

Instructor: Walid Saad El- Din



CCNA 200- 301

Cisco Certificates

CCIE [Cisco Certified Internetwork Expert]

CCNP [Cisco Certified Network Professional]

CCNA [Cisco Certified Network Associate]

Course Topics

- Network fundamentals
- Network access
- IP connectivity
- IP services (Protocols)
- Security fundamentals
- Automation and programmability

Network fundamentals

- **Network definition**
- **Network Types**
- **Network Topologies**
- **Network Devices**

Network fundamentals

Types of Network

The two most common types of Network infrastructures are:

- Local Area Network (LAN)
- Wide Area Network (WAN)

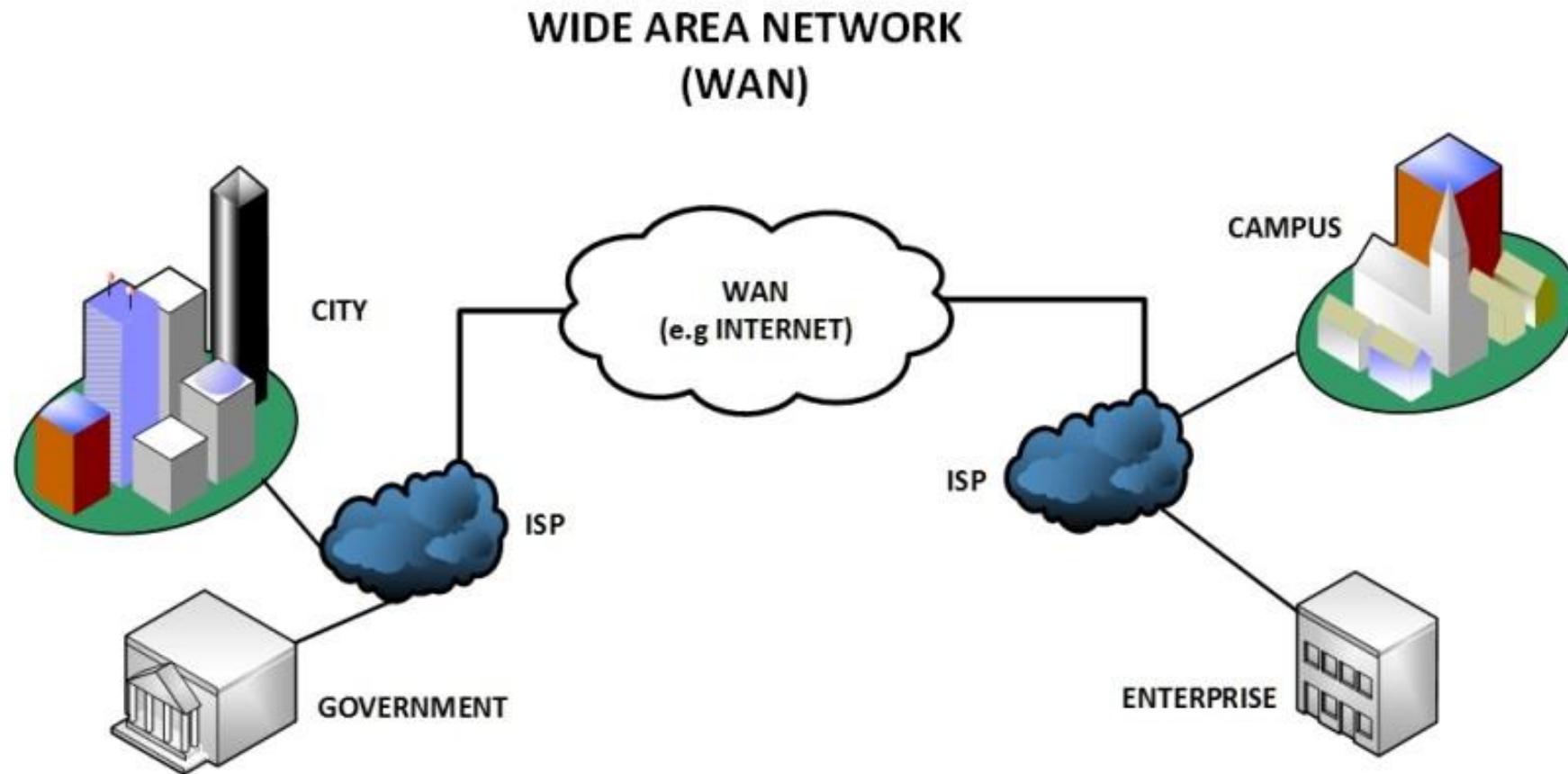
Other type of Networks include:

- Personal Area Network (PAN)
- Wireless LAN (WLAN)
- Camps Are Network (CAN)
- Metropolitan Area Network (MAN)

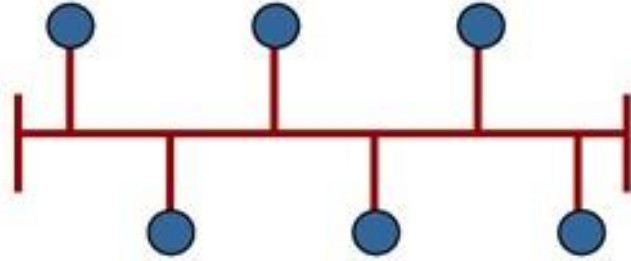
Local Area Network (LAN)



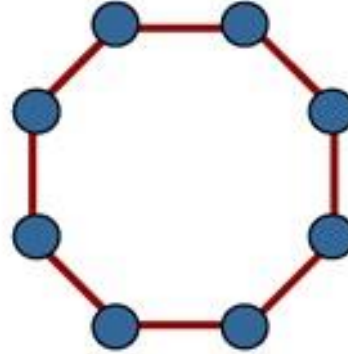
Wide Area Network (WAN)



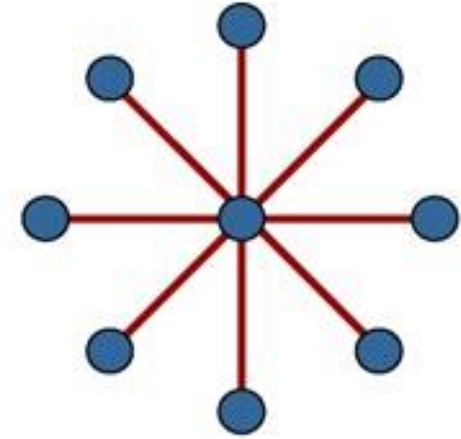
Network Topologies



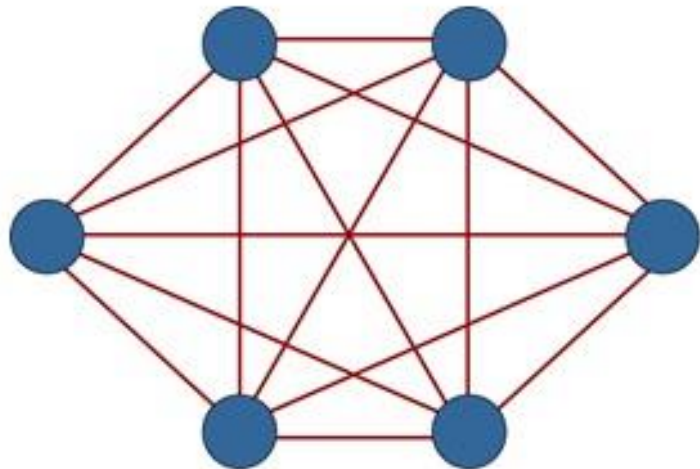
Bus Topology



Ring Topology



Star Topology



Mesh Topology

Network Devices



Layer 2 Switches



Hub



Multi Layer Switches



Firewalls



Modems



Routers



Bridges

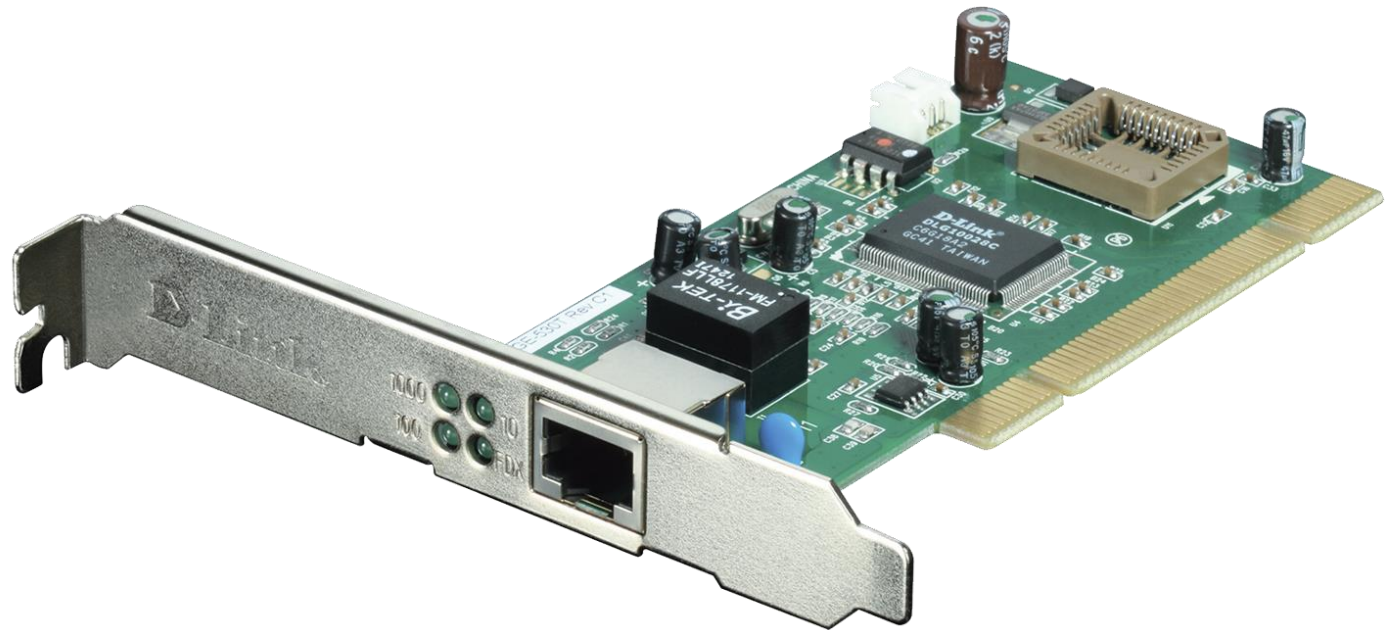


Repeater

Network Devices

Network Interface Card/ NIC/ Network Adapter

- Ethernet= 10 Mbs
- Fast Ethernet= 100 Mbps
- Giga Ethernet= 1 Gbps



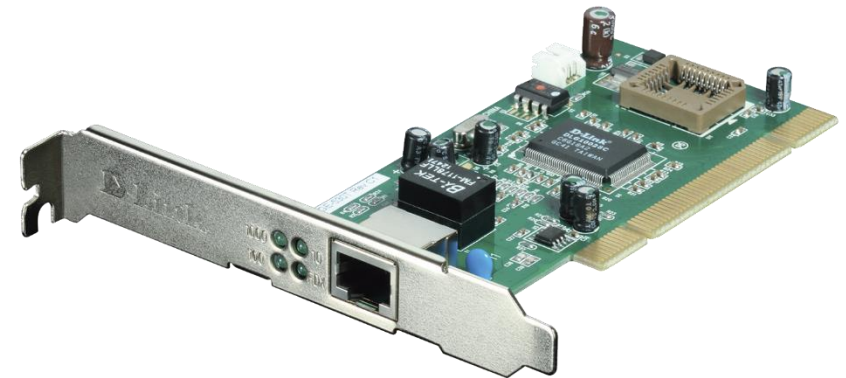
Mac Address

MAC

Media Access Control Address



Organizational Unique Identifier Network Interface Controller Specific



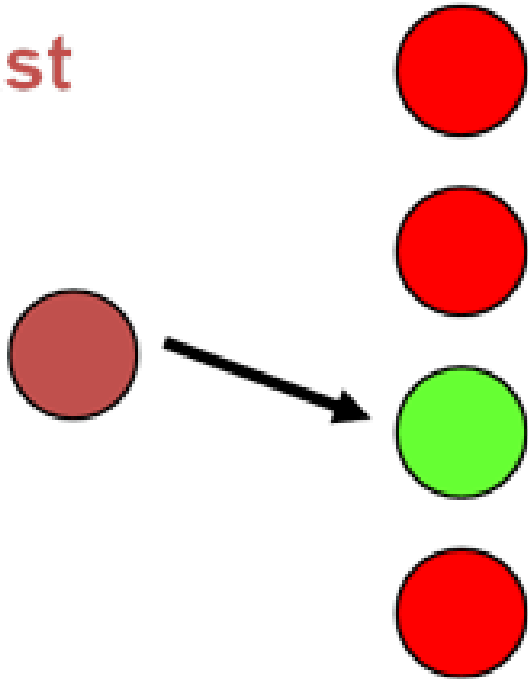
Signal Types

1. Single: Transmission in on direction only.
2. Half duplex: Transmission in the two direction, But not at the same time.
3. Full duplex: Transmission in the two direction at the same time.

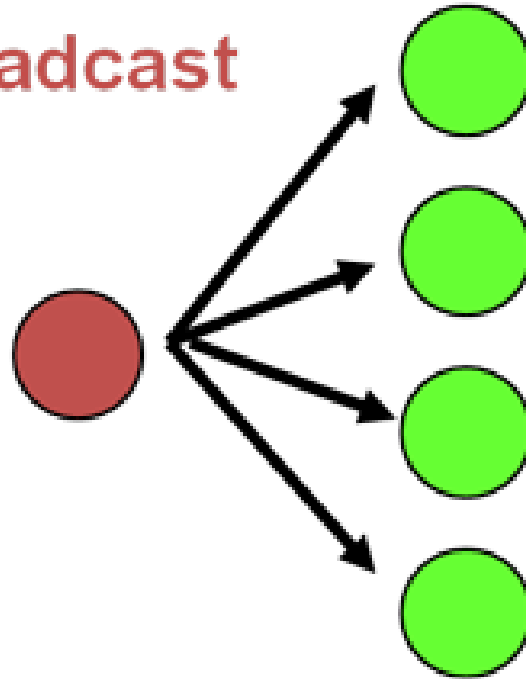
Data is transported over a network by three methods:

- Unicast
- Broadcast
- Multicast

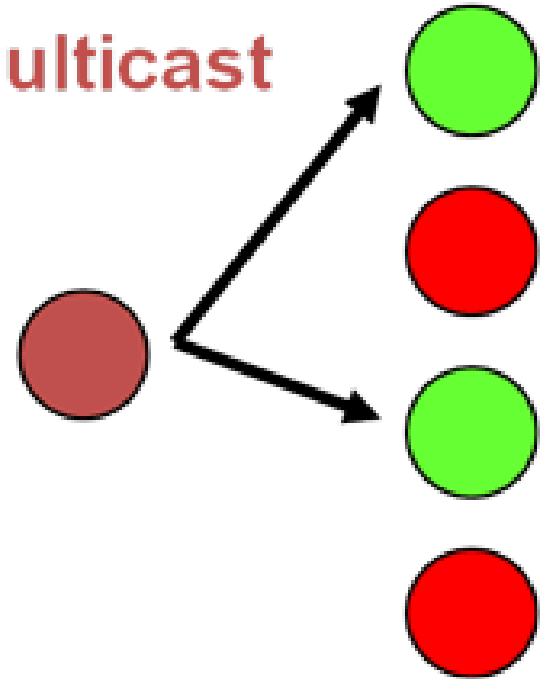
Unicast



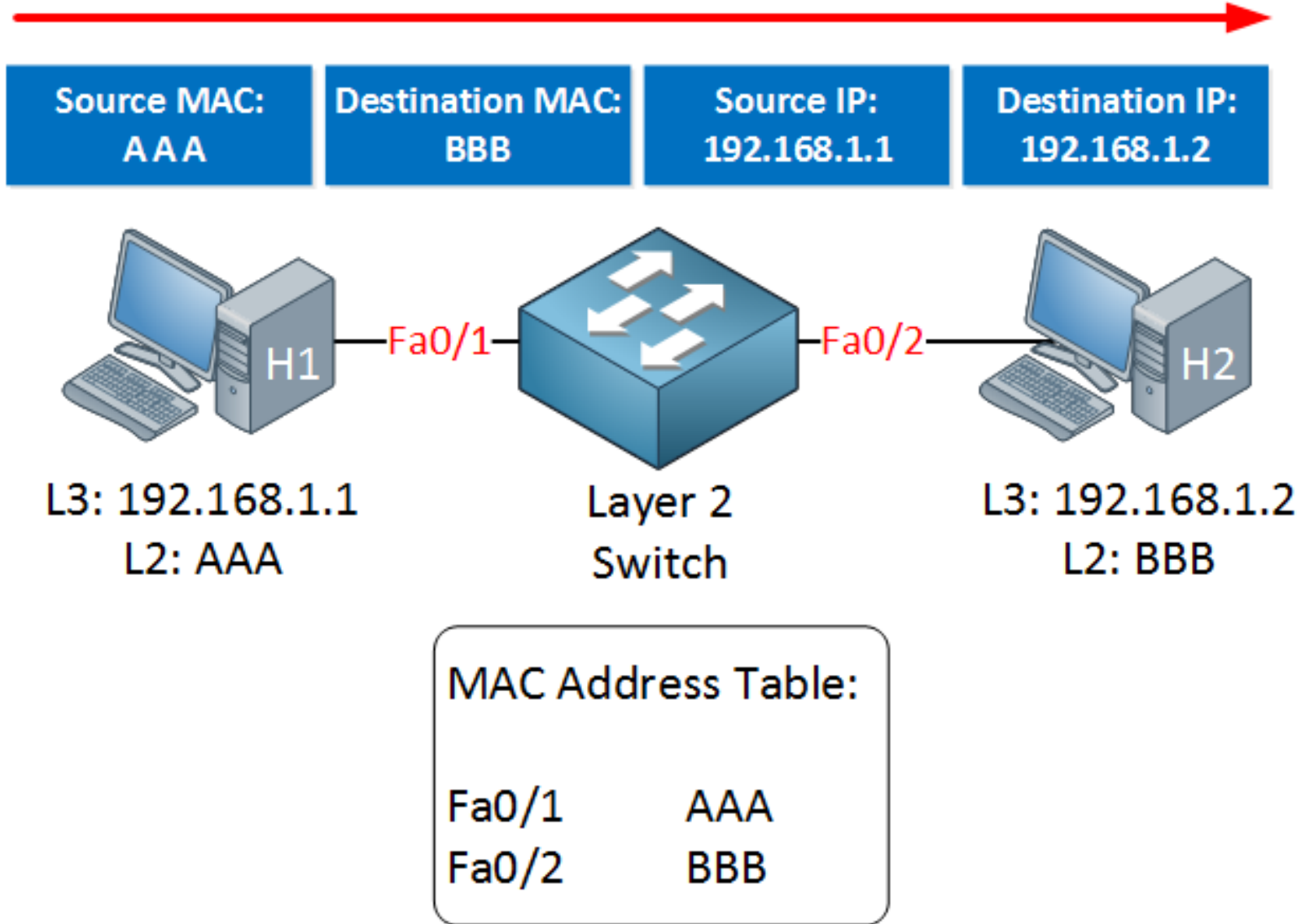
Broadcast



Multicast

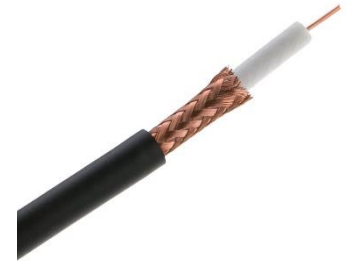


Switch – ARP- Lab



Network Media/ Cables

1. Coaxial

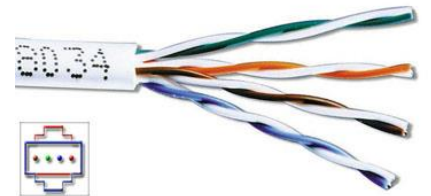


2. Twisted Pair

Shielded twisted pair (STP)



Unshielded twisted pair (UTP)



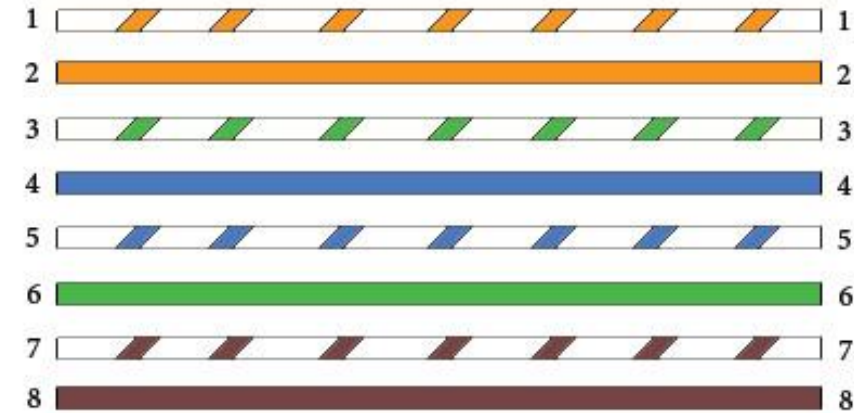
3. Fiber



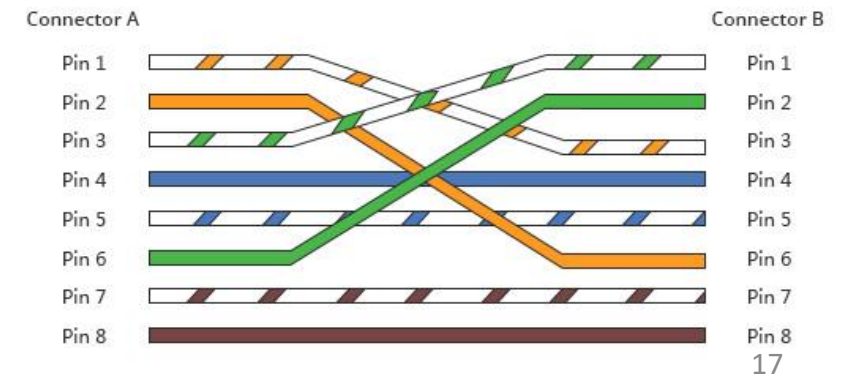
Twisted Pair

- Straight through cable
- Crossover cable

Straight Through Wiring Guide
568-B



Crossover Cable Wiring Scheme



IP Address (Private & Public)

Internet Assigned Numbers Authority (IANA)

Class	Subnet Mask decimal	No. of Hosts per Network	No. of Networks	Start -End Address
A	255.0.0.0	16 Million	127	1.0.0.0 - 126.255.255.255
B	255.255.0.0	65000	16000	128.0.0.0 - 191.255.255.255
C	255.255.255.0	254	2 Million	192.0.0.0 - 223.255.255.255
D	Reserved for multicast groups			224.0.0.0 - 239.255.255.255
E	Reserved for future use, or Research and Development Purposes			240.0.0.0 - 254.255.255.254

4 Octets = 32 bits = 4 byte

Private IP Address

Private IP address space

From	To
10.0.0.0	10.255.255.255
172.16.0.0	172.31.255.255
192.168.0.0	192.168.255.255

Reserved IP Address

Purpose	Start of range	End of range
Network Address	0.0.0.0	0.255.255.255
Loopback- Local host	127.0.0.1	127.255.255.255
Automatic Private IP Addressing (APIPA-Link local)	169.254.0.0	169.254.255.255

IP Address- Lab

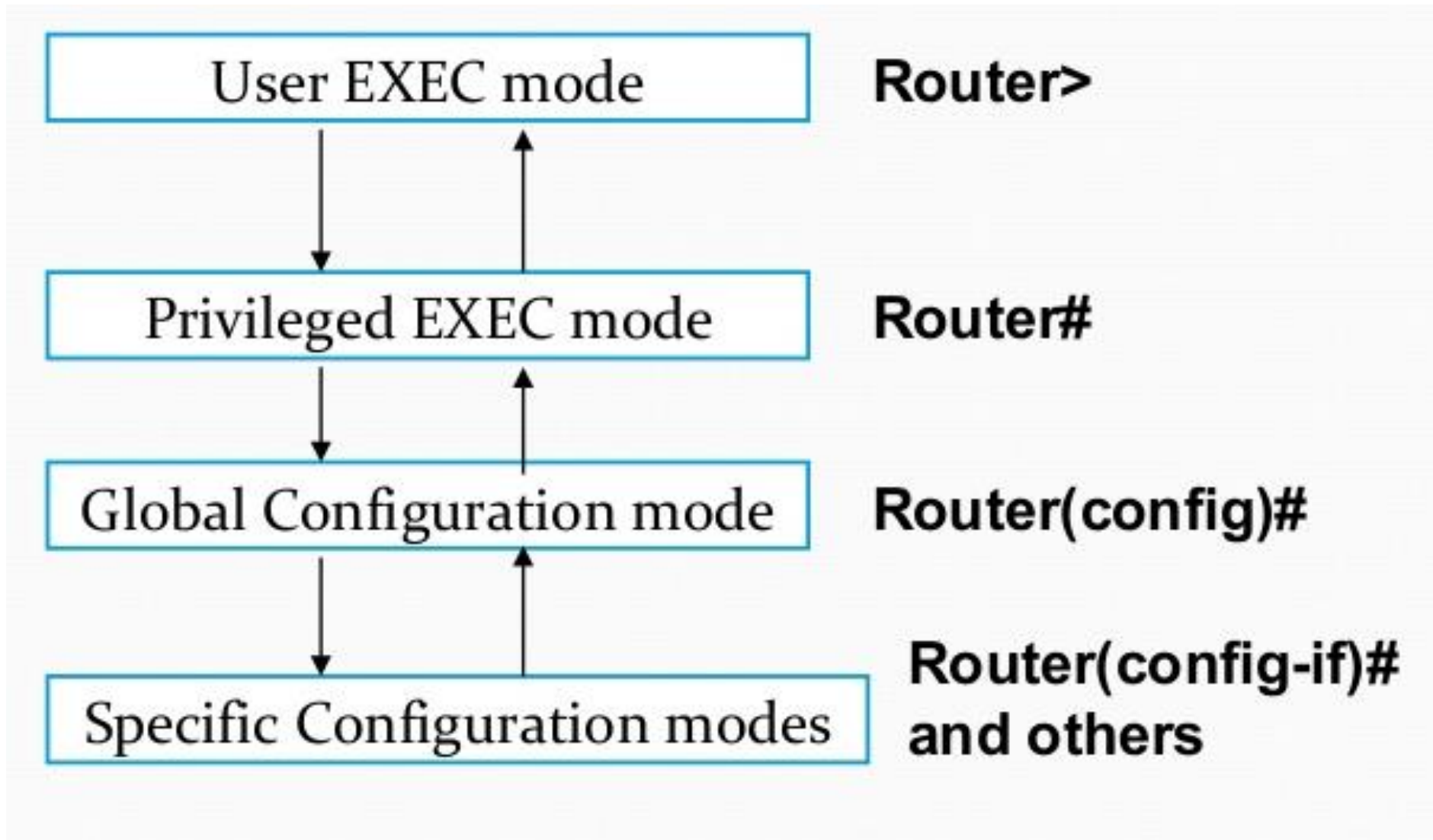
How computer get IP Address?!

1. Static IP address
2. Dynamic Host Configuration Protocol (DHCP)
3. Alternate IP
4. APIPA

Topics- Lab

1. Cisco Packet Tracer- IP Address
2. Ipconfig
3. Ipconfig/all
4. Ping (-l, -t)

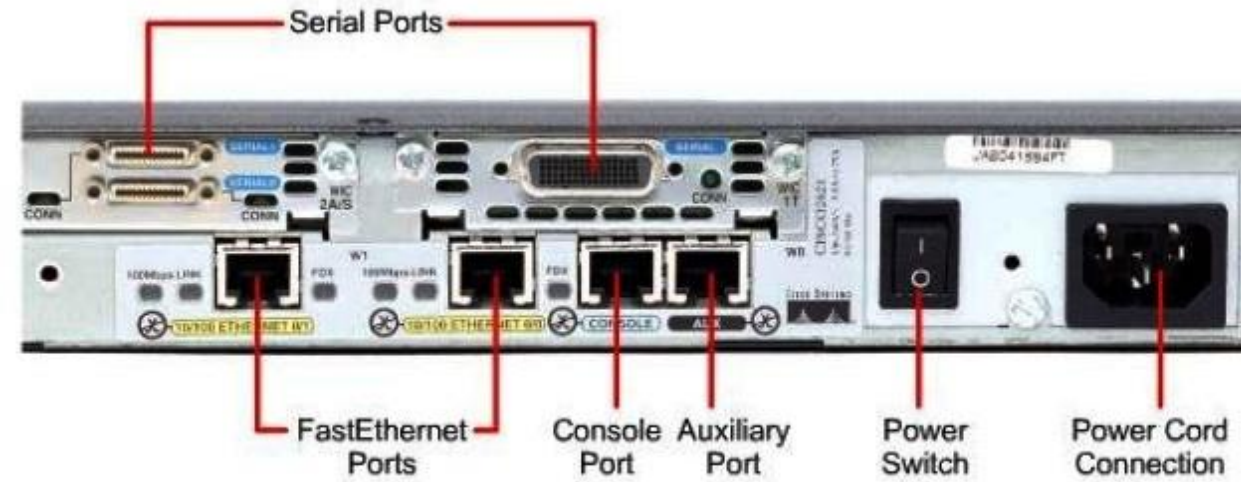
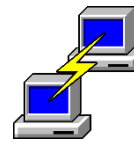
Router Basic Configuration- Router Modes- Lab



Router Basics

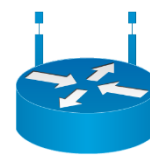


Putty



1. What is the Router?

2. Router Components!



Wireless router



Router

Router Components

1. ROM: Read Only Memory /Power On Self Test (POST).

2. FLASH Memory:

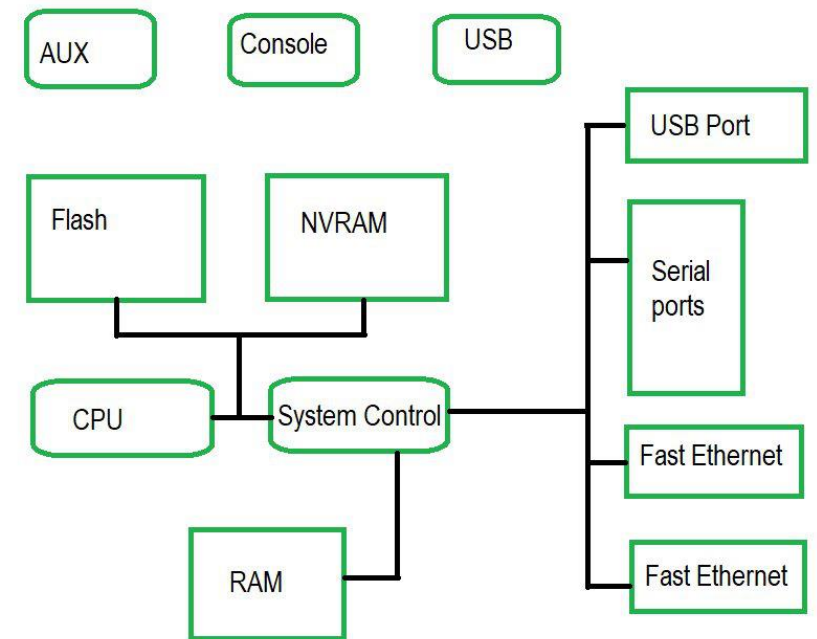
- . IOS Images are kept here.
- . Contents are kept on power down or reload.

3. RAM:

- . Random Access Memory.
- . Routing Tables.
- . Running Configuration.
- . Content are lost on reboot.

4. NVRAM:

- . Start up Configuration.
- . Contents are kept on reload.



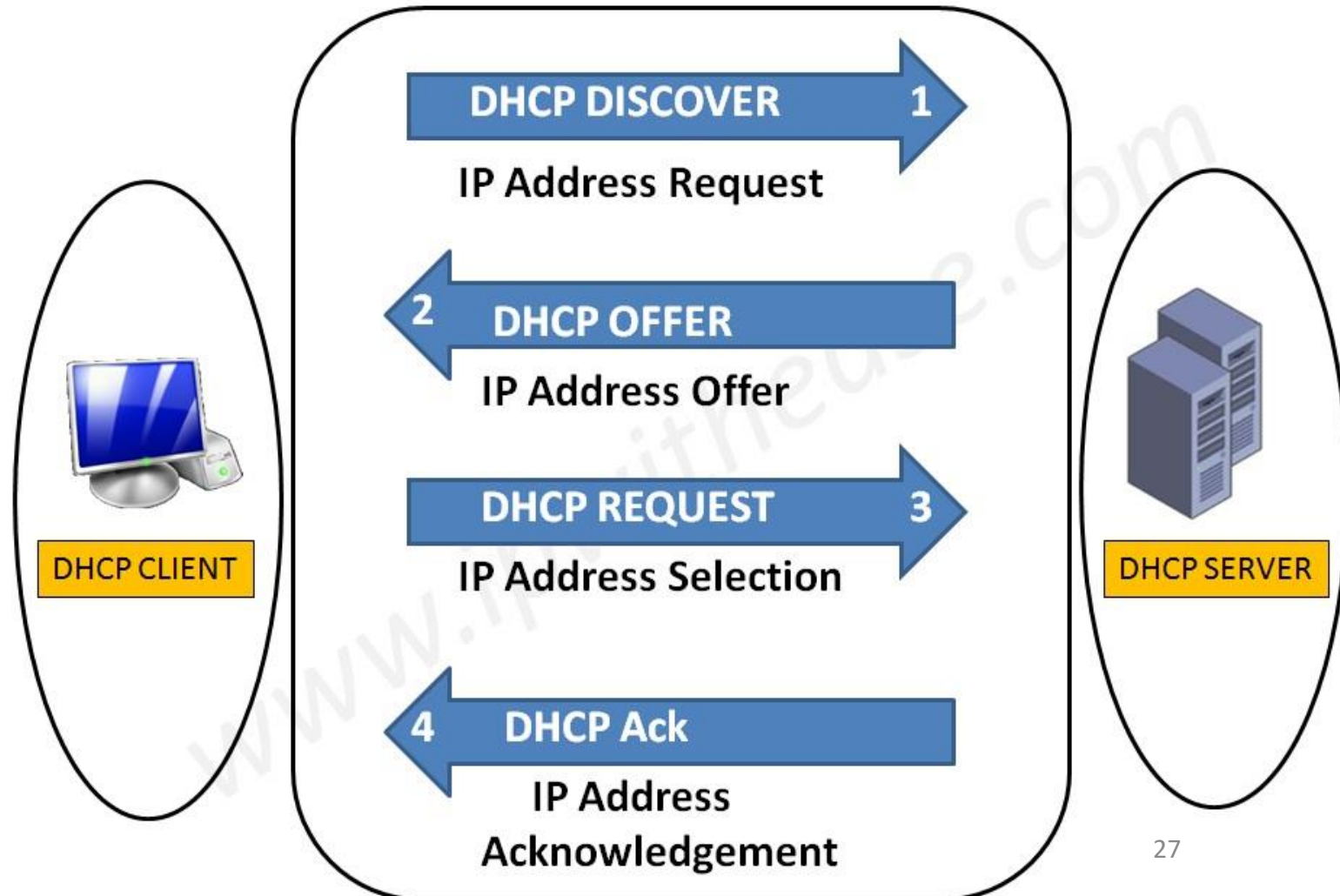
Router Basic- Lab

- enable ,disable, exit.
- show clock, clock set `hh:mm:ss month, day, year`.
- configure terminal, exit, do `command`.
- interface `port name & number`, exit, end.
- show running-config, show ip interface brief, show ip route.
- no ip domain-lookup.
- copy running-config startup-config, write.

* For Delete editing, Just enter `[no]command`.

DHCP Server, Router- Lab

- ip dhcp pool number
- network address
- default-router address
- excluded-address network



Subnetting

1. What is Subnetting?
2. Why do we need to Subnet a network?
3. Binary (0, 1) and Decimal (0- 9)!, Convert.
4. Subnettings Steps!

Subnetting Steps- Lab

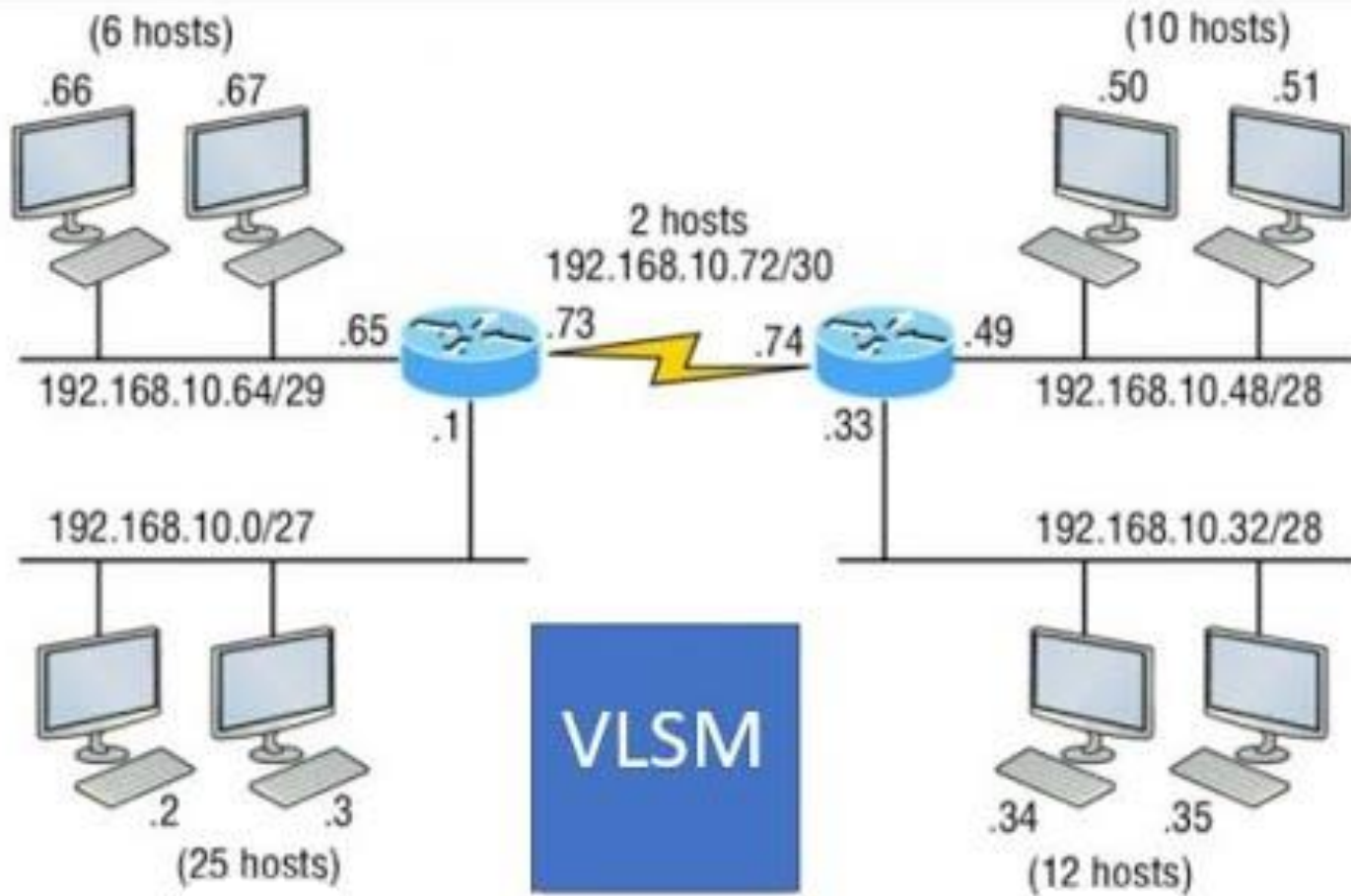
1. Binary^{Subnet mask}

Subnet	1	2	4	8	16	32	64	128	256
Host	256	128	64	32	16	8	4	2	1
Subnet Mask	/24	/25	/26	/27	/28	/29	/30	/31	/32

2. $2^{\text{Network (1)}}$

3. $2^{\text{Host (0)}} - 2^{\text{(Broadcast, Network)}} = \text{Hop}$

Variable Length Subnet Mask (VLSM)- Lab

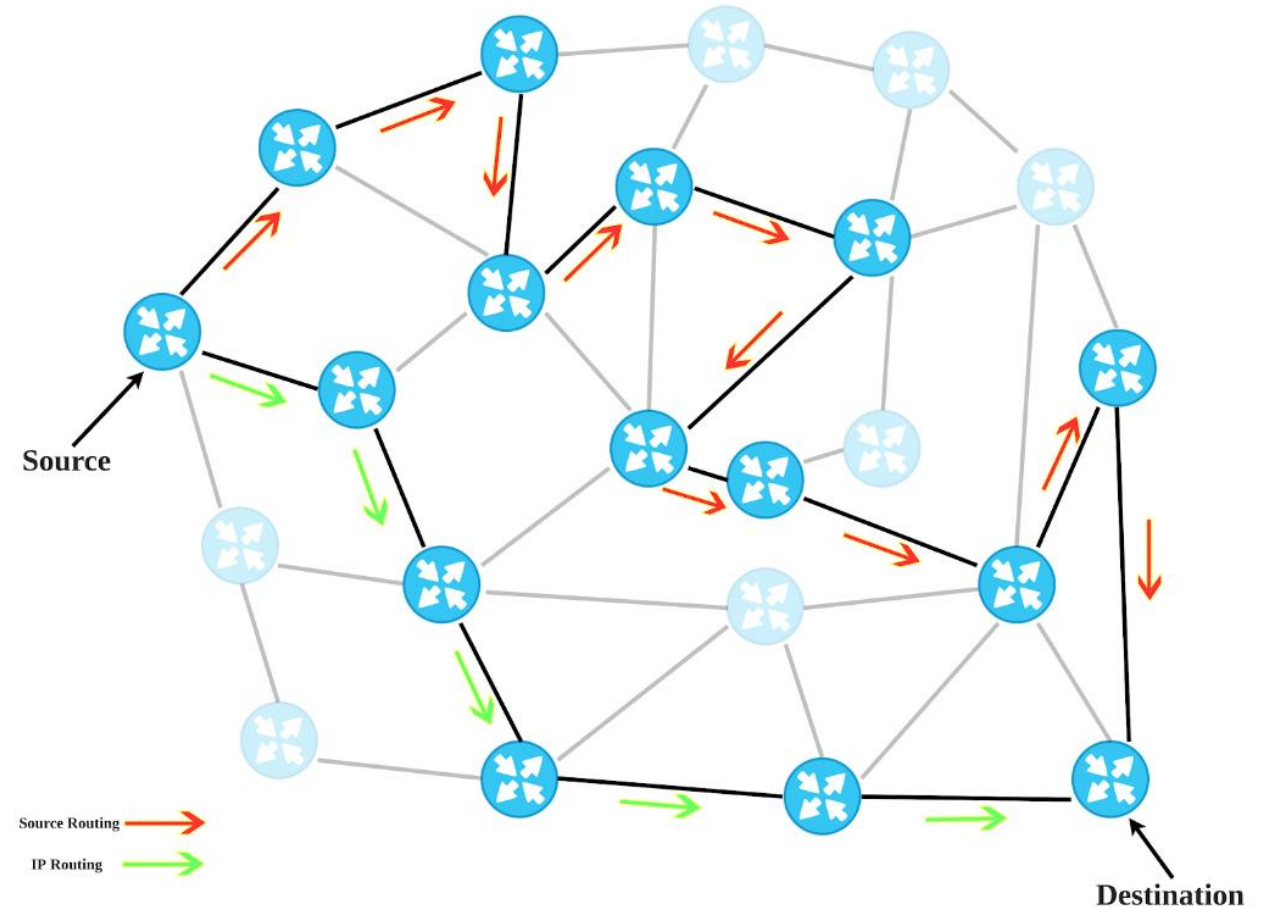


Subnet	1	2	4	8	16	32	64	128	256
Host	256	128	64	32	16	8	4	2	1
Subnet Mask	/24	/25	/26	/27	/28	/29	/30	/31	/32

Routing Protocol

The Router should know:

- ✓ Destination addresses.
- ✓ Possible routes.
- ✓ Best route.



Routing Protocols	Default Administrative Distance
Directly connected	0
Static route	1
EIGRP	90
OSPF	110
RIP	120
Unknown	255

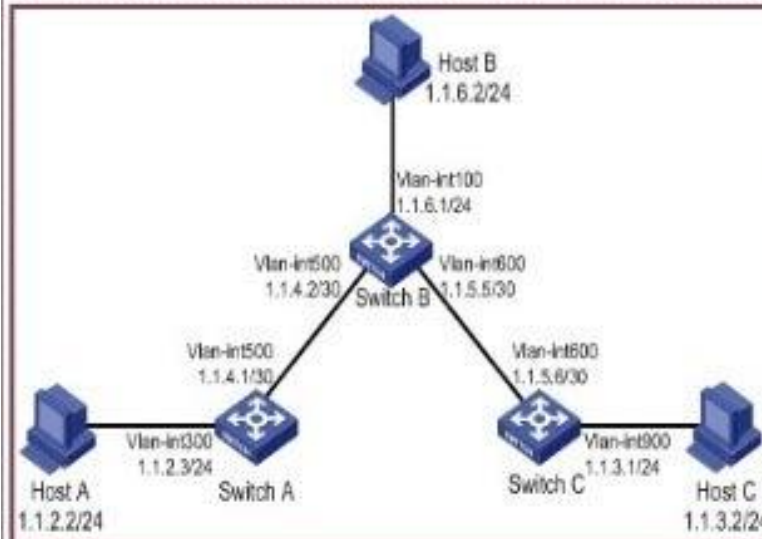
Routing Types

- Static Routing:

- dynamic route:

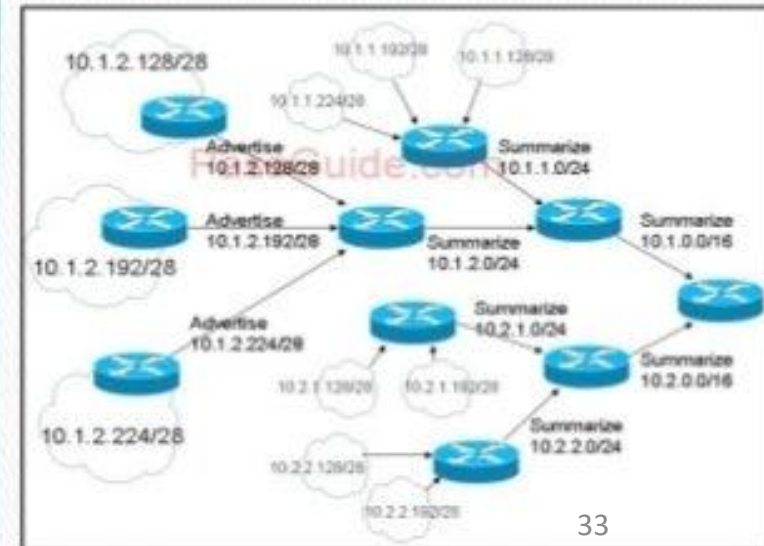
STATIC

- ▶ non-adaptive routing
- ▶ networks may use manually configured routing tables.
- ▶ suitable on small networks
- ▶ public switched telephone network (PSTN).



DYNAMIC

- ▶ adaptive routing
- ▶ constructing routing tables automatically
- ▶ Small+Large Networks
- ▶ RIP , OFPS , ISIS , BGP etc.



Static Route- Lab



```
ip route 172.16.1.0 255.255.255.0 172.16.3.2  
or  
ip route 172.16.1.0 255.255.255.0 s0/1
```

- **Benefits:**

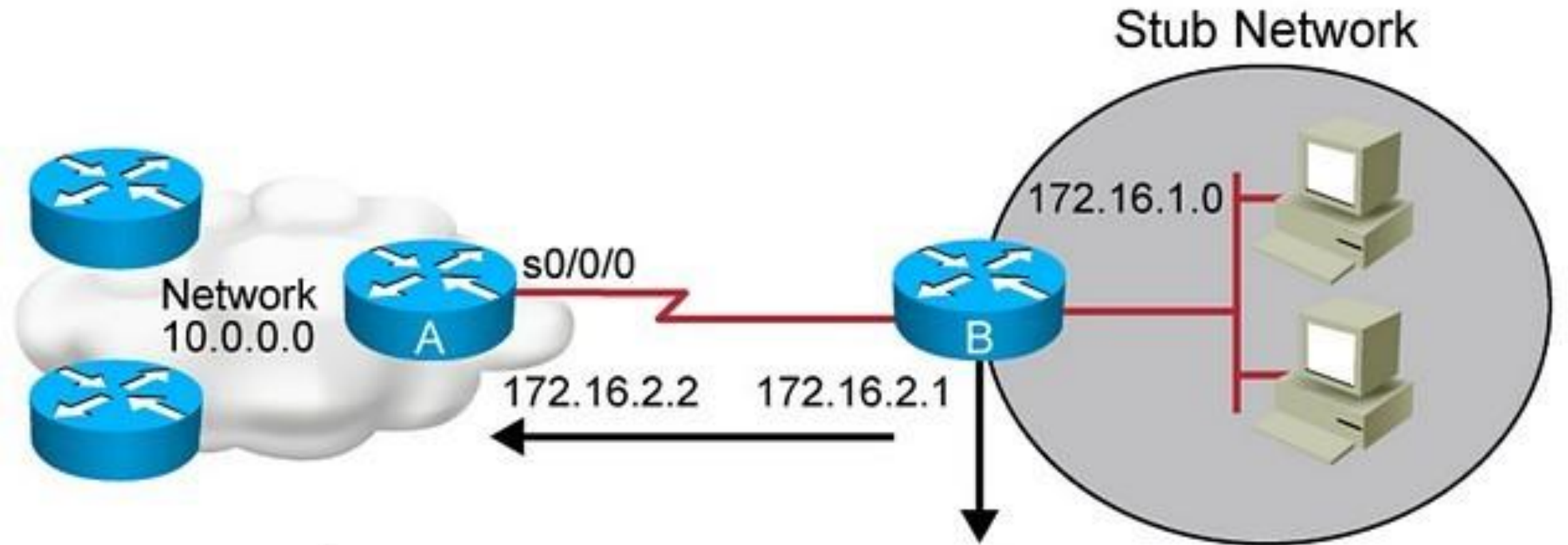
1. No overhead on the router CPU.
2. Adds security.

- **Disadvantage:**

1. Administrator must really understand the internetwork.
2. Not feasible in large networks.

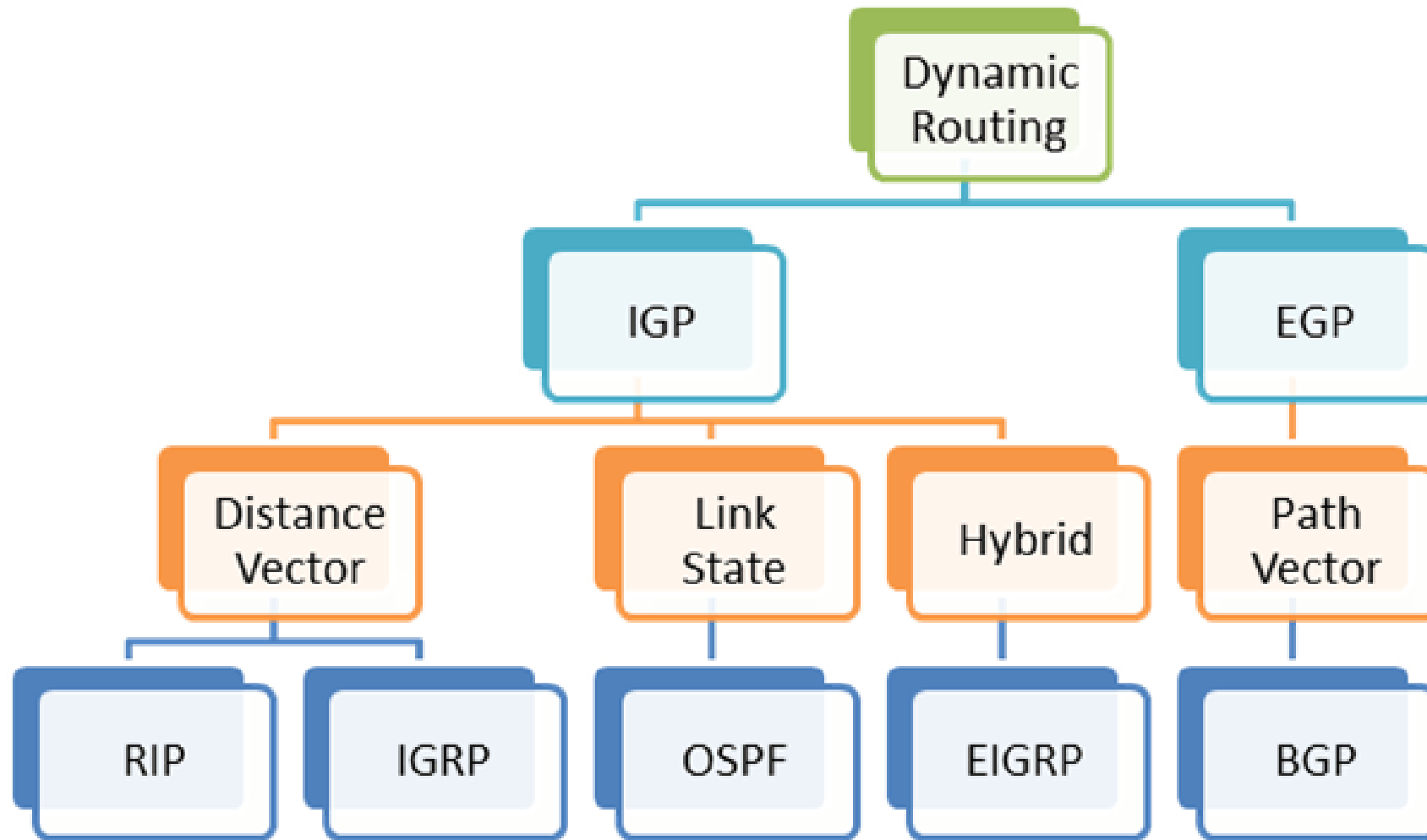
ip route Destination Subnet mask Next Hop

Default Route- Lab

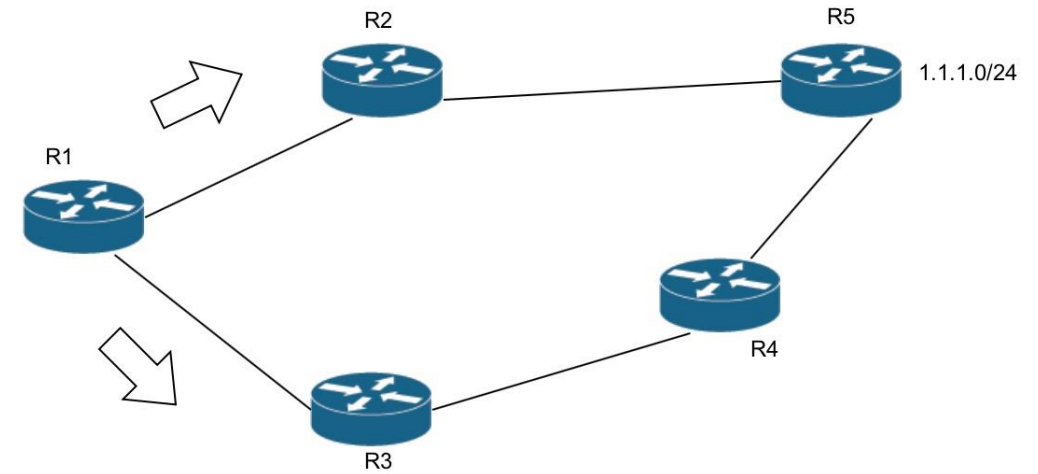


```
RouterX(config)# ip route 0.0.0.0 0.0.0.0 172.16.2.2
```

Dynamic Route



Routing Metric



Routing Protocols	Metrics
RIP	hop count
EIGRP	bandwidth & delay
OSPF	cost

Difference Between Routing Protocols

[The various Routing Protocols]

Classful= No support VLSM

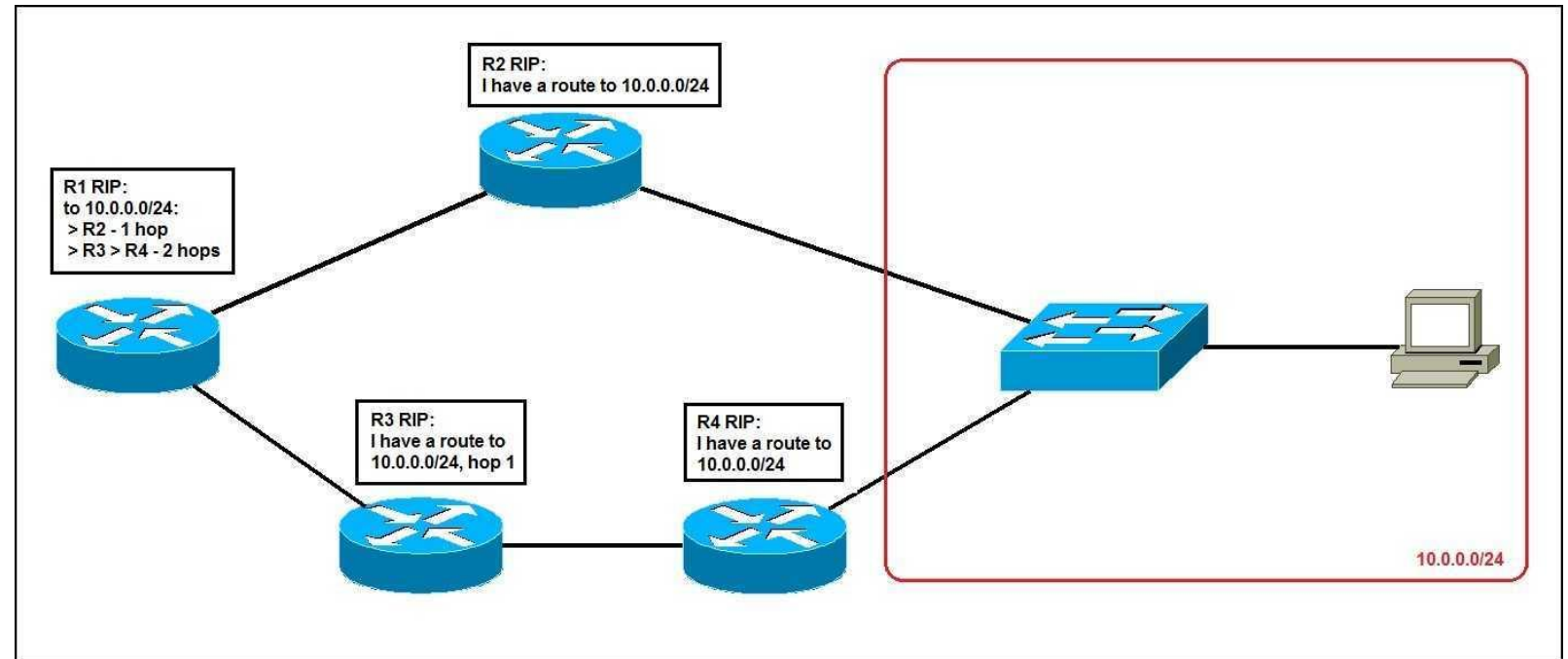
Classless= Support VLSM

The Various Routing Protocols

Features	RIP v1	RIP v2	IGRP	OSPF	EIGRP
Classful / Classless	Classful	Classless	Classful	Classless	Classless
Metric	Hop	Hop	Composite (bw and delay)	Cost 100,000/BW	Composite (bw and delay)
Periodic Advertisement	30 seconds	30 seconds	90 seconds	none	30 seconds
Advertising Address	255.255.255.255 (broadcast)	224.0.0.9 (multicast)	255.255.255.255 (broadcast)	224.0.0.5 224.0.0.6 (multicast)	224.0.0.10 (multicast)
Administrative Cost	120	120	100	110	Internal: 90 External: 170
Category	Distance Vector	Distance Vector	Distance Vector	Link State	Hybrid

RIP- Routing- Lab

- router rip
- version
- network Address

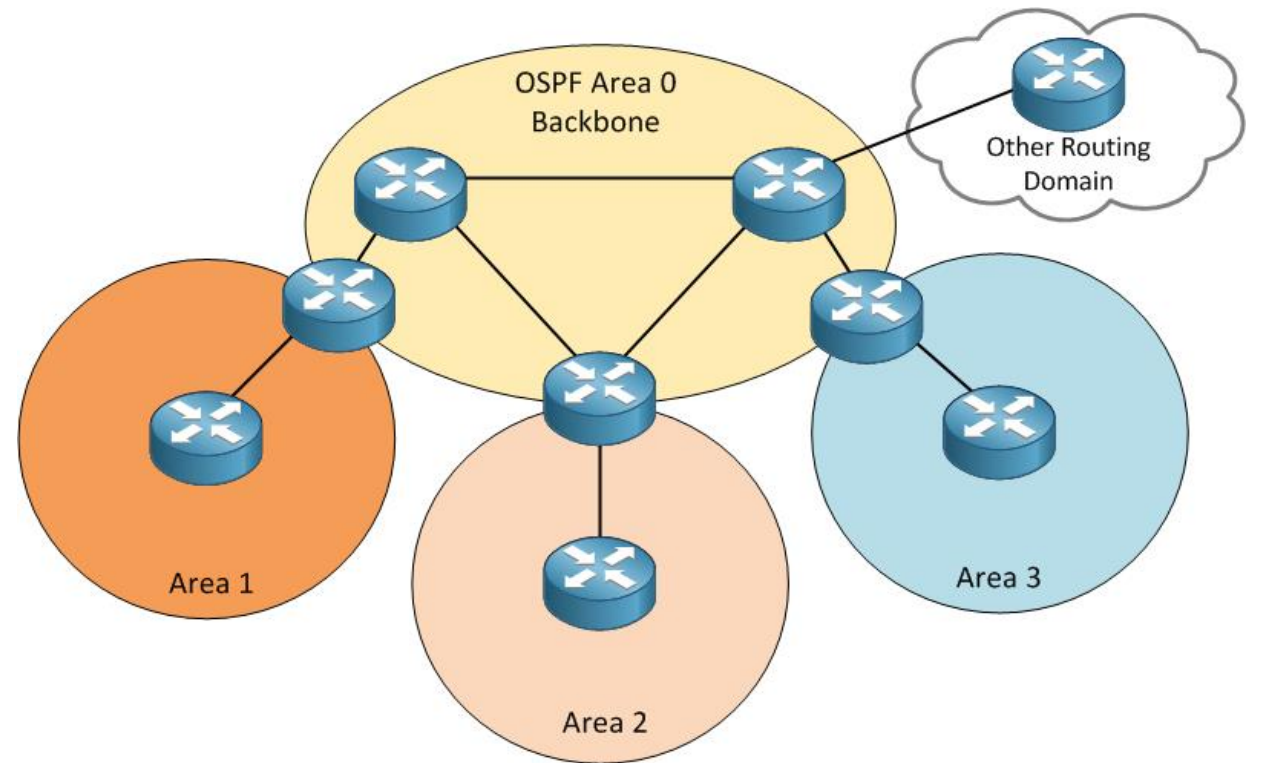


EIGRP- Routing- Lab

- router eigrp ? Should be a same Autonomous system number
- network Address

OSPF- Routing- Lab

- router ospf ? You can change the number
- network address, wildcard, area



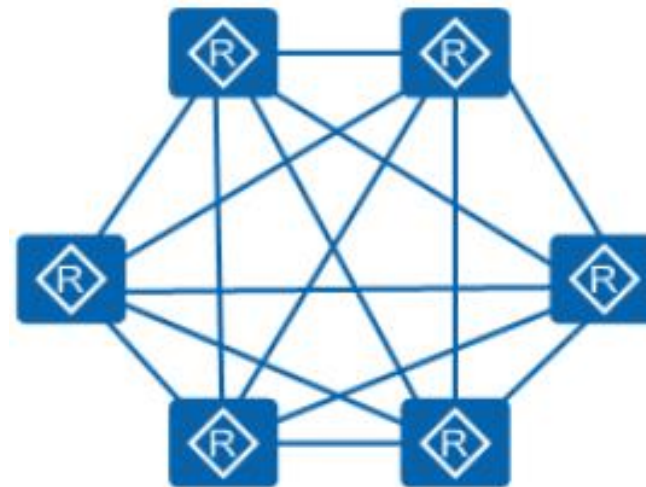
Designated Route (DR)- Backup Designated Route (BDR)-OSPF- Lab

- organize Traffic Router.
- 40 SEC to Choose DR.
- Router Priority 1- 255, Highest.
- The default is 1.
- Router ID- Manual.
- Highest IP Address.

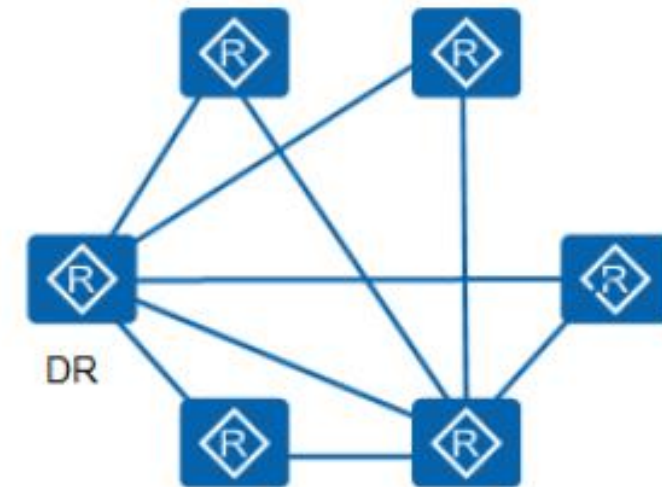
Lab

- interface ip ospf priority
- show ip ospf neighbor.
- show router ospf.

Loopback interface it is Better.



Before a DR is elected



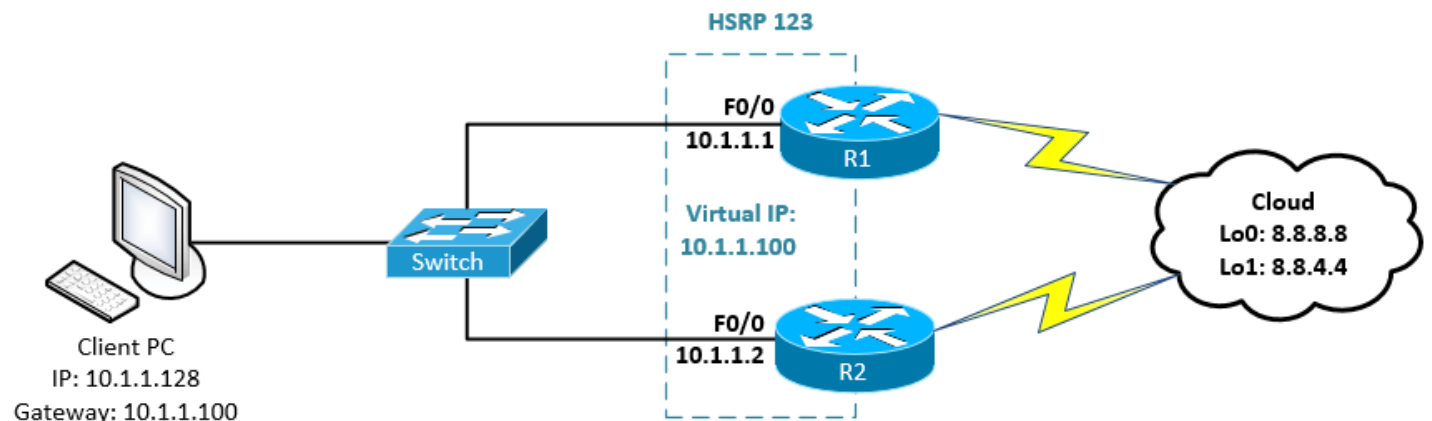
After a DR is elected.

Redundancy Protocols- HSRP- Lab

- Hot Standby Router Protocol (HSRP): Cisco proprietary.
- Hello Message: 3 sec.
- Hold time: 10 sec.
- Active, Standby.
- No Load balance.
- 2 Gateway.

Lab

1. interface.
2. standby+ Group number+ ip.
3. show standby.

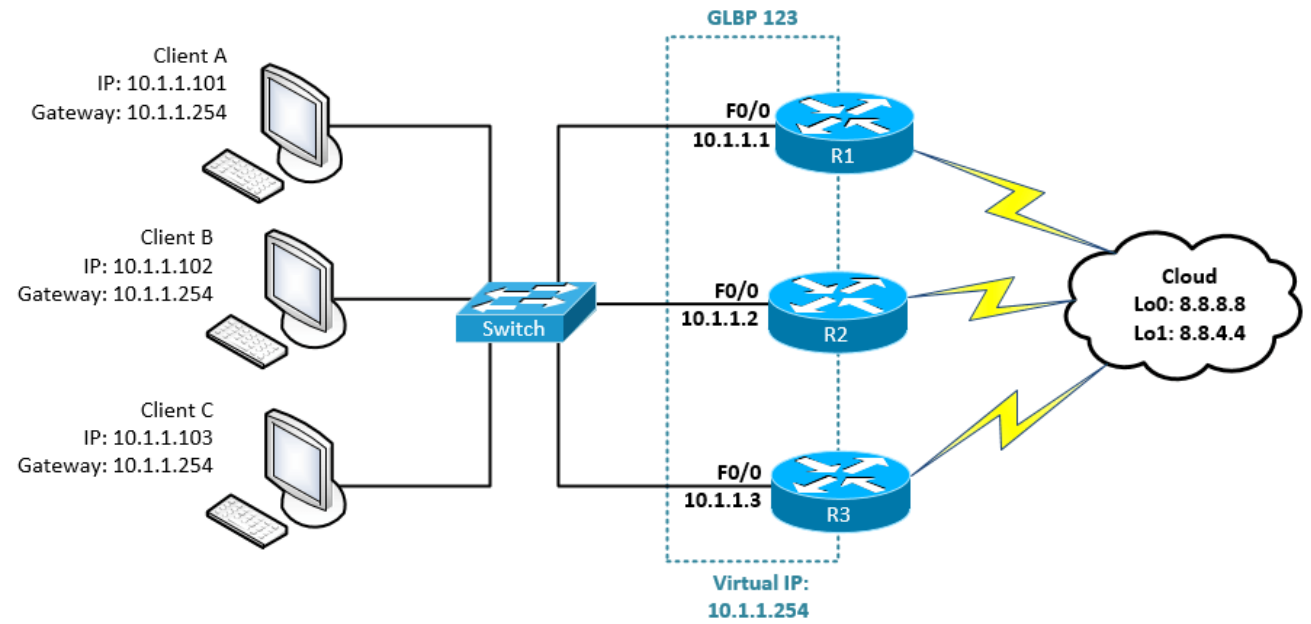


Redundancy Protocols- VRRP

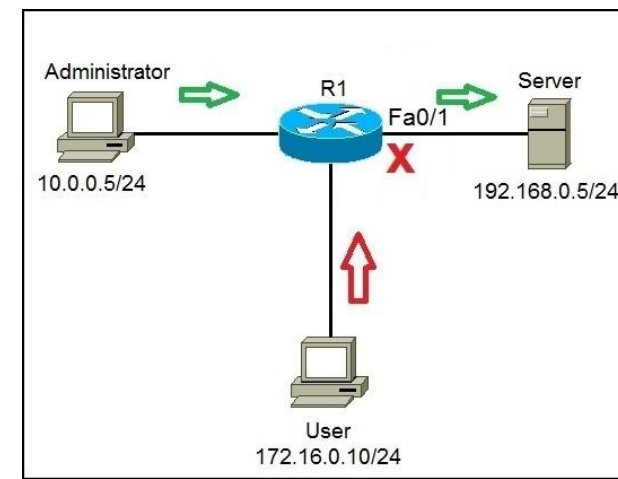
- Virtual Router Redundancy Protocol (VRRP): Open Standard.
- Hello Message: 1 sec.
- Hold time: 3 sec.
- Active, Standby.
- No Load balance.
- 2 Gateway.

Redundancy Protocols- GLBP

- Gateway Load Balancing Protocol (GLBP): Cisco proprietary.
- Load Balance.
- 4 Gateway.



Access Control List (ACL)



Standard

Numbered

Named

- 1- 99
- Source
- Permit/ Deny **Everything**
- **Nearest** INT **Destination**

Extended

Numbered

Named

- 100- 199
- Source
- Destination
- Protocol (Port Number)
- **Nearest** ITN **Source**

Standard ACL- Lab

- access-list 1- 99 deny or permit ip address.
- access-list permit any.
- ip access-group 1- 99 in or out.
- show access-list

* If you want Deny a network use Wildcard.

Extended ACL- Lab

- access-list 100- 199 deny or permit protocol host ip address host ip address eq port number
- access-list 100- 199 deny or permit ip any any
- interface.
- ip access group-list in or out.

* If you want Deny a network use Wildcard.

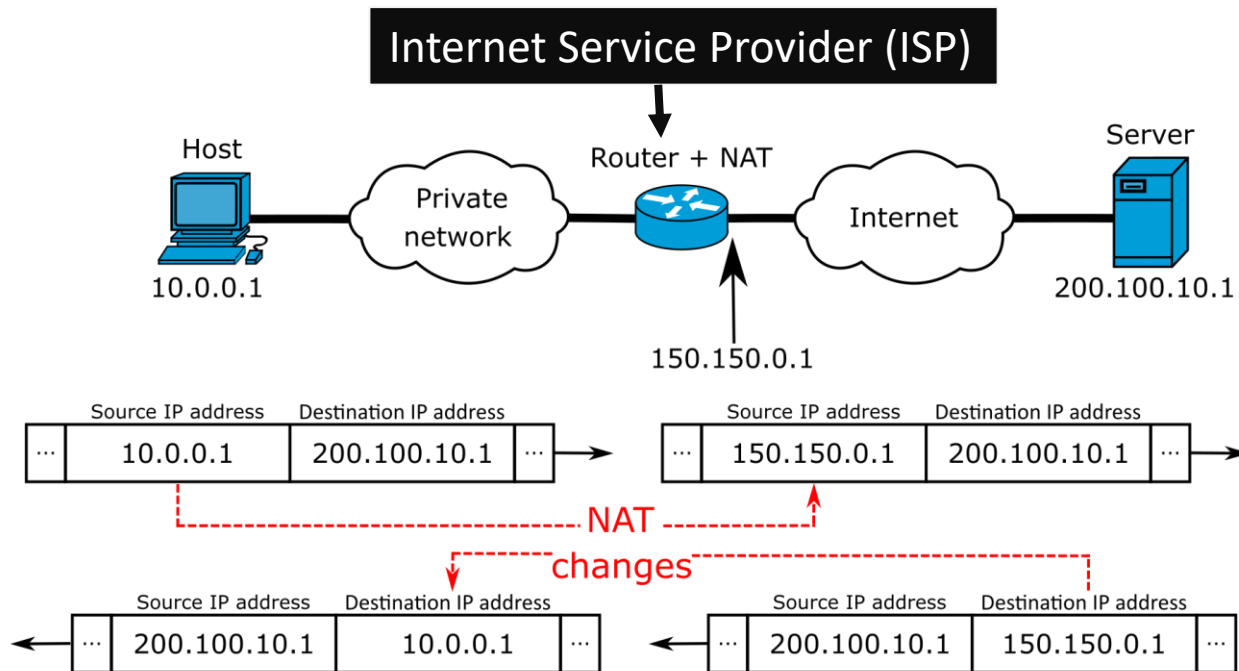
Example ACL

- access-list 1 deny 1.1.1.1
 - access-list 1 permit any
- access-list 2 deny 1.0.0.0 0.255.255.255
 - access-list 2 permit any
- access-list 110 deny ip 1.1.1.5 host 2.2.2.5 eq 80
 - access-list 110 permit any any
- access-list 150 deny tcp 1.0.0.0 0.255.255.255 host 2.2.2.5 eq 23
 - access-list 150 permit any any

Network Address Translation (NAT)

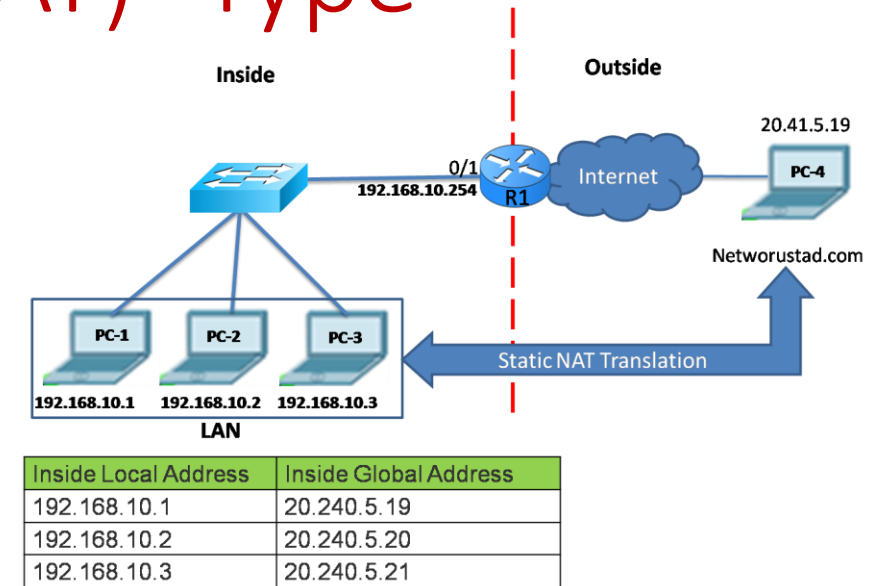
Reason NAT:

1. IPv4

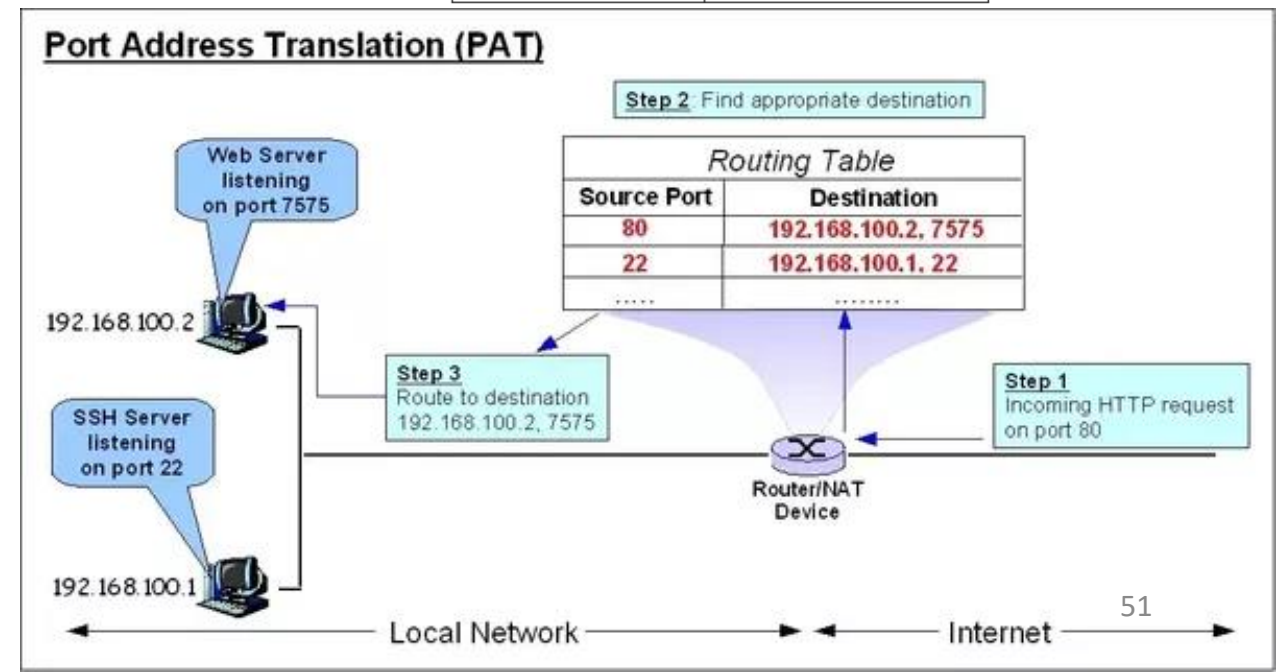


Network Address Translation (NAT)- Type

1. Static:
2. Dynamic: Range Number



3. PAT:



Network Address Translation (NAT)- Type- Lab

1. Static Network Address Translation- Lab.
2. Dynamic Network Address Translation- Lab.
3. PAT Network Address Translation- GNS3.

✓ **ip nat inside source static ip ip**

✓ **interface ip nat inside/outside**

✓ **access-list 1 permit network wildcard**

✓ **ip nat pool name ip range netmask**

✓ **ip nat inside source list 1 pool name**

✓ **interface inside/ outside**

✓ **access-list 2 permit network wildcard**

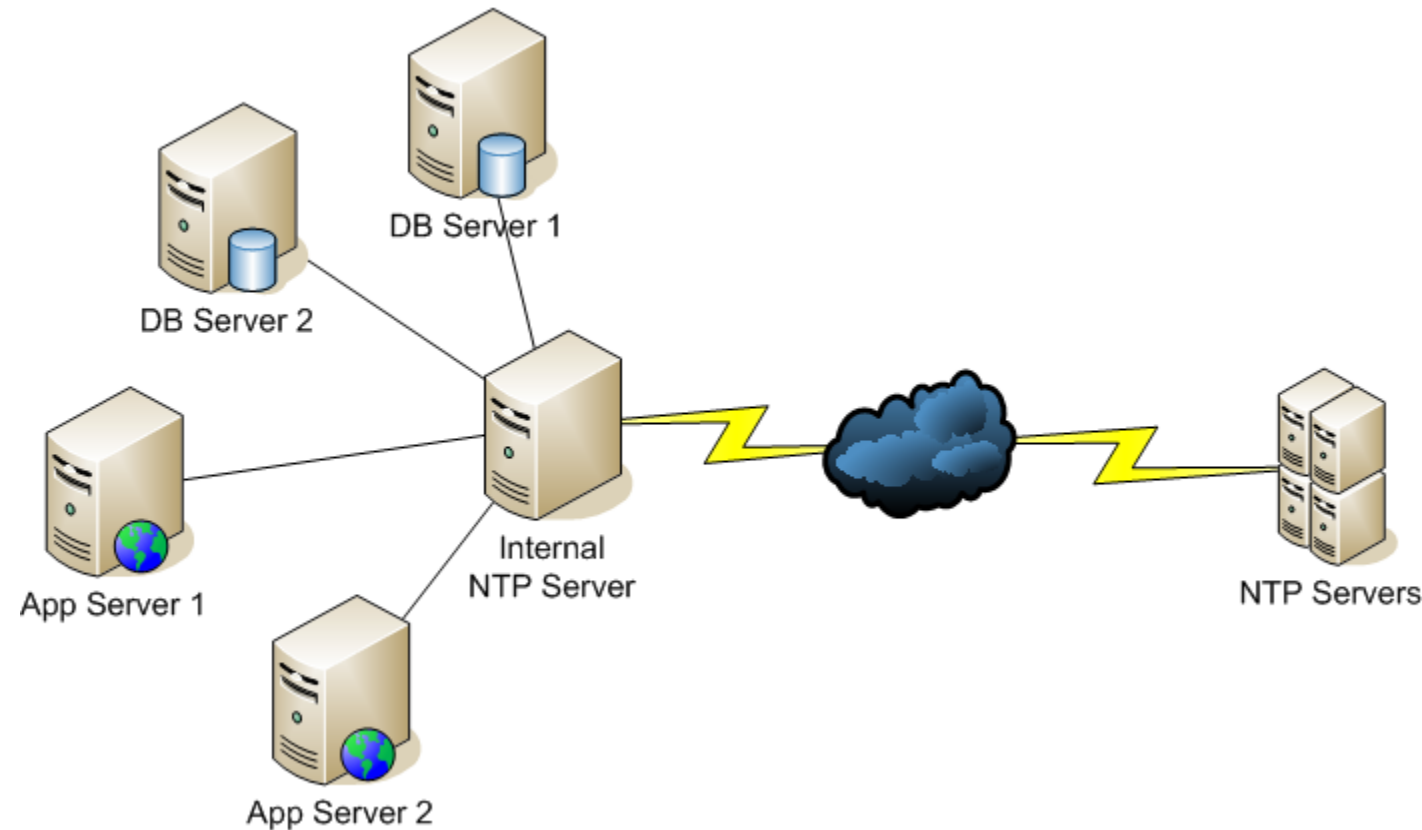
✓ **ip nat pool name ip range netmask**

✓ **ip nat inside source list 2 pool name overload**

✓ **interface inside/outside**

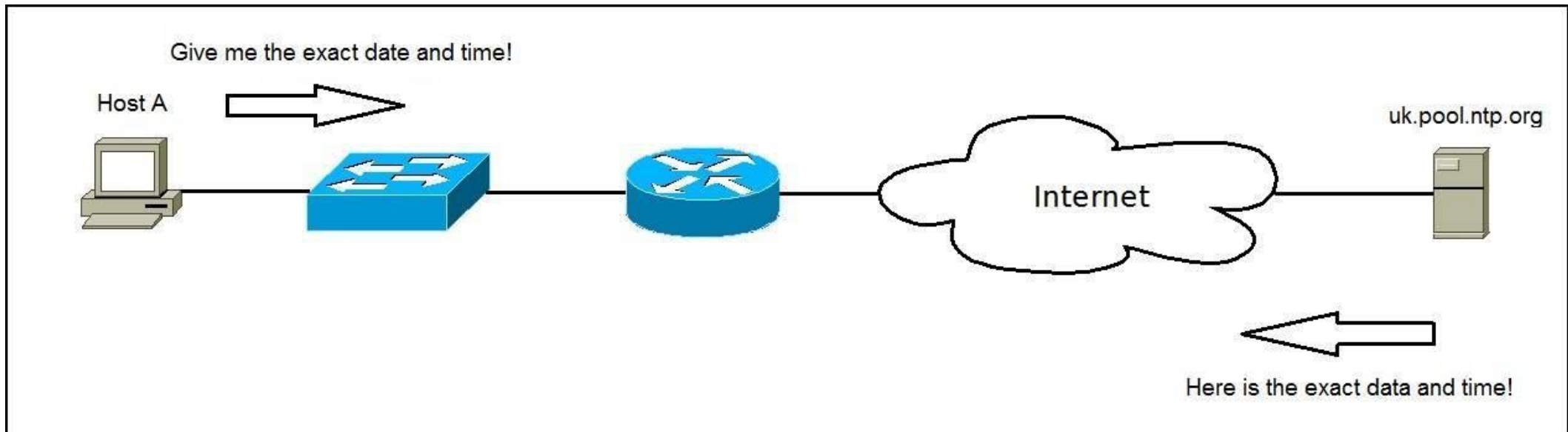
Network Time Protocol (NTP)- Manual (Static)- Lap

- It provides internet synchronization between the devices.
- security.
- clock set `hh:mm:ss month, day, year`.
- NTP Master.
- NTP Server ip address.
- show ntp status.
- show ntp associations.



Network Time Protocol (NTP)- Dynamic

- ntp server pool.ntp.org- EVE- NG



Securing Router- Lab

1. Console Cable/ Rollover

➤ line console 0

➤ password 000

➤ login

* user/password-secret/ login local

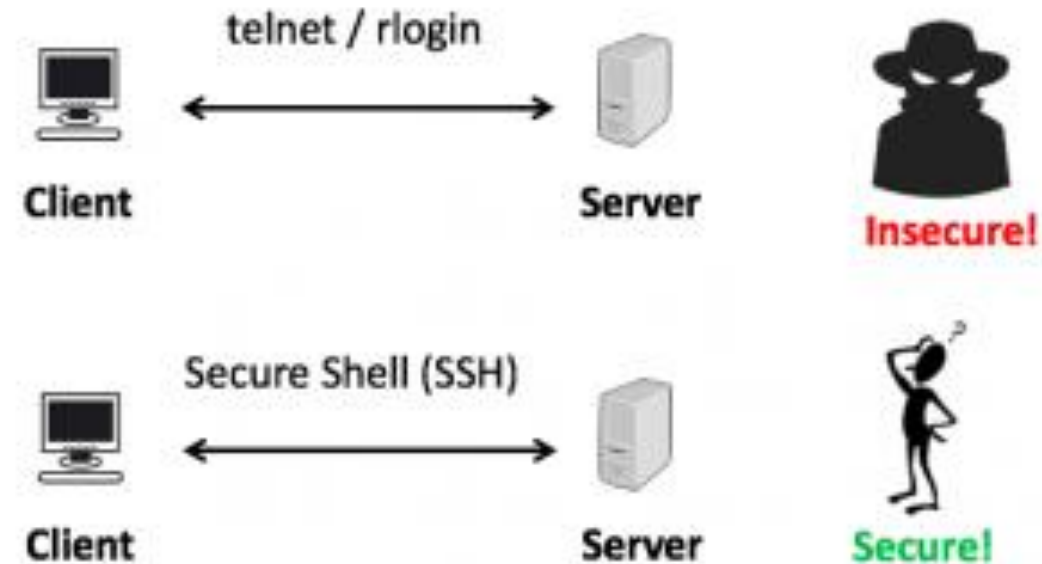
2. Privilege mode/ enable mode

➤ enable password/ secret 000

* service password-encryption

3. Telnet/ SSH

* enable password set



Telnet/ SSH- Lab

----- Telnet -----

- line vty 0 4
- password

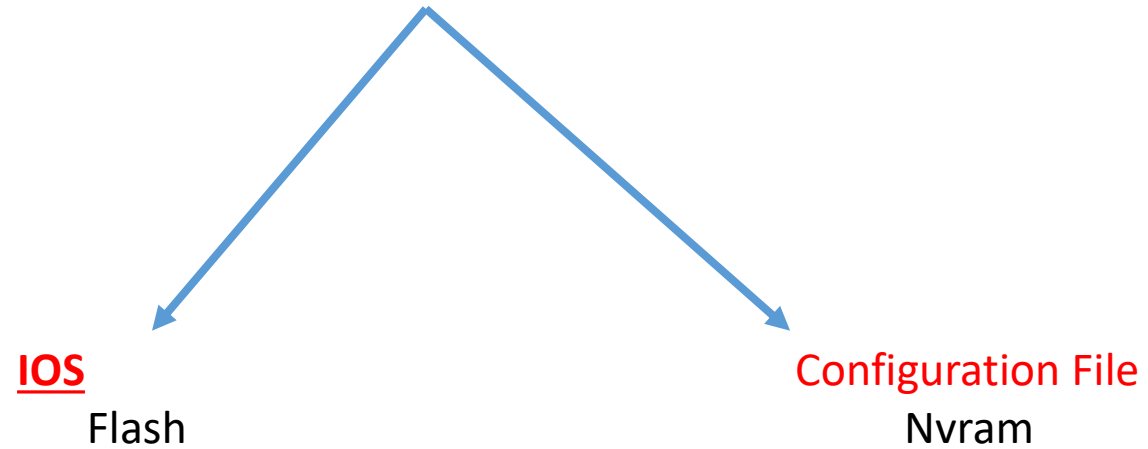
----- SSH -----

- user name/ password
- * enable password
- hostname
- ip domain-name {name.name}
- crypto key generate rsa 512, 1024, 2048
- line vty 0 4
- transport input ssh
- login local

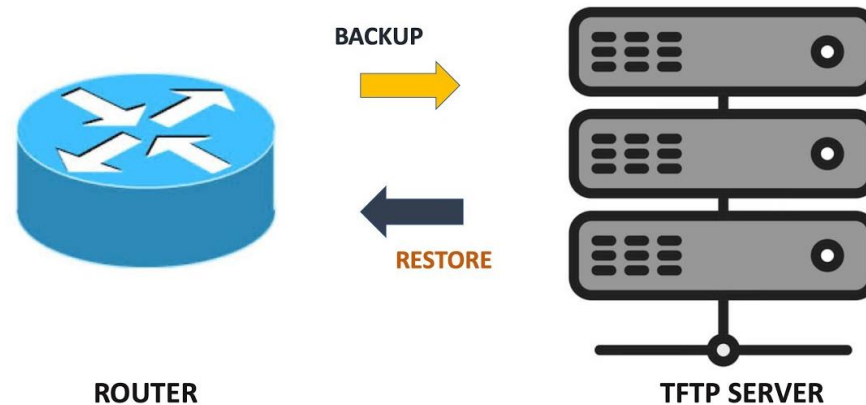
```
telnet ip address
```

```
ssh -l name ip address
```


Backup & Restore- Lab



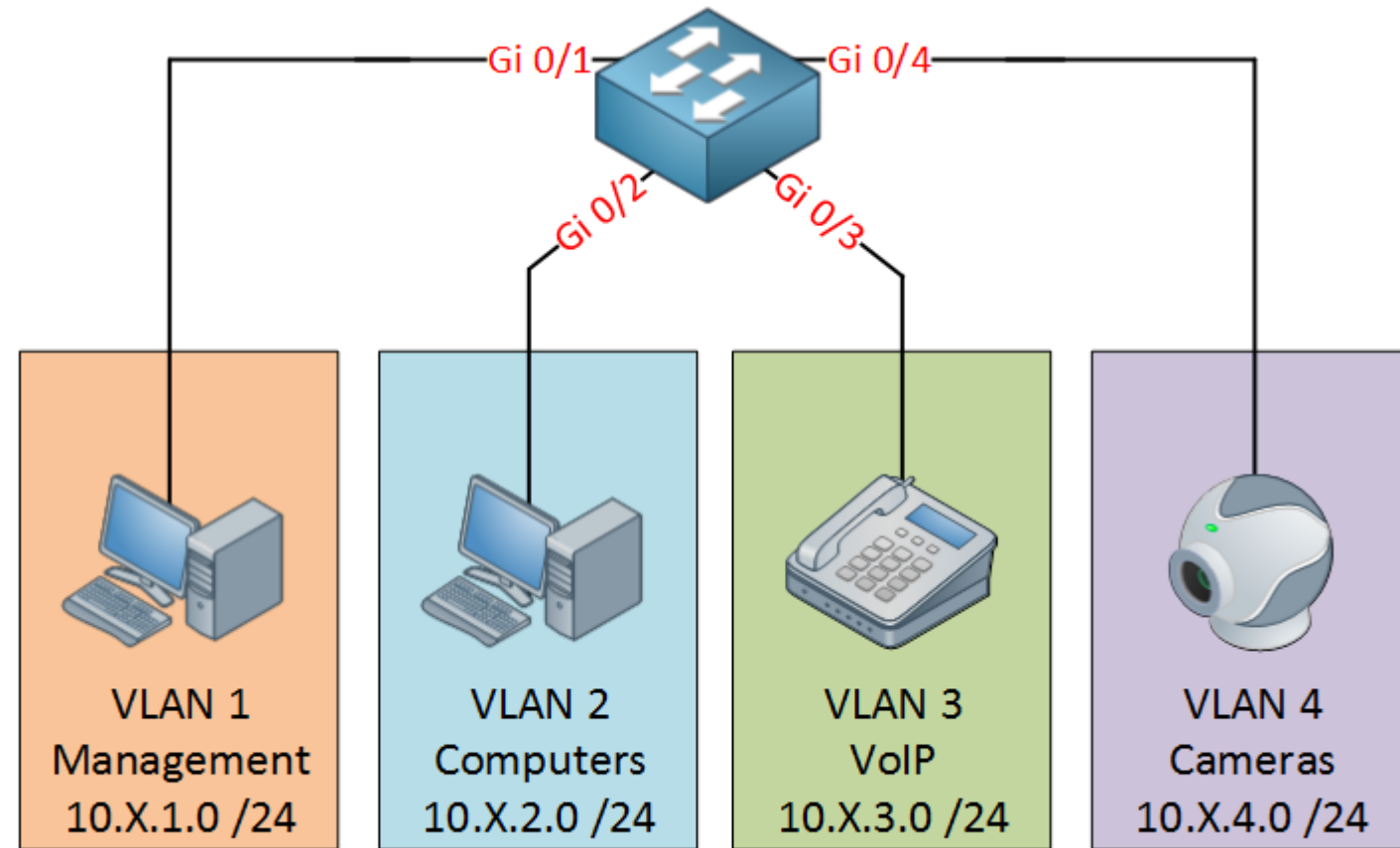
- show flash
- copy flash: tftp:



- copy running-config tftp:
- copy tftp running-config

Virtual LAN (VLAN)- Lab

- Security
- Broadcast
- management
- vlan 1– 1001
- name
- switchport access vlan for PC
- switchport trunk vlan for switch

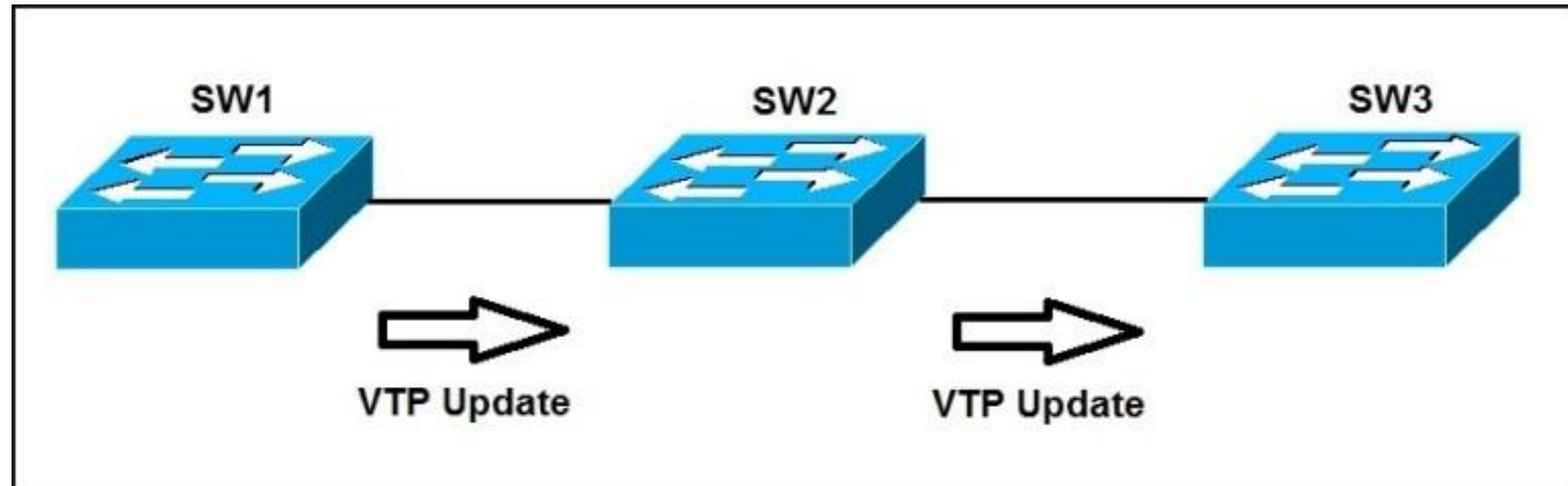


* show VLAN

VLAN Trunking Protocol (VTP)- Lab

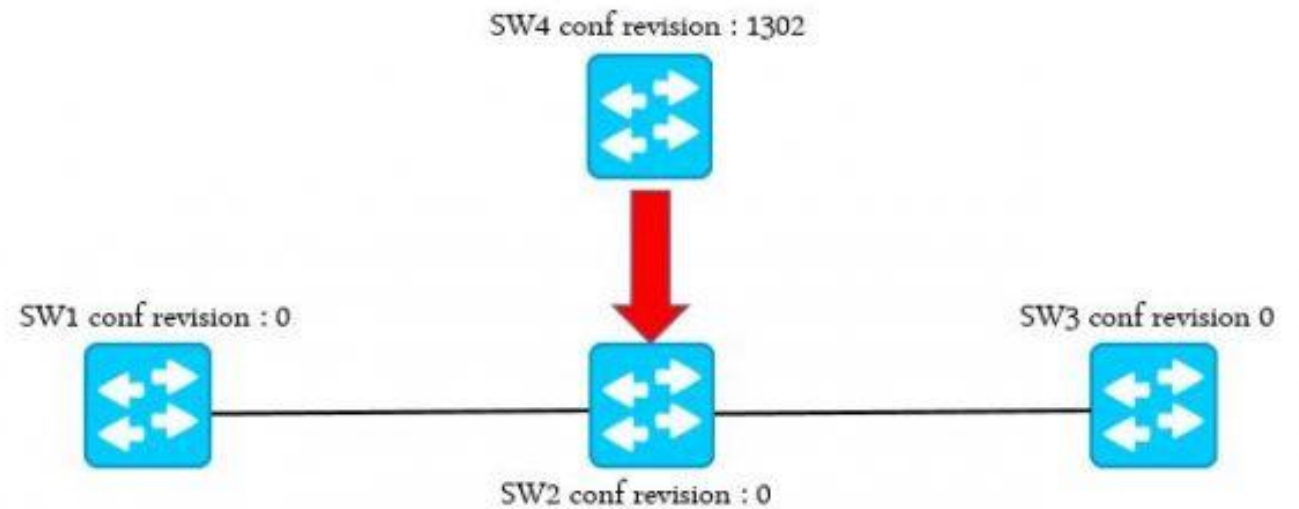
- VTP mode Server can Edit and delete vlan (Default).
- VTP mode Clint can Copy VLAN and forwarding, Can not Edit and delete vlan.
- VTP mode Transparent Can build vlan own in data base, can not copy vlan just forwarding.

1. vtp domain
2. vtp password
3. show vtp status
4. interface trunk



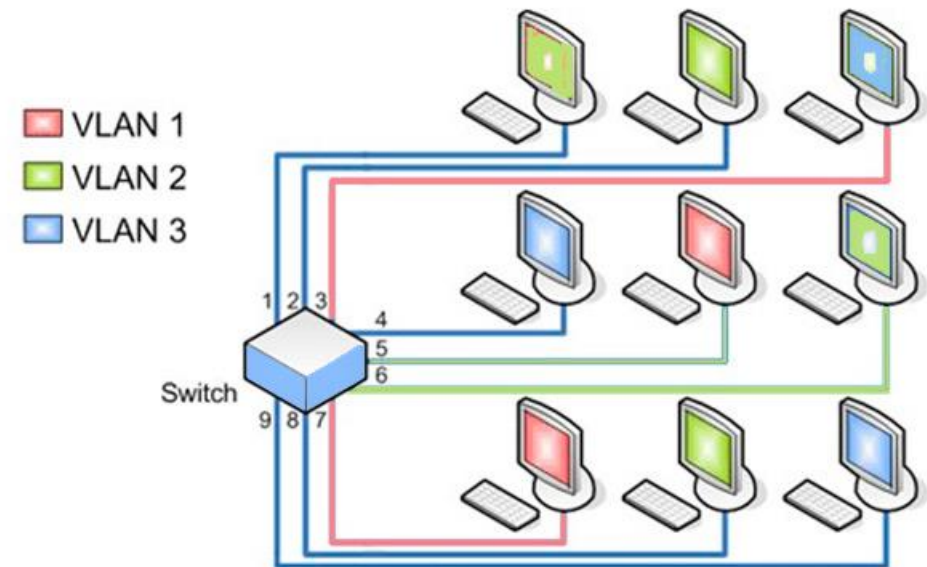
Configuration Revision (VTP)- Lab

- Highest
 1. To return 0:
 2. VTP mode Transparent
 3. Or change domain name



VLAN Types- Lab

1. Data (Made VLAN)
2. Default (VLAN 1)
3. Management Switch (Telnet & SSH)
4. Native



Management Switch- Lab

- interface vlan number
- no shutdown
- ip address
- line vty 0 4
- password
 1. set password
 2. username password

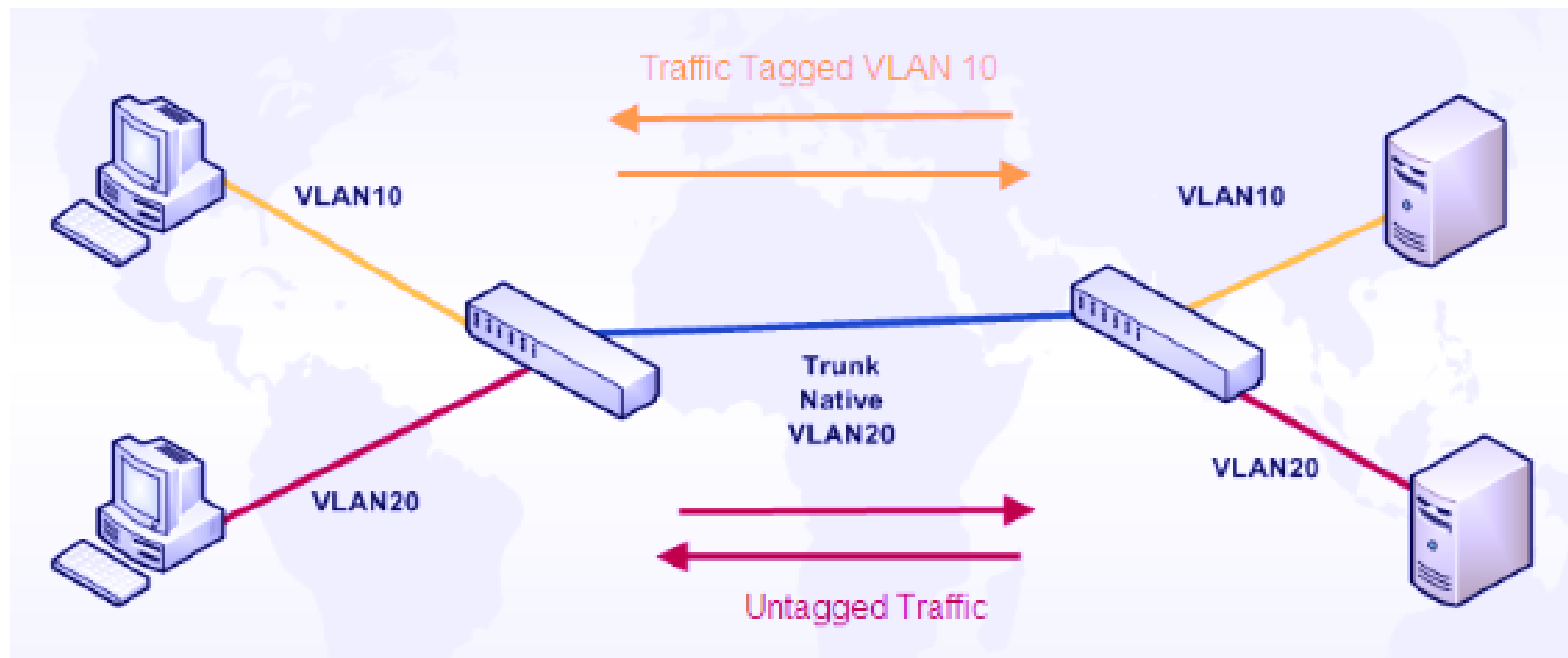
Native Vlan

Untagged frame

accept vlan: switchport trunk vlan allowed number,number range- range

native vlan: switchport trunk native vlan

show interface trunk



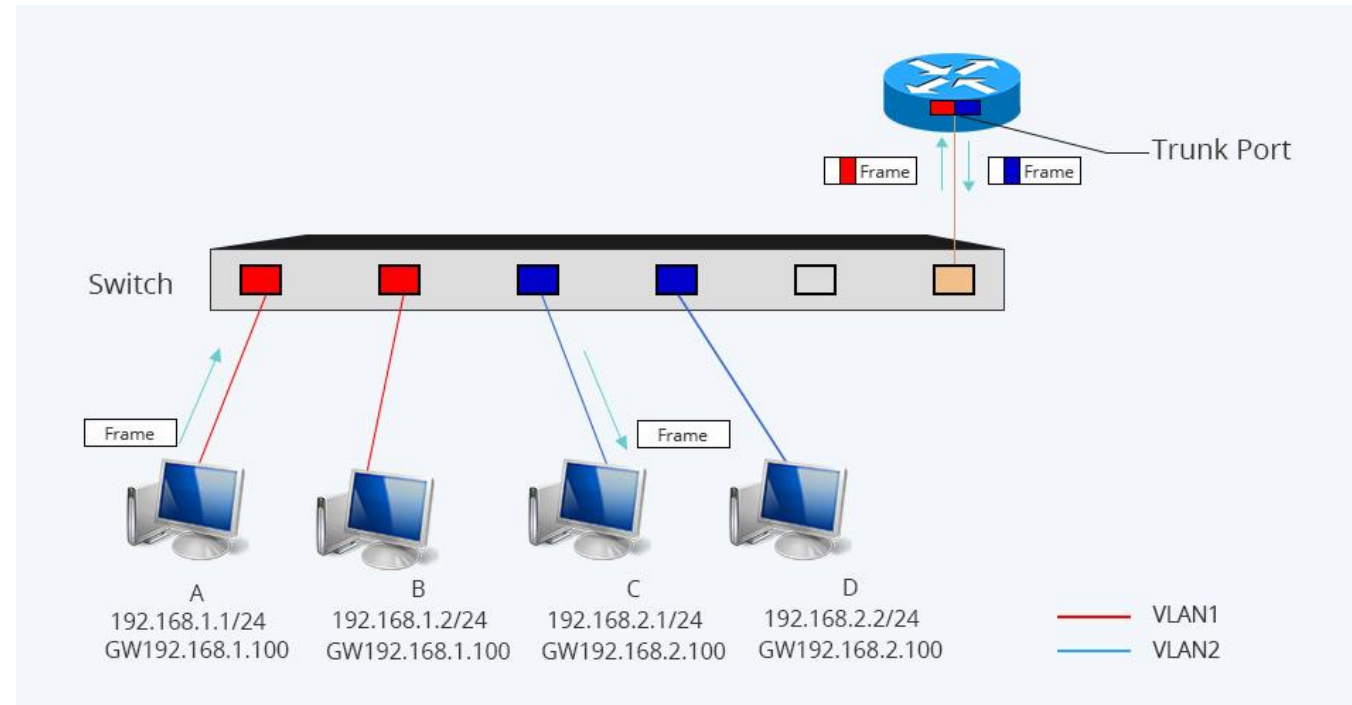
Inter-VLAN (Router On Stick)- Lab

Router

- interface g0/0.1
- ip address
- show ip interface

Switch Layer 3

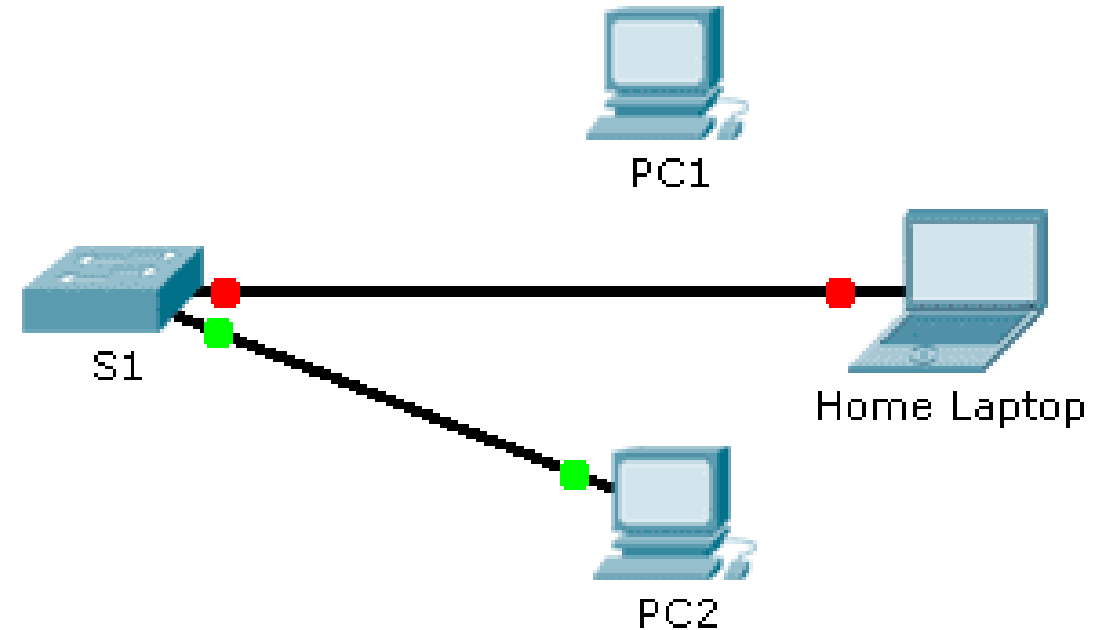
- interface vlan number
- ip address
- show ip route
- ip routing



Port Security- Lab

port Security with access mode pc
interface fastEthernet 0/number
switchport mode access
switchport port-security
shutdown (error disabled)
no shutdown

- switchport port-security violation protect, NO notification
- switchport port-security violation restrict, With notification
- switchport port-security maximum number- maximum mac address (Save in Switch)

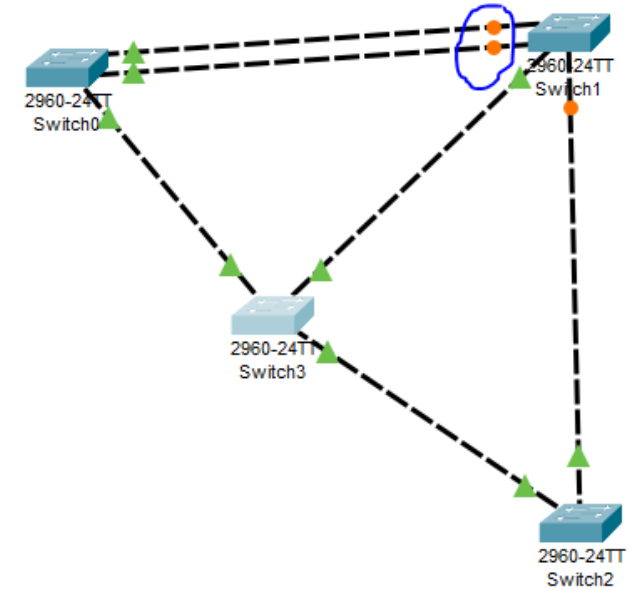
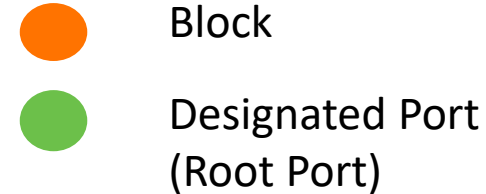


Spanning Tree Protocol (STP)- Lab

No loop- Broadcast
Cables- Switch+ 1= STP
Root (Root Bridge- Switch)
Bridge ID= Priority, MAC-Address
Other= Designated Switch (NON Root)
Lower Bridge ID, Cost

- 10 Mbps= Ethernet = 2
- 100 Mbps= FastEthernet = 19
- 1Gbps= GigabitEthernet = 4

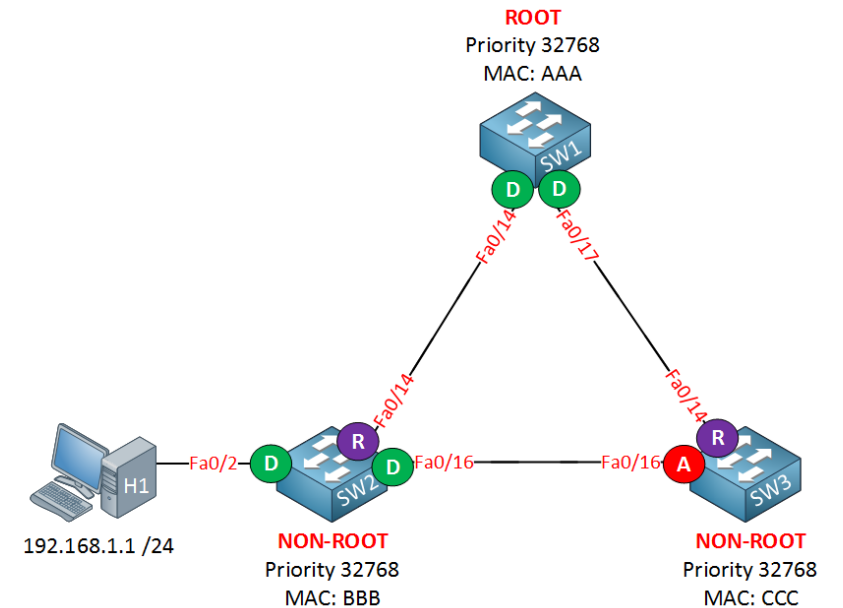
* show spanning-tree



Port Speed	STP Port Cost
10 Mbps	100
100 Mbps	19
1 Gbps	4
10 Gbps	2

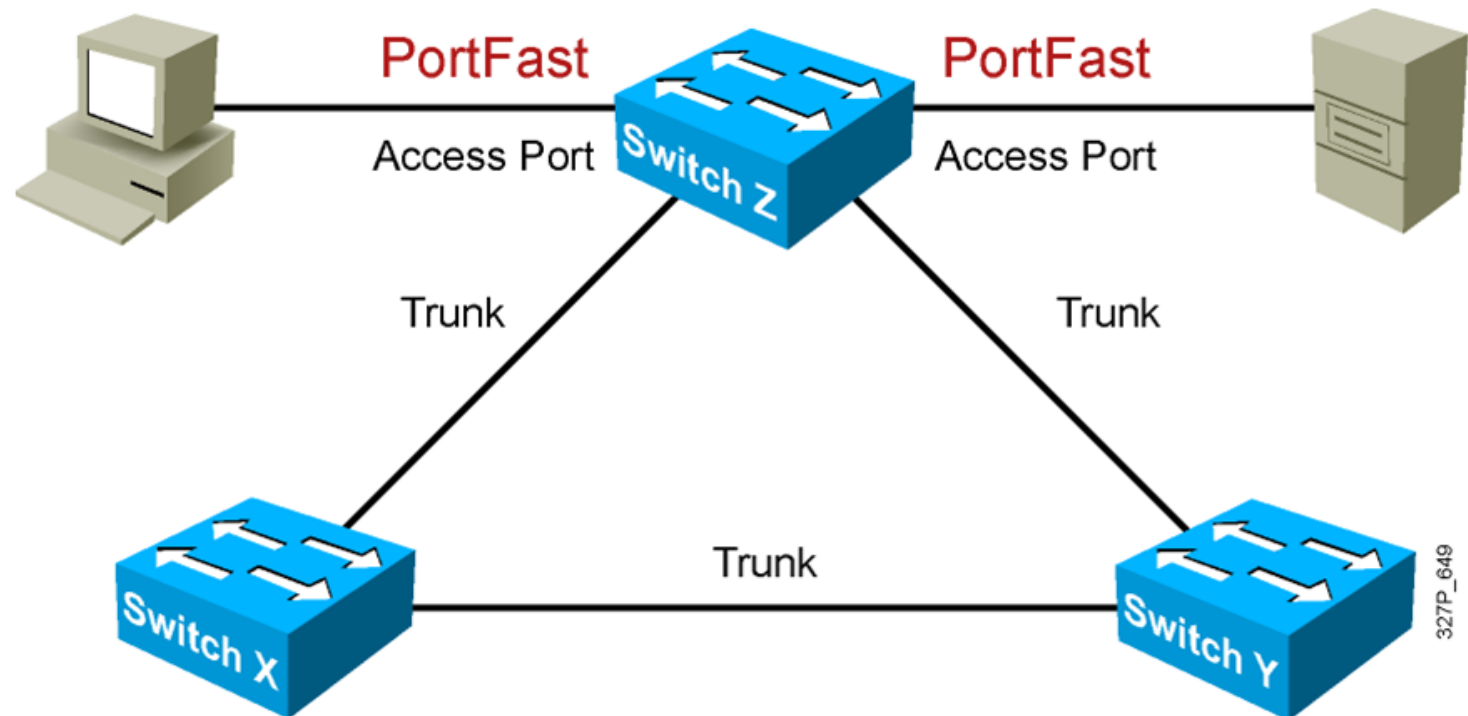
Rapid Spanning Tree Protocol- Lab

- rapid spanning tree
- 1- 2 sec
- spanning-tree mode rapid-pvst
- configure all switch



Port Fast (STP)- Lab

- spanning-tree portfast
- 1- 2sec
- End devices



VLAN (STP)- LAB

- spanning-tree vlan **number** root primary

Internet Protocol Version 6 (IPv6)

IPv6	IPv4
Site Local	Private IP
Global	Public IP
Link Local	APIPA IP
8 Group, 128 Bit, HexaDesimal "1- E", ":", 4 Number-Character	4 Octets, 32 Bit, Decimal "1- 9", ".", 3 Number
Ex: 1f2d:a22a:a1bc:c1c49:7934:0adb	Ex: 111.1.1.1.103

Internet Protocol Version 6 (IPv6)

- Large Address Space
- Fast speed = Small Header
- Secure = IPSec
- AUTO Configuration

DECIMAL	HEX	BINARY
0	0	0000
1	1	0001
2	2	0010
3	3	0011
4	4	0100
5	5	0101
6	6	0110
7	7	0111
8	8	1000
9	9	1001
10	A	1010
11	B	1011
12	C	1100
13	D	1101
14	E	1110
15	F	1111

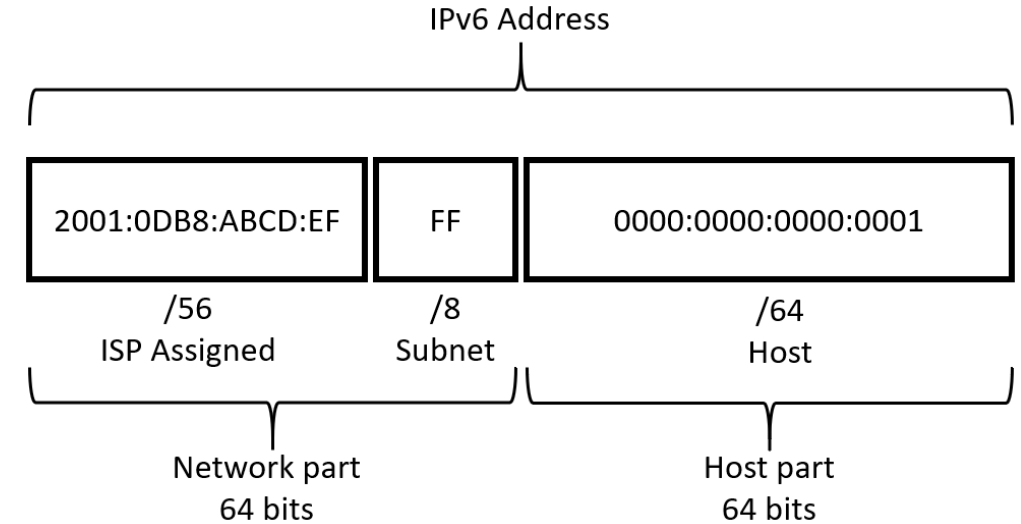
Summarization Ipv6- Lab

1. 00AA= Remove the left 0
2. 000:000 =0
3. 0:0:0= :: * only one

Example:

FE33:00AB:0000:0000:0AB0:0000:0000:1205

1. FE33:AB:0000:0000:AB0:0000:0000:1205
2. FE33:AB:0:0:AB0:0:0:1205
3. FE33:AB::AB0:0:0:1205



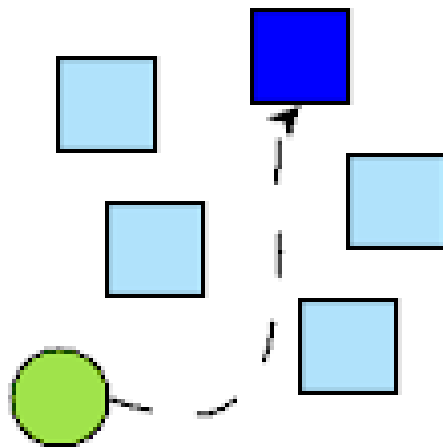
2002:343A::/64

2002:343A::/64 Same Network

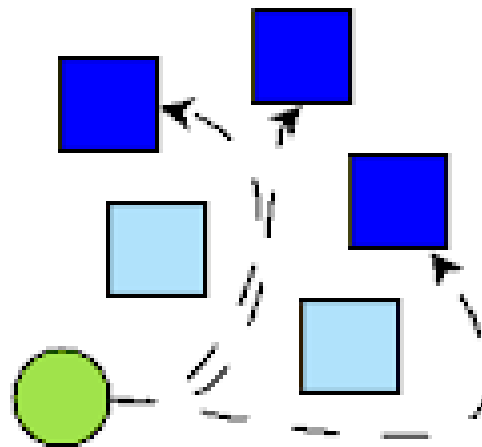
2002:343A:2::/64 = Different Network

PC Mac-Address= 48 Bit

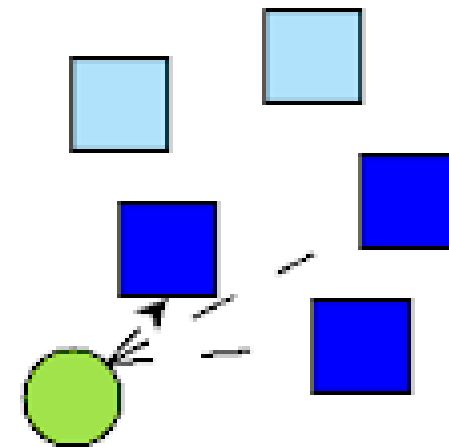
IPv6	IPv4
Unicast	Unicast
Multicast	Multicast
Anycast	Broadcast



UNICAST



MULTICAST



ANYCAST

IPv6

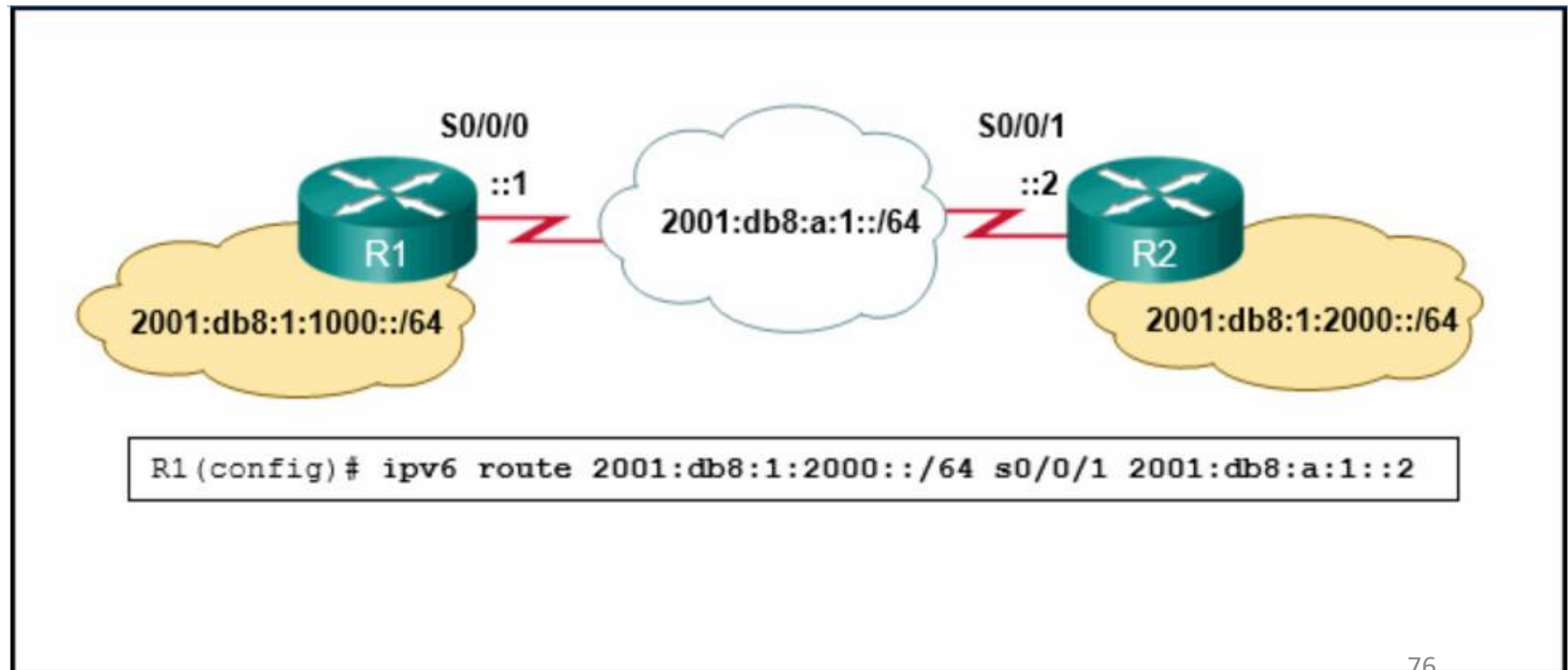
1. Manual
2. Link Local (EUI64)= FE80:: Mac- Address: FFFE **NO Network**
3. Dynamic (DHCPv6)
4. STATEful - DHCPv6
5. STATEless - Router IP Interface+ Mac PC, DNC
6. SLAAC - Router IP Interface+ Mac PC

IPv6 Routing- Lab

- interface
- ipv6 address ip address
- show ipv6 interface brief
- show ipv6 route
- **show ipv6 route**
- ipv6 unicast-routing

Static Route IPv6- Lab

- ipv6 unicast-routing
- ipv6 route **Network Next Hop**
- show ipv6 route



* NO default route

RIP IPv6- Lab

- ipv6 router rip **NAME**
- **interface**
- ipv6 rip **NAME** enable
- show ipv6 route
- show ipv6 protocols

OSPF IPv6- Lab

- ipv6 router ospf **NUMBER**
- **router-id IPv4**
- interface
- **ipv6 ospf NUMBER area 0**
- show ipv6 route

EIGRP IPv6- Lab

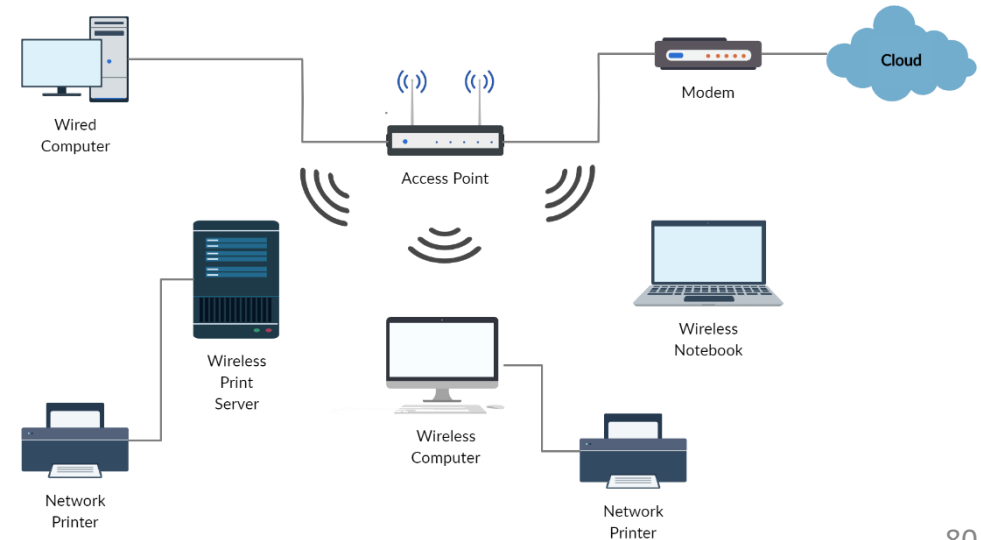
- ipv6 router eigrp **NUMBER**
- eigrp router-id **IPv4**
- **no shutdown**
- interface
- ipv6 eigrp **NUMBER**
- show ipv6 route
- show ipv6 protocols

Wireless Wlan

- Cables (Ethernet)- 802.3

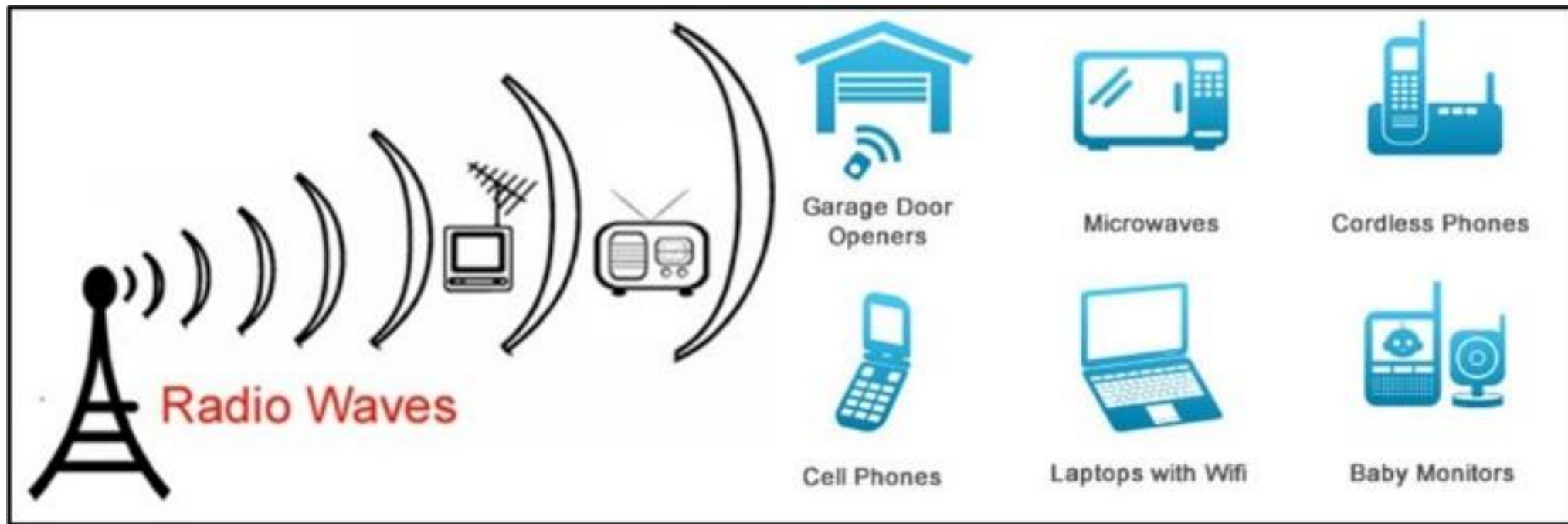


- Wireless (Wifi)- 802.11



Wireless Media

- Air
- Radio Wave



Wireless Components

- Wifi Adapter - Desktop

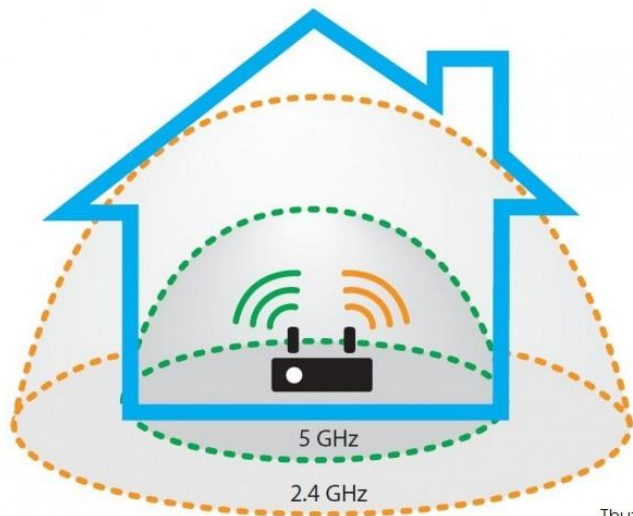


- Access Point (AP)- Wireless Router- Same Switch



Frequencies and Channels

- Frequencies and Channels- 2.4 More devices same (Mobile, Camera, Laptop, Microwave, Remote, Wireless Printer, est...).
- Frequencies and Channels- 5 Less devices same (Personal Devices).



Thuthuattienich.com

WLAN Frequency Bands	
2.4 GHz	5 GHz
Slow Data Transmission	Fast Data Transmission
Covers Long Distance	Covers Short Distance
14 Channels	23 Channels
Overlapping Channels	No Overlapping
IEEE 802.11b IEEE 802.11g IEEE 802.11ax	IEEE 802.11a IEEE 802.11n IEEE 802.11ac IEEE 802.11ax

Securing Wireless

- Mac Address Filtering
- Disabling SSID (Name Wifi)
- Password (!!!, SSS, 111, sss)
- IEEE 802.1X (User, Password)
- Encryption (WEP, WPA, WPA2)



Wireless- Lab

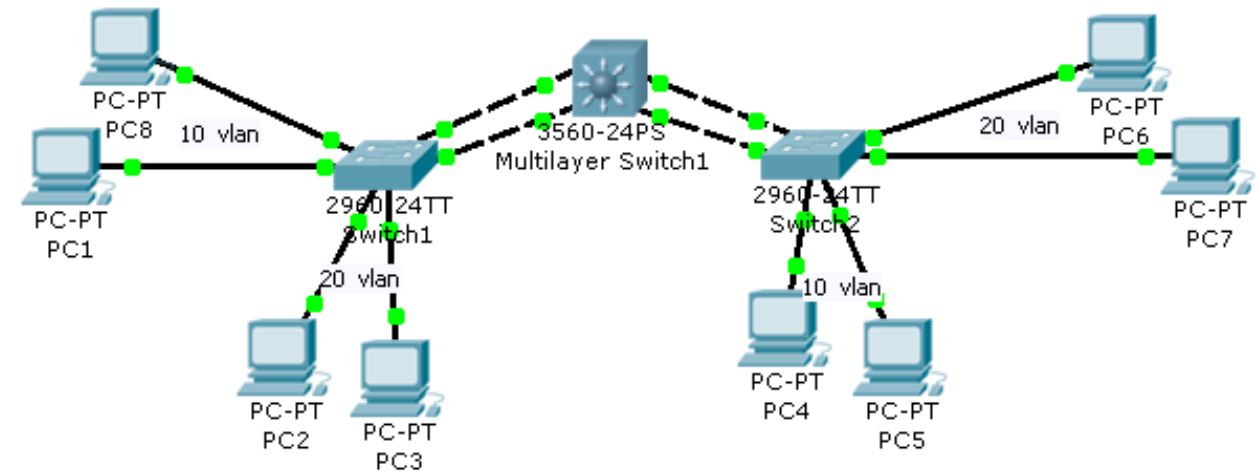
- Graphical user interface
- SSID- Disable For Security (Option)
- Save Settings
- Set up- IP address, DHCP (Option)
- Wireless Security
- PC Wireless (In PC)
- MAC Filtering (Option)
- WPA 2 (Option)

Ethernet Channel

- **No** Loading
- All Cables= One Cable (**No STP**)
- Speed (Same Port Speed in Switch)

protocols:

1. PAGP (Cisco Protocols)
2. LACP (Open Standards)



Ethernet Channel- Lab

- switchport mode trunk
- channel-group 1 mode ??
- show etherchannel
- show etherchannel summary

LACP

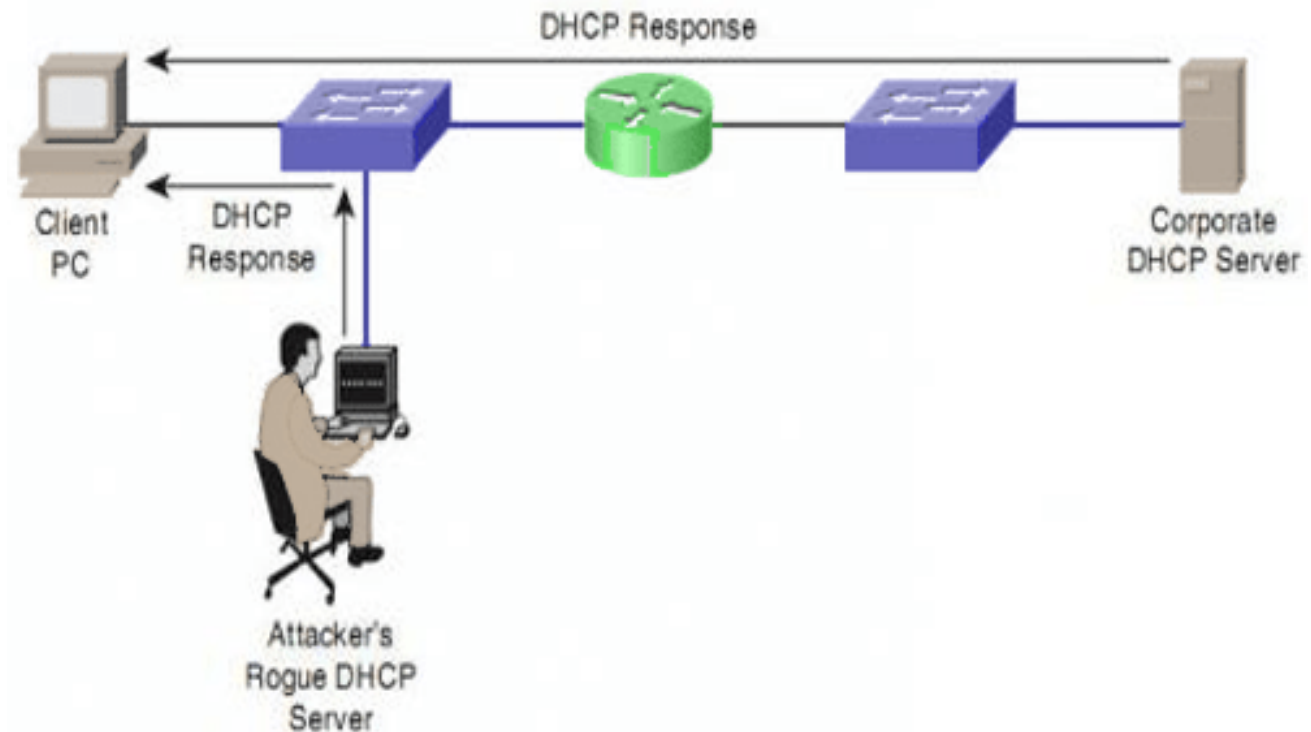
Channel Establishment	On	Active	Passive
On	Yes	NO	NO
Active	NO	Yes	Yes
Passive	NO	Yes	NO

PAgP

Channel Establishment	On	Desirable	Auto
On	Yes	NO	NO
Desirable	NO	Yes	Yes
Auto	NO	Yes	NO

DHCP Spoofing- Lab

- Snooping- Fix
- Switch Configuration
- ip dhcp snooping
- no ip dhcp snooping information
- ip dhcp snooping vlan 1
- interface fastEthernet 0/1
- ip dhcp snooping trust
- show ip dhcp snooping

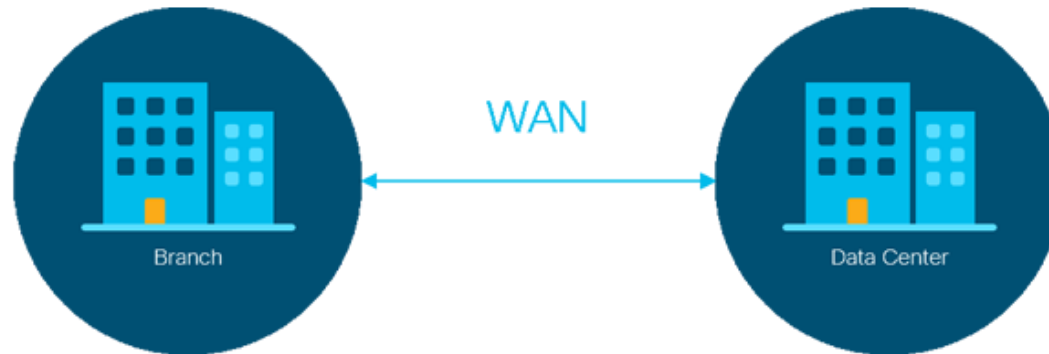


CDP/ LLDP- Lab

- CDP- Cisco
 - LLDP- Open Standers
 - Default enable in Devices Cisco- CDP
 - Switch, Router- IP Phone, Firewall- NO PC
-
- Lab
 - show cdp neighbors
 - show cdp neighbors detail (With IP Router)
 - no cdp run
 - cdp run
 - interface range fast0/1-24
 - cdp enable
 - lldp run
 - show lldp neighbors

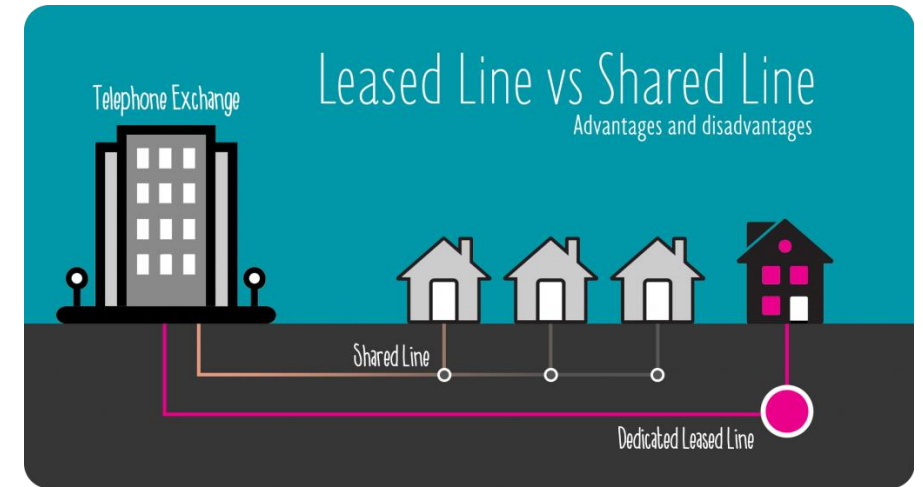
WAN Technology

- What is WAN Technology?
- WAN Connection?
- Protocols.



WAN Connection Type

- Private:
 1. Leased Lines:
 - 24/7 Support.
 - Secure.
 - Dedicated (Specific Line).
 - **Very Expensive**



How does a Leased Line work?



WAN Connection Type

- Private:

- 2. Circuit Switching

- No Expensive
- Lower Cost
- Lower Speed
- Point to Point
- Use same Path

- 3. Packet Switching

- Point to Multipoint
- Packet travel independently

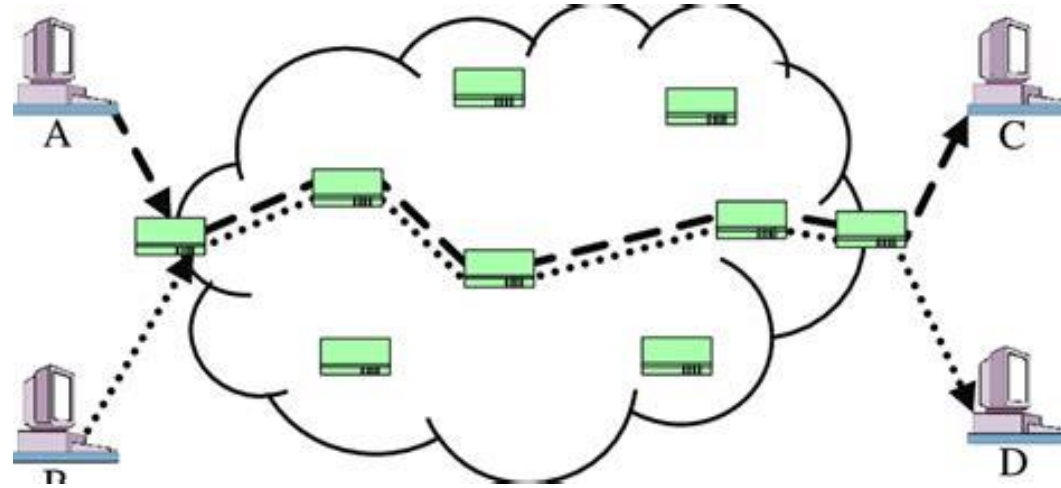
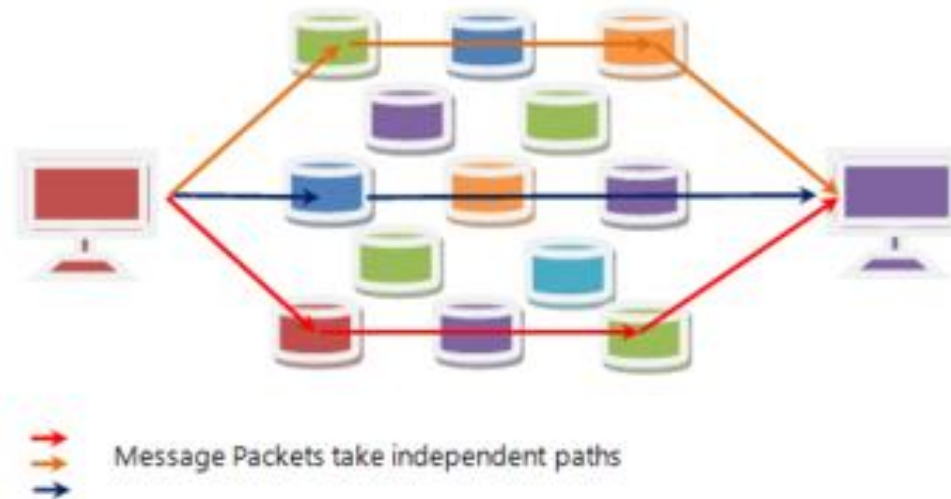


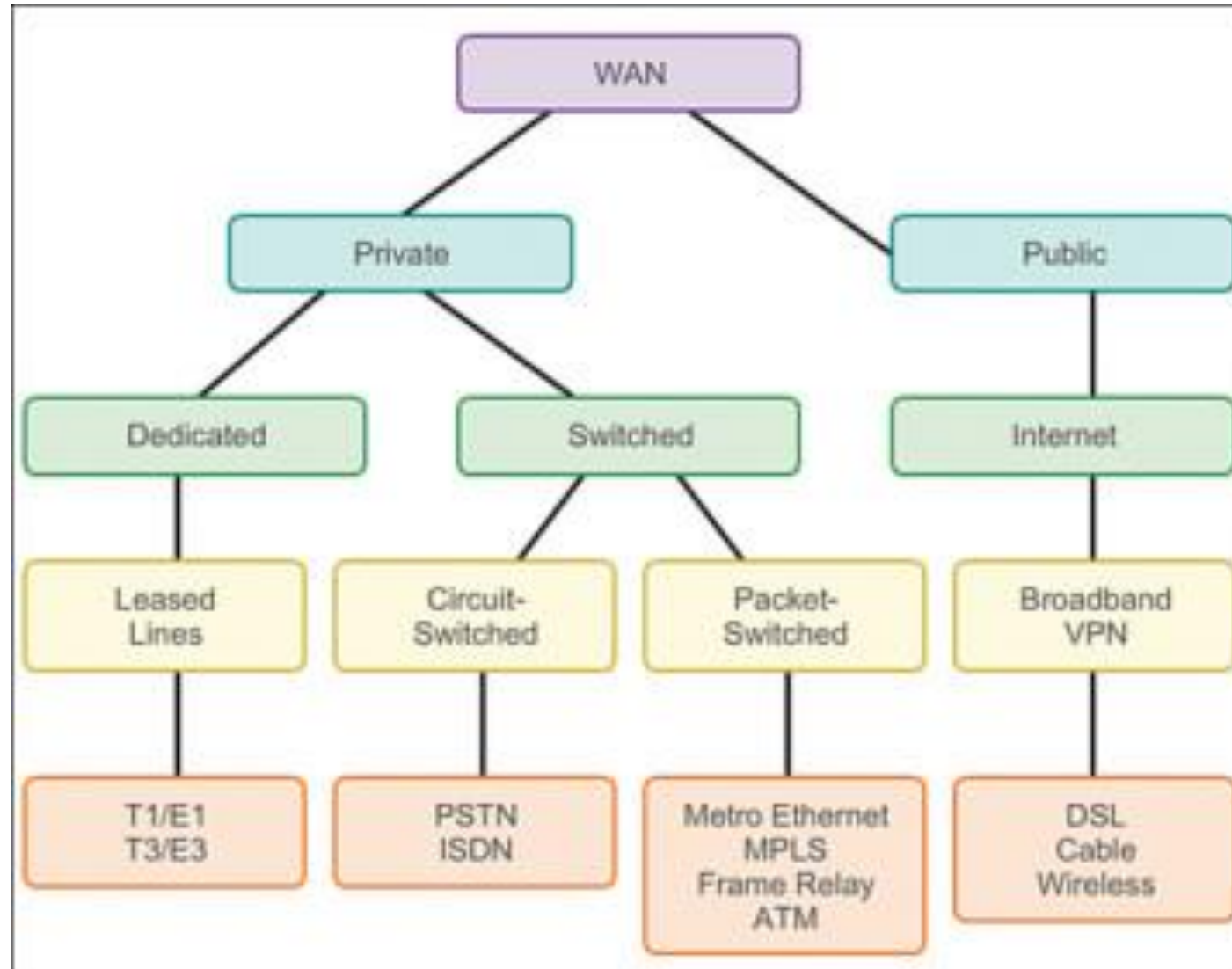
Figure 2: Packet Switching



WAN Connection Type

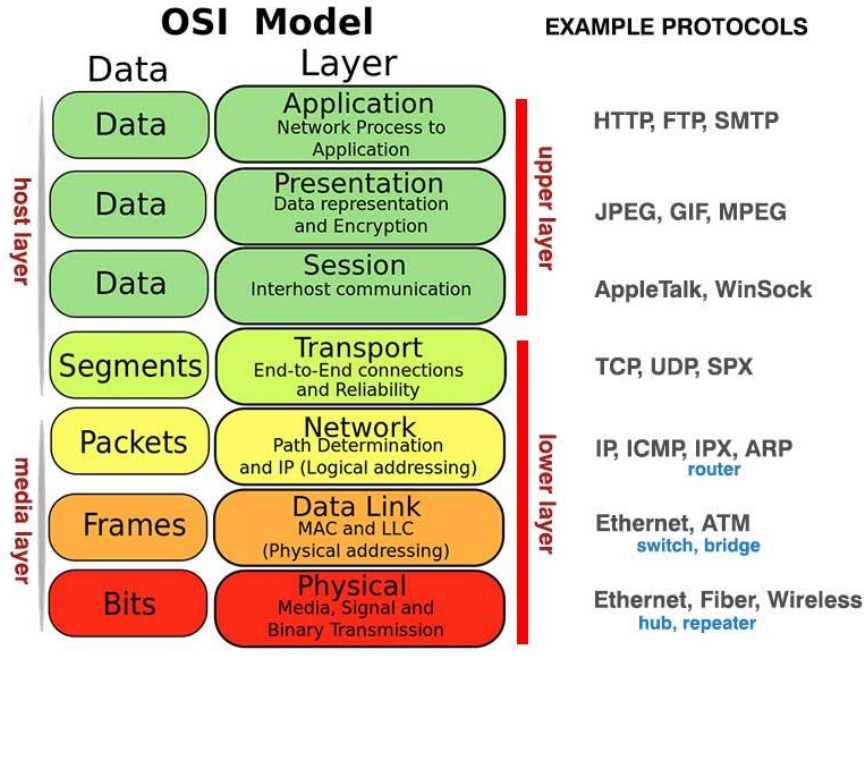
Protocols (For send Data):

- PPP (Point to Point)
- HDLS
- ATM
- MPLS

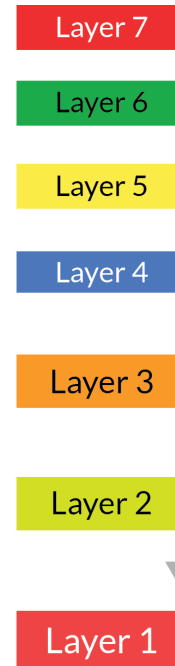


OSI, TCP/IP Models

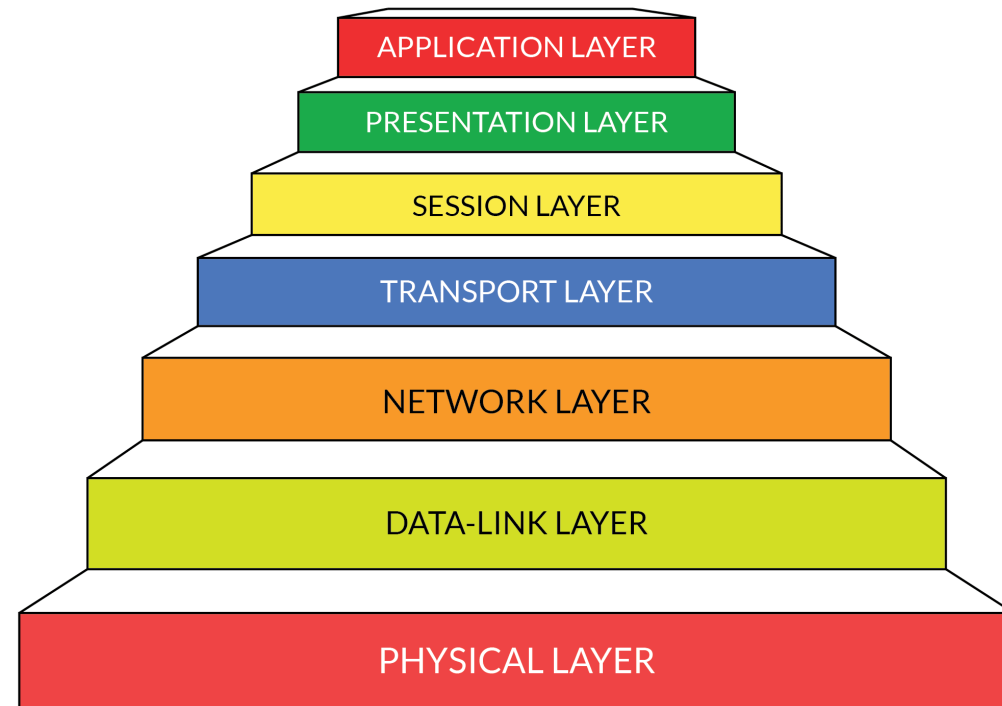
ISO- IEEE Organization



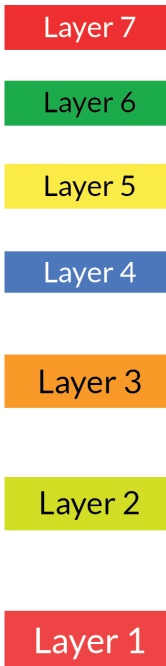
Client Side



OSI MODEL



Server Side



Quality Of Service (QoS)

- Traffic is:

1. Voice.
2. Video.
3. Data (HTTP, TFTP, Mail).

