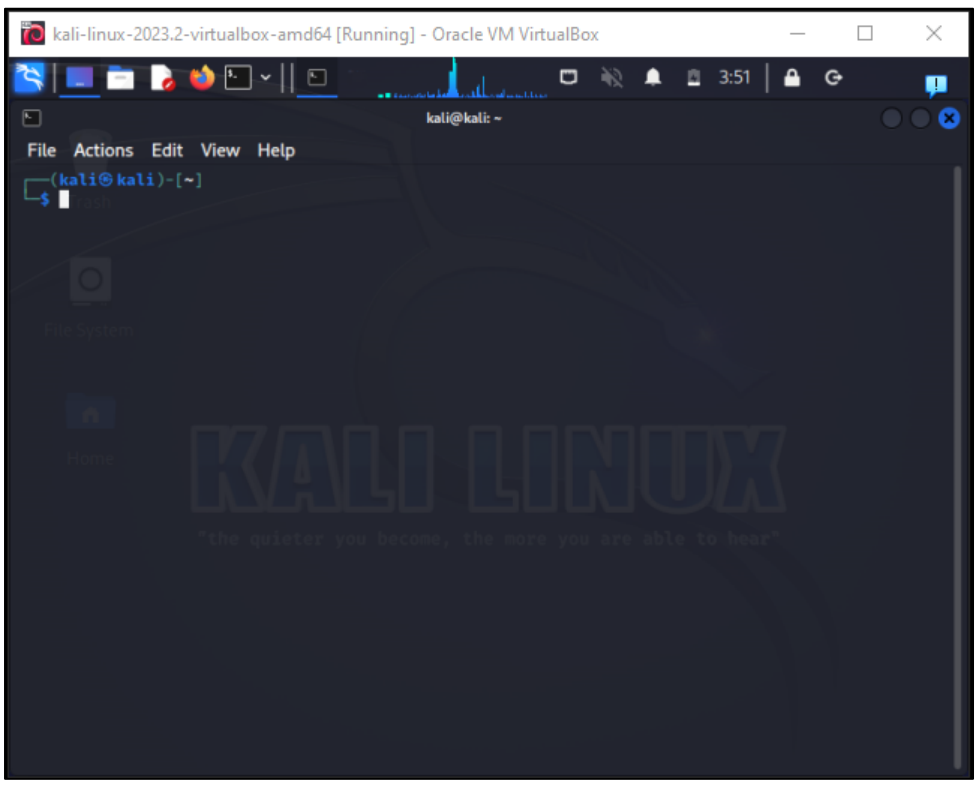
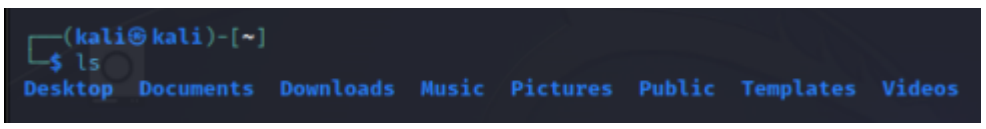
Laboratory 7: Basic Linux Command **Thursday, July 20, 2023**

Launch “Terminal” in Kali-Linux.



Explore the following commands:

ls (list of all directory content) – what we have



pwd (print working directory) -tell current location and output directory name

cd (used to navigate between directories and folders //case sensitive)

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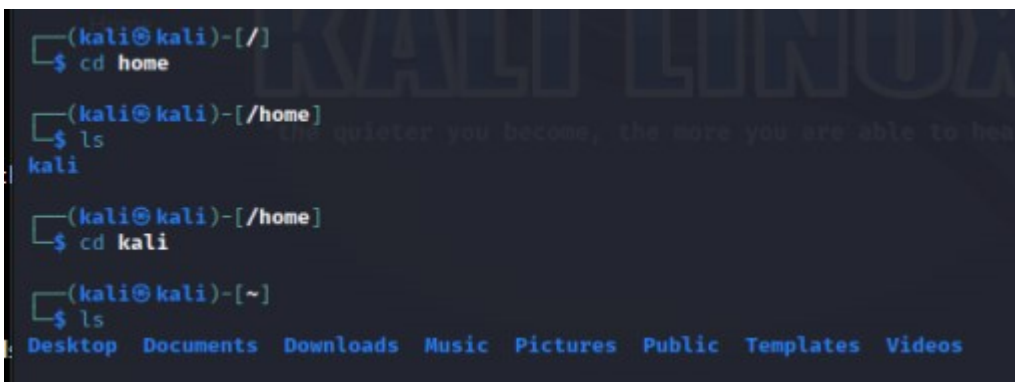
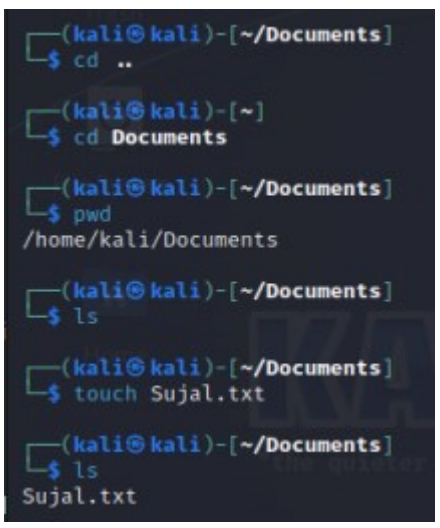
cd .. (variations/ go back to previous directory)

cd / (variations/ go to root directory, windows equivalent is C drive)

view username go back to start



touch (crate file)



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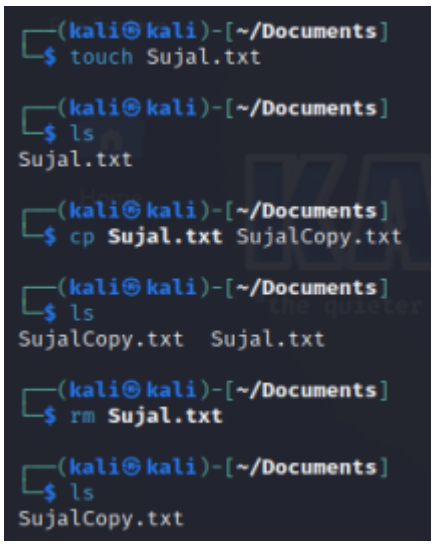
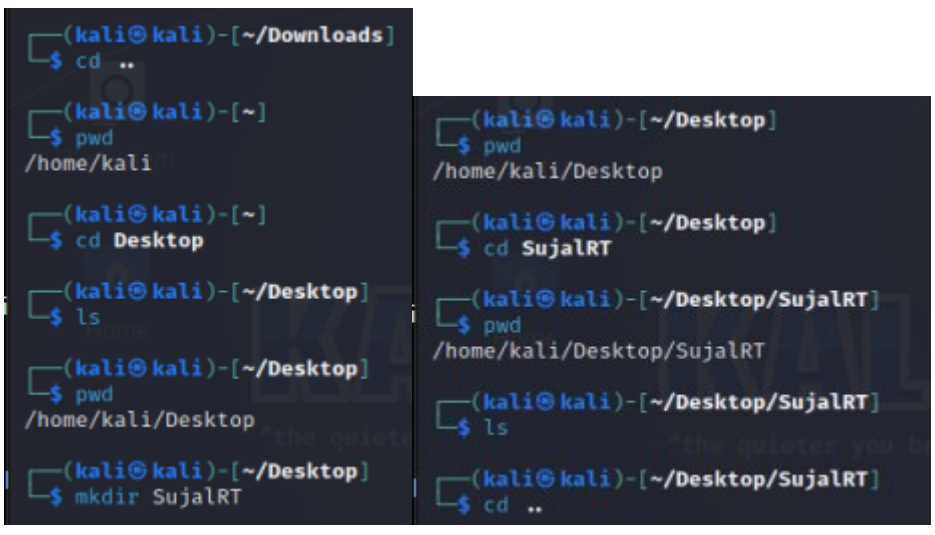
cp (copy file)

rm (remove or delete file)



mkdir (make new directory/folder)



rmdir (remove directory/folder)

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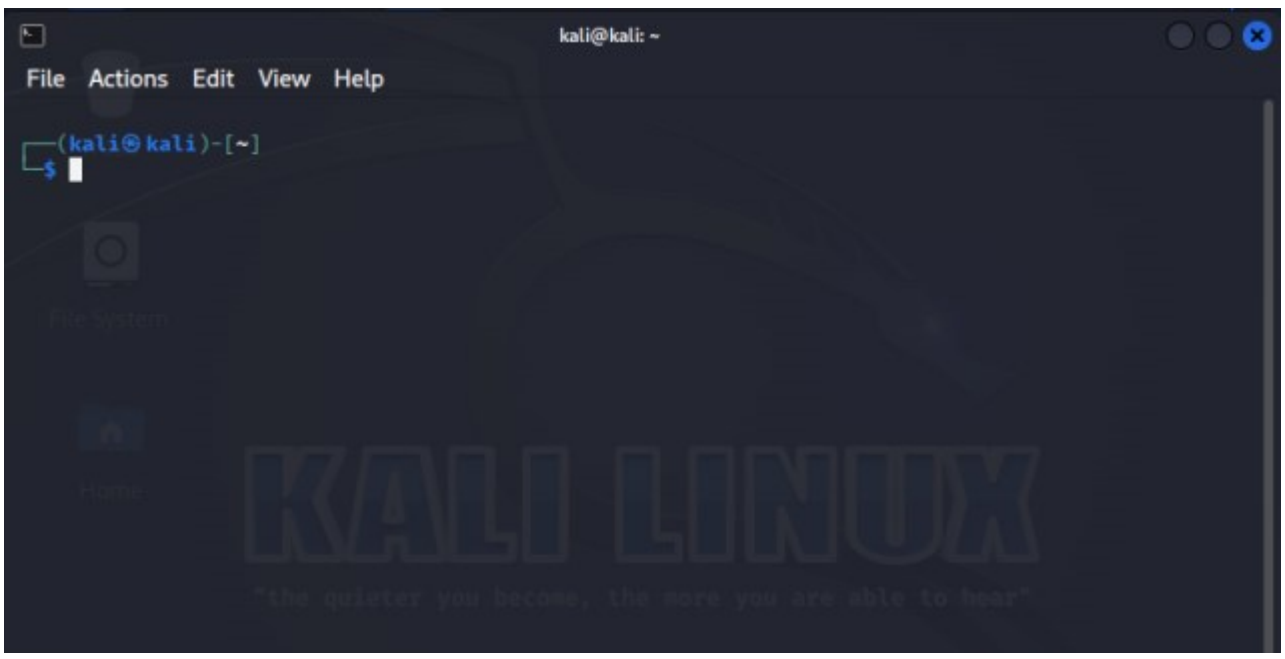
rm -r [folder name] (remove non empty directory)

```
┌──(kali㉿kali)-[~/Documents]
└─$ cd ..

┌──(kali㉿kali)-[~]
└─$ mkdir FloderWithDocumentInside

┌──(kali㉿kali)-[~]
└─$ ls
Desktop    Downloads                Music     Public     Videos
Documents  FloderWithDocumentInside  Pictures  Templates

┌──(kali㉿kali)-[~]
└─$ cd FloderWithDocumentInside

┌──(kali㉿kali)-[~/FloderWithDocumentInside]
└─$ pwd
/home/kali/FloderWithDocumentInside
```

```
┌──(kali㉿kali)-[~/FloderWithDocumentInside]
└─$ ls

┌──(kali㉿kali)-[~/FloderWithDocumentInside]
└─$ touch test

┌──(kali㉿kali)-[~/FloderWithDocumentInside]
└─$ ls
test

┌──(kali㉿kali)-[~/FloderWithDocumentInside]
└─$ cd ..

┌──(kali㉿kali)-[~]
└─$ ls
Desktop    Downloads                Music     Public     Videos
Documents  FloderWithDocumentInside  Pictures  Templates

┌──(kali㉿kali)-[~]
└─$ rmdir FloderWithDocumentInside
rmdir: failed to remove 'FloderWithDocumentInside': Directory not empty
```

```
┌──(kali㉿kali)-[~]
└─$ rm -r FloderWithDocumentInside

┌──(kali㉿kali)-[~]
└─$
```

clear (clear the terminal screen) – CTRL+L



df

```
┌──(kali㉿kali)-[~/Desktop]
└─$ df
Filesystem     1K-blocks     Used Available Use% Mounted on
udev             967760        0    967760   0% /dev
tmpfs            201460      976    200484   1% /run
/dev/sda1      82083148 13978808  63888792  18% /
tmpfs           1007284        0   1007284   0% /dev/shm
tmpfs              5120        0      5120   0% /run/lock
tmpfs            201456       80    201376   1% /run/user/1000
```

date

```
┌──(kali㉿kali)-[~/Desktop]
└─$ date
Sat Jul 22 05:36:43 AM EDT 2023
```

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id

```
┌──(kali㉿kali)-[~/Desktop]
└─$ id
uid=1000(kali) gid=1000(kali) groups=1000(kali),4(adm),20(dialout),24(cdrom),25(floppy),27(sudo)
,29(audio),30(dip),44(video),46(plugdev),100(users),106(netdev),111(bluetooth),114(scanner),137(
wireshark),140(kaboxer),141(vboxsf)
```

hostname

```
┌──(kali㉿kali)-[~/Desktop]
└─$ hostname
kali
```

uptime

```
┌──(kali㉿kali)-[~/Desktop]
└─$ uptime
 05:37:58 up  2:34,  1 user,  load average: 0.29, 0.31, 0.20
```

free

```
┌──(kali㉿kali)-[~/Desktop]
└─$ free
               total        used        free      shared  buff/cache   available
Mem:         2014568      771224      938908        5900      458200     1243344
Swap:        1048572           0     1048572
```

history (look through list of previous commands) – CTRL+R

```
┌──(kali㉿kali)-[~/Desktop]
└─$ history
    1  pwd
    2  ls
    3  cd Desktop
    4  pwd
    5  ls
    6  cd ..
    7  cd /
    8  pwd
    9  ls
   10  cd home
   11  ls
   12  cd kali
   13  ls
   14  cd Documents
   15  pwd
   16  ls
   17  dir sujal
   18  cd sujal
   19  cd ..
   20  cd Documents
   21  pwd
   22  ls
   23  touch Sujal.txt
   24  ls
   25  cp Sujal.txt SujalCopy.txt
   26  ls
   27  rm Sujal.txt
```

man (call the manual)

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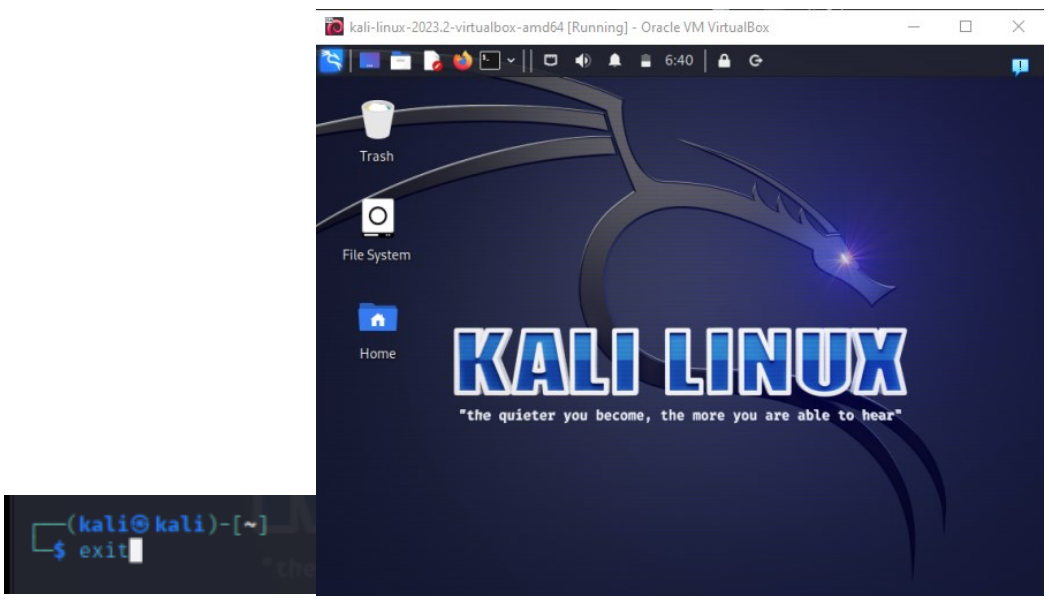
```
MAN(1)                          Manual pager utils                          MAN(1)

NAME
       man - an interface to the system reference manuals

SYNOPSIS
       man [man options] [[section] page ...] ...
       man -k [apropos options] regexp ...
       man -K [man options] [section] term ...
       man -f [whatis options] page ...
       man -l [man options] file ...
       man -w|-W [man options] page ...

DESCRIPTION
       man  is  the  system's  manual pager.  Each page argument given to man is normally the
       name of a program, utility or function.  The manual page associated with each of these
       arguments  is  then  found  and displayed.  A section, if provided, will direct man to
       look only in that section of the manual.  The default action is to search  in  all  of
       the  available sections following a pre-defined order (see DEFAULTS), and to show only
       the first page found, even if page exists in several sections.

       The table below shows the section numbers of the manual followed by the types of pages
       they contain.

       1   Executable programs or shell commands
       2   System calls (functions provided by the kernel)
       3   Library calls (functions within program libraries)
       4   Special files (usually found in /dev)
       5   File formats and conventions, e.g. /etc/passwd
       6   Games
 Manual page man(1) line 1 (press h for help or q to quit)
```

exit (end current session and close terminal) – CTRL+D



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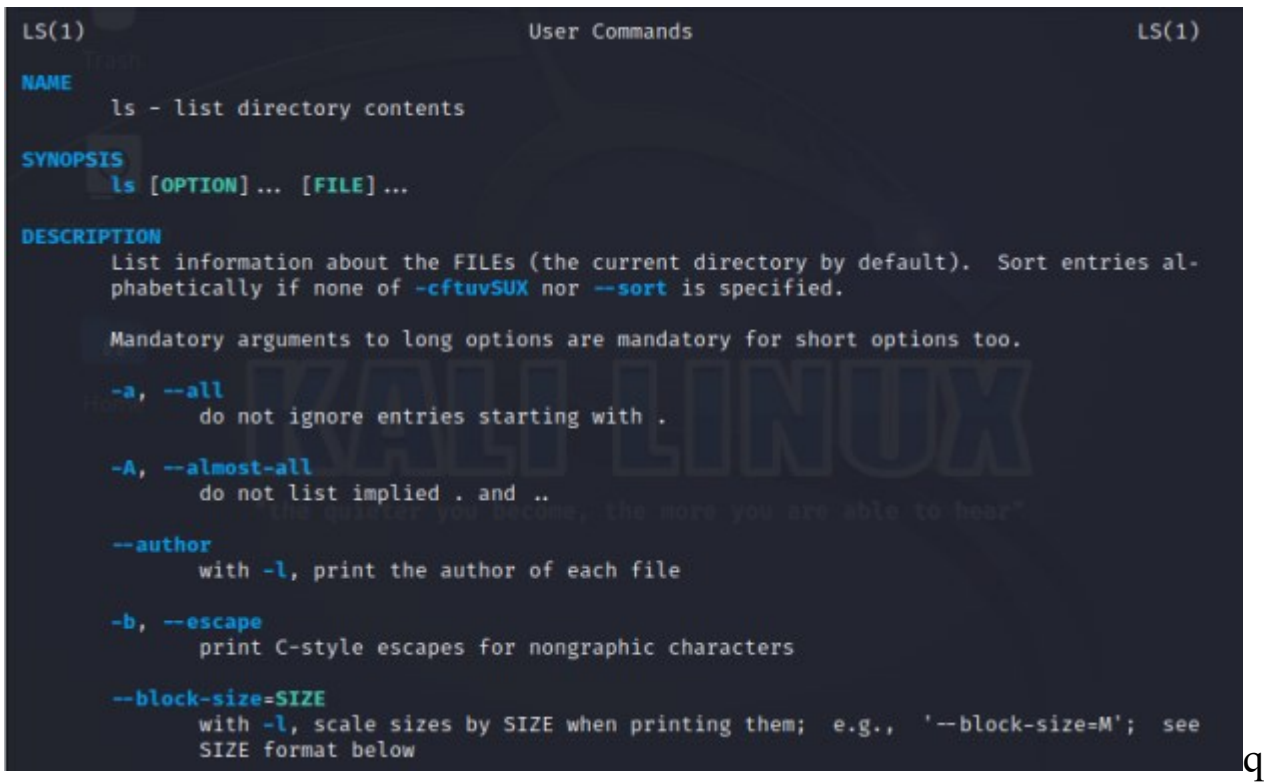
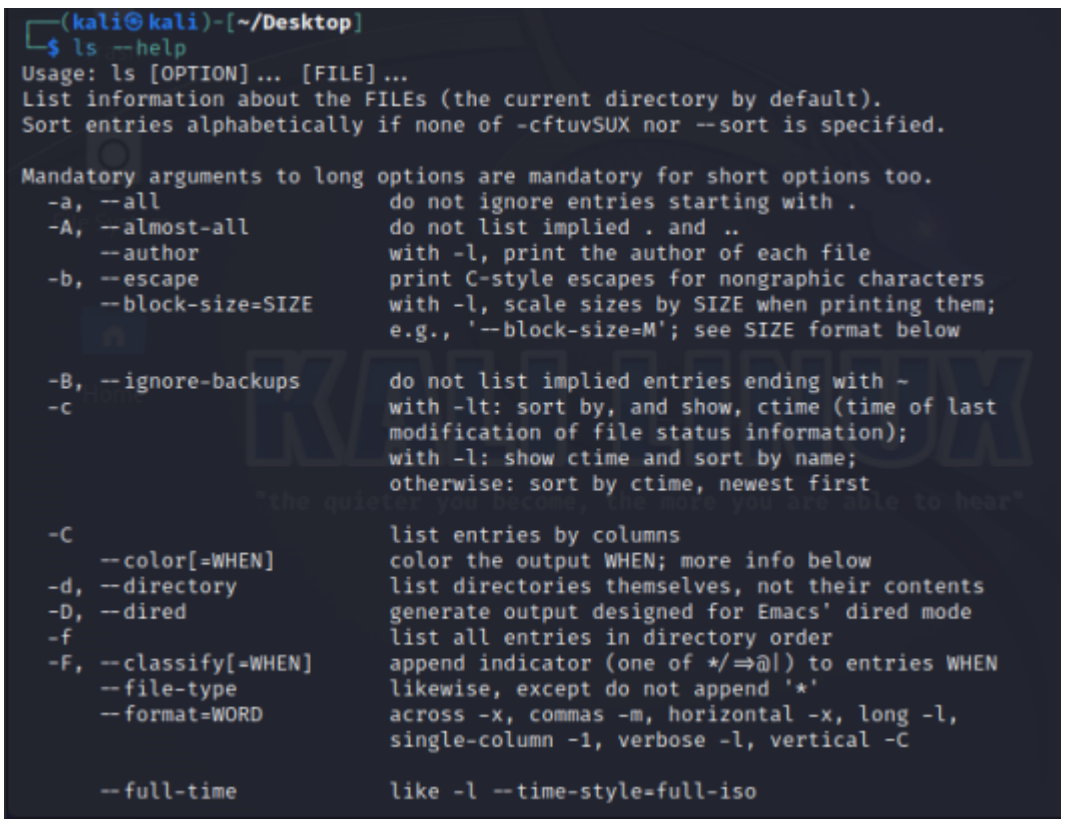
To get more information on each of the command, you can:

man ls



q

ls –help



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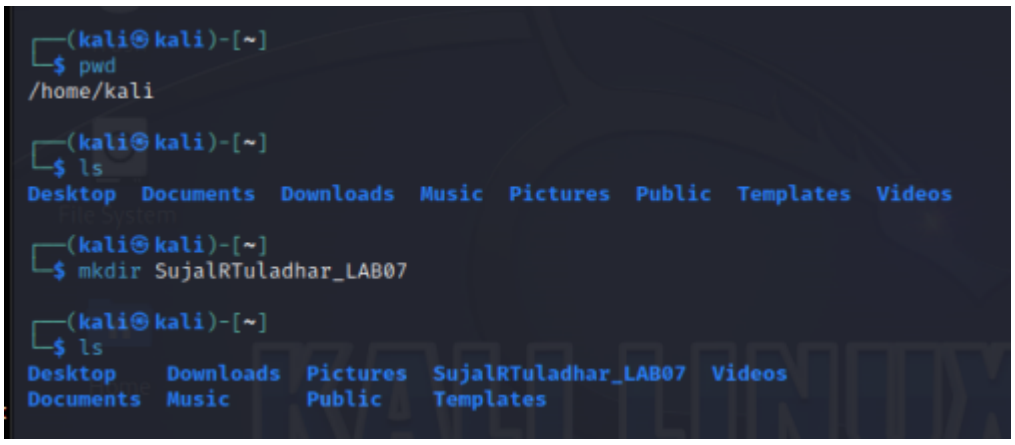
Tasks

Using mkdir command, create a new directory with name of “Name_Lab07”

Using ls command, list the new file created



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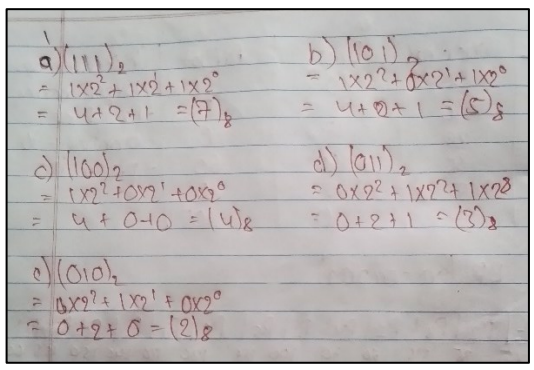
Laboratory 8: Linux File Permissions **Friday, July 21, 2023**

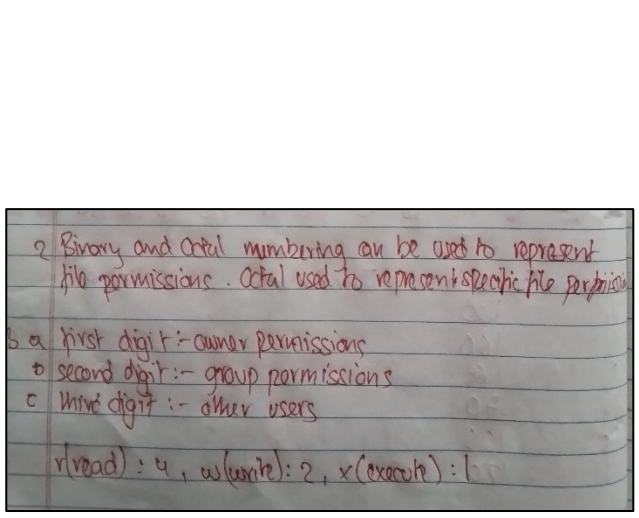
THEORY EXERCISE

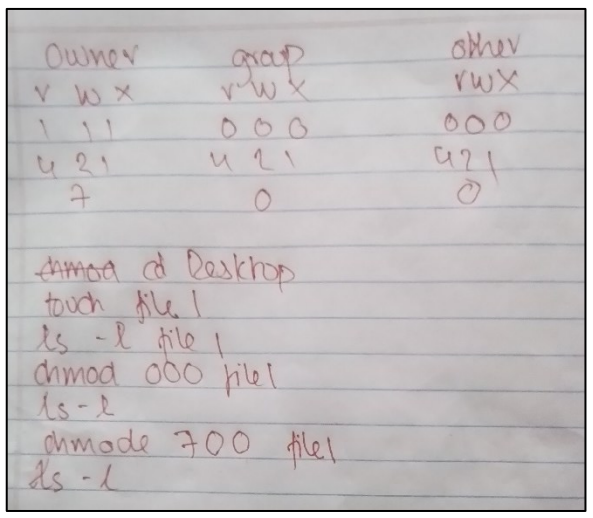
Convert the following binary (base 2) numbers to octal (base 8):

- 111
- 101
- 100
- 011
- 010



In binary and octal numbering, how do you express granting read, write and execute permission to the Owner of a file and no permissions to anyone else?





In binary and octal numbering, how do you express granting write, and execute permission to the Owner of a file, read and write permission to Group, and read permissions to Other?

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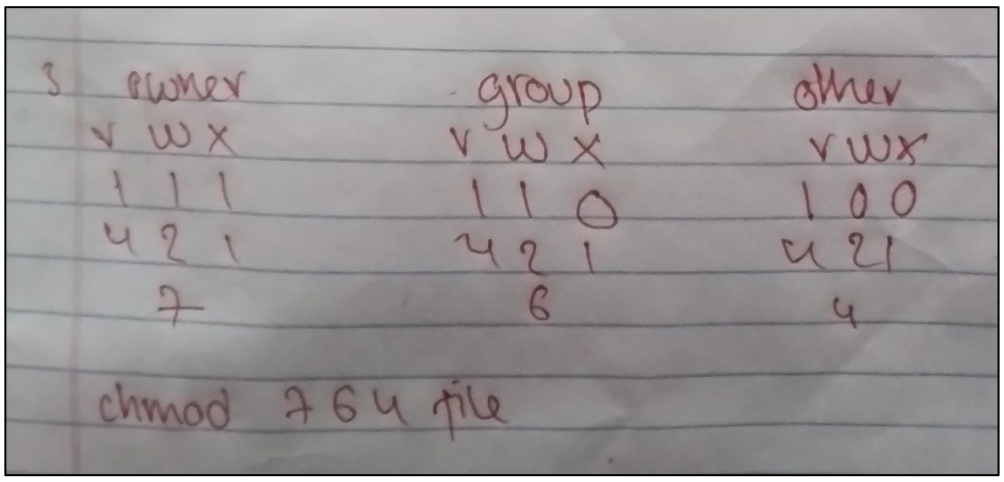

LAB EXERCISE

Create a file using touch command:

```
┌──(kali㉿kali)-[~]
└─$ pwd
/home/kali

┌──(kali㉿kali)-[~]
└─$ ls
Desktop    Downloads  Pictures  SujalRTuladhar_LAB07  Videos
Documents  Music      Public    Templates

┌──(kali㉿kali)-[~]
└─$ cd Desktop

┌──(kali㉿kali)-[~/Desktop]
└─$ pwd
/home/kali/Desktop

┌──(kali㉿kali)-[~/Desktop]
└─$ ls

┌──(kali㉿kali)-[~/Desktop]
└─$ touch Lab8SujalRT
```

Type ls -l commands to view the file permission.

```
┌──(kali㉿kali)-[~/Desktop]
└─$ ls -l
total 0
-rw-r--r-- 1 kali kali 0 Jul 22 07:43 Lab8SujalRT
```

Type the following commands to change the permission of the file.

```
┌──(kali㉿kali)-[~/Desktop]
└─$ chmod 777 Lab8SujalRT
```

Review the permission of the file using the ls –l command.

```
┌──(kali㉿kali)-[~/Desktop]
└─$ ls -l
total 0
-rwx------ 1 kali kali 0 Jul 22 07:43 Lab8SujalRT
```

Using chmod command, grant the permission accordingly.

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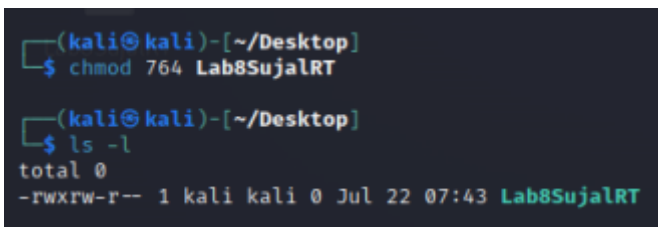
Grant read, write and execute permission to the Owner of a file and no permissions to anyone.

OWNER			GROUP			OTHERS		
R	W	X	R	W	X	R	W	X
1	1	1	0	0	0	0	0	0
4	2	1	4	2	1	4	2	1
7			0			0		

Grant read, write, and execute permission to the Owner of a file, read and write permission to Group, and read permissions to Other.

OWNER			GROUP			OTHERS		
R	W	X	R	W	X	R	W	X
1	1	1	1	1	0	1	0	0
4	2	1	4	2	1	4	2	1
7			6			4		



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Laboratory 9: Creating User Account in LINUX **Saturday, July 22, 2023**

```
┌──(kali㉿kali)-[~]
└─$ whoami
kali

┌──(kali㉿kali)-[~]
└─$ sudo su
[sudo] password for kali:

Sorry, try again.
[sudo] password for kali:
kSorry, try again.
[sudo] password for kali:
┌──(root㉿kali)-[/home/kali]
└─# root
Command 'root' not found, did you mean:
  command 'foot' from deb foot
  command 'toot' from deb toot
  command 'proot' from deb proot
  command 'rootv' from deb xawtv
Try: apt install <deb name>

┌──(root㉿kali)-[/home/kali]
└─# whoami
root
```

Adding new user <adduser> (1%)

adduser [your name]

```
┌──(root㉿kali)-[/home/kali]
└─# adduser sujal
\Adding user `sujal' ...
Adding new group `sujal' (1001) ...
Adding new user `sujal' (1001) with group `sujal (1001)' ...
Creating home directory `/home/sujal' ...
Copying files from `/etc/skel' ...
New password:
Retype new password:
Sorry, passwords do not match.
passwd: Authentication token manipulation error
passwd: password unchanged
Try again? [y/N] y
New password:
Retype new password:
passwd: password updated successfully
Changing the user information for sujal
Enter the new value, or press ENTER for the default
        Full Name []: Sujal Ratna Tuladhar
        Room Number []: 2129
        Work Phone []:
        Home Phone []:
        Other []:
Is the information correct? [Y/n] y
Adding new user `sujal' to supplemental / extra groups `users' ...
Adding user `sujal' to group `users' ...
```

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Try adding a new user with <useradd>

useradd [use a different username to 1]

```
┌──(root㉿kali)-[/home/kali]
└─# useradd SRT
```

What is the difference between adduser and useradd?

The ‘adduser‘ is much similar to useradd command, because it is just a symbolic link to it.

Access /etc/passwd file (1%

```
chew_sess2:$6$/j4xdhoIjBtU42Zo$KIT2U1REfbWTTt/dXXqNAys2HDTvrvTvy/Ek4JjgJyCnQRk/hAVu0LZm.NxV7fkHPsfI1EIYIQjAm8gRPIudD1:19311:0:99999:7:::
```

)

```
┌──(root㉿kali)-[/home/kali]
└─# access /etc/passwd file
Command 'access' not found, did you mean:
  command 'kaccess' from deb plasma-desktop
Try: apt install <deb name>

┌──(root㉿kali)-[/home/kali]
└─# access /etc/passwd
Command 'access' not found, did you mean:
  command 'kaccess' from deb plasma-desktop
Try: apt install <deb name>

┌──(root㉿kali)-[/home/kali]
└─# /etc/passwd
zsh: permission denied: /etc/passwd
```

Sudo nano /etc/passwd

Find the new user that you have created.

```
┌──(root㉿kali)-[/home/kali]
└─# sudo nano
```

Explain the meaning for each of the informati on that are separated with semicolon “:”.

```
hahatest:x:1002:1002:zcxv,asdf,wqer,1234,zxcv:/home/hahatest:/bin/bash
```

Access /etc/shadow file (1%)S

Sudo nano /etc/shadow

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What is the information stored in shadow file?

```
┌──(root㉿kali)-[/home/kali]
└─# sudo nano

┌──(root㉿kali)-[/home/kali]
└─# passwd sujal
New password:
Retype new password:
Sorry, passwords do not match.
passwd: Authentication token manipulation error
passwd: password unchanged
```

Changing password of a user. (1%)

Passwd [username]

```
┌──(root㉿kali)-[/home/kali]
└─# passwd sujal
New password:
Retype new password:
passwd: password updated successfully
```

whoami

Access /etc/shadow file again, and notice the difference.

Switch the current user to the new user account that you have just created. (1%)

Su [username]

```
┌──(root㉿kali)-[/home/kali]
└─# /etc/shadow
zsh: permission denied: /etc/shadow

┌──(root㉿kali)-[/home/kali]
└─# su SRT
$
$ whoami
SRT
$
```

```
$
$ su sujal
Password:
┌──(sujal㉿kali)-[/home/kali]
└─$
```