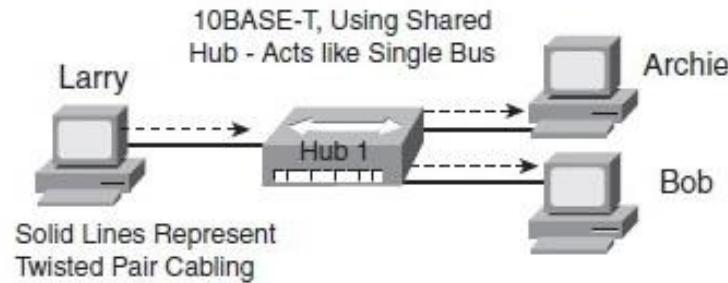
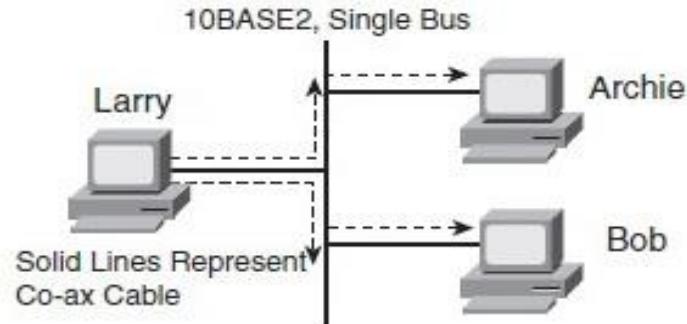
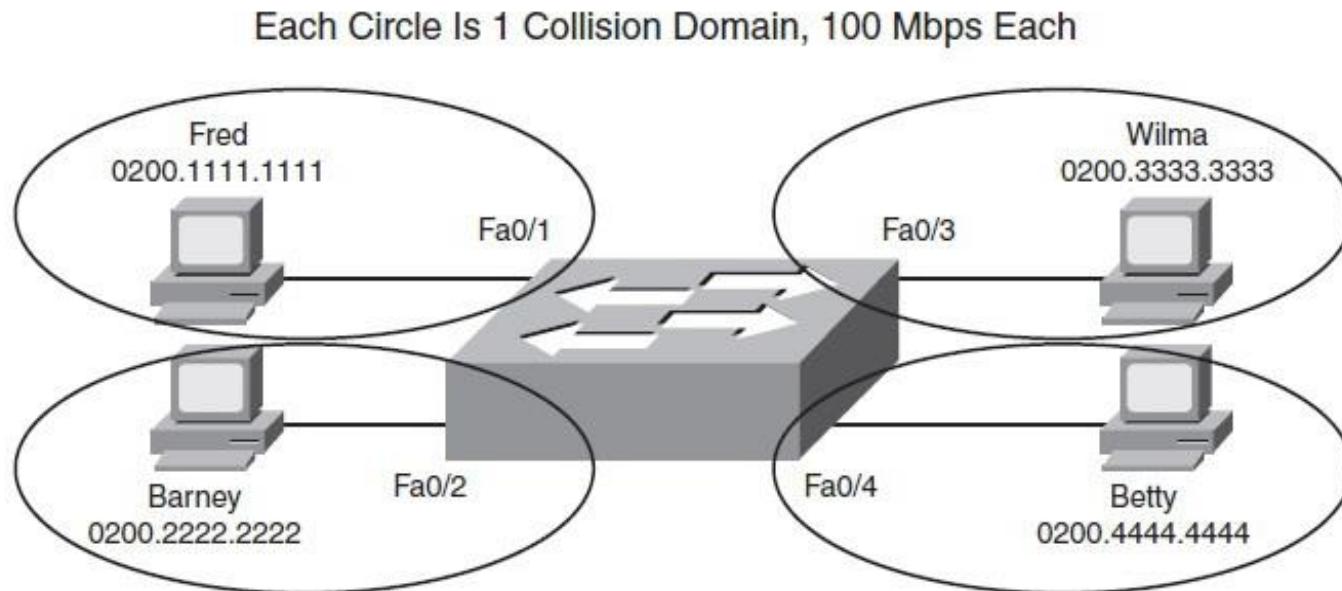


# Hub, Switch and Router Functions

# Historical Progression: HUB



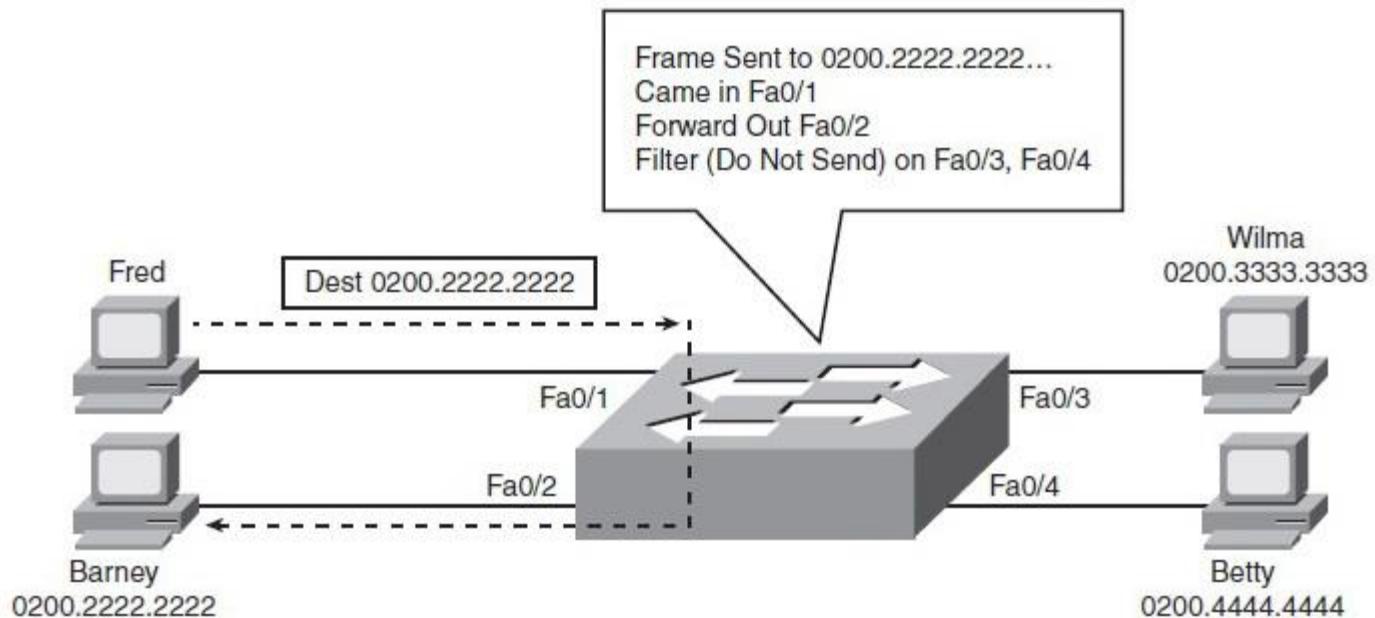
# Historical Progression: Switch



# Switching Logic

- Switches do three main jobs:
  - Deciding when to forward a frame or when to filter (not forward) a frame, based on the destination MAC address
  - Learning MAC addresses by examining the source MAC address of each frame received by the bridge
  - Creating a (Layer 2) loop-free environment with other bridges by using Spanning Tree Protocol (STP)

# Decision Making

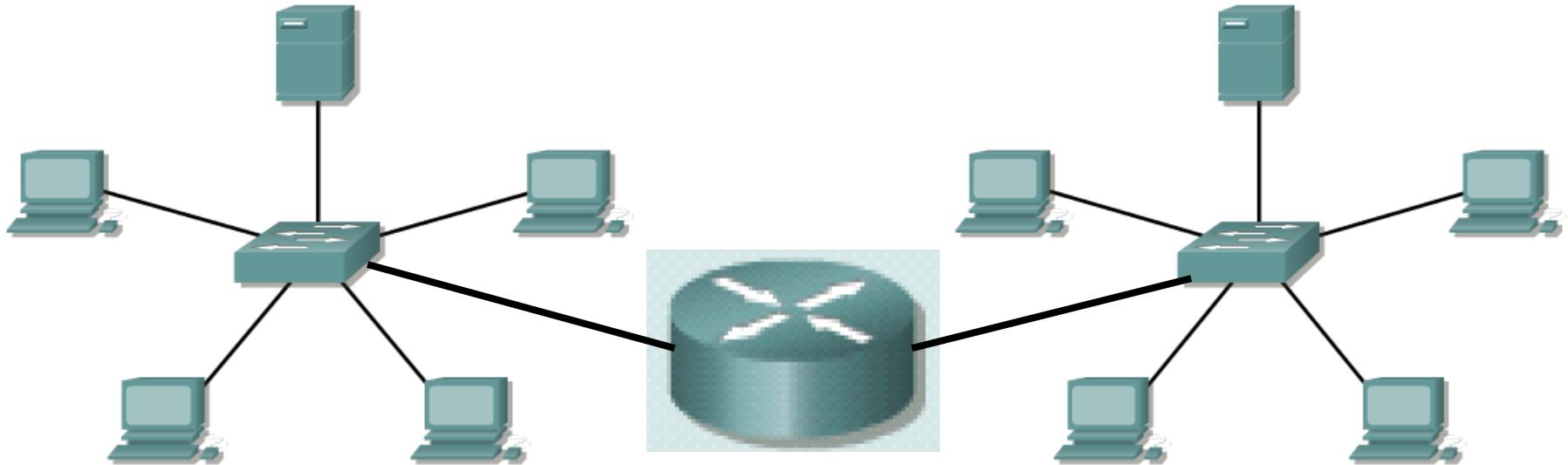


Address Table

0200.1111.1111	Fa0/1
0200.2222.2222	Fa0/2
0200.3333.3333	Fa0/3
0200.4444.4444	Fa0/4

# Router

- Routers have all capabilities of the previous devices
- Routers can regenerate signals, concentrate multiple connections, and manage data transfers
- They can also connect to a WAN, which allows them to connect LANs that are separated by great distances
- **Router is a Network Layer Device**



# Main Parts of Router and Switch

- RAM:
- NVRAM:
- ROM:
- Flash:
- Interface:
  - Ethernet / FastEthernet / GigabitEthernet / Serial
  - Console
  - AUI
  - AUX

# Accessing Switch and Router for Configuration

- Setup Mode
- CLI
- Telnet or SSH

# Main Access Modes in CLI

- User Mode
- Privilege Mode (Enable Mode)
- Global Configuration Mode
- Interface Mode

# User Mode

➤ Switch>

➤ Router>

# Privilege Mode (Enable Mode)

➤ Switch> *enable*

➤ Switch#

➤ Router> *enable*

➤ Router#

# Global Configuration Mode

- Switch# *configure terminal*
- Switch(config)#
  
- Router# *configure terminal*
- Router(config)#

# Interface Mode

- Switch(config)# *interface {ethernet | fastethernet | gigabitethernet} {N | N/N | N/N/N}*
- Switch(config-if)#+
- Router(config)# *interface {ethernet | fastethernet | gigabitethernet | serial } {N | N/N | N/N/N}*
- Router(config-if)#+

# Movement Between Modes

➤ Back:

➤ Switch(config-if)# *exit*

➤ Switch(config)# *exit*

➤ Switch#

➤ Router(config-if)# *exit*

➤ Router(config)# *exit*

➤ Router#

# Movement Between Modes

➤ Back to Enable Mode from each Mode:

➤ Switch(config-if)# *end* or ctrl+z

➤ Switch#

➤ Router(config-if)# *end* or ctrl+z

➤ Router#

# Movement Between Modes

➤ Go to User Mode:

➤ Switch# *exit*

➤ Switch>

or

➤ Switch# *disable*

# Movement Between Modes

➤ Go to User Mode:

➤ Router# *exit*

➤ Router >

or

➤ Router # *disable*

# Name Configuration

➤ Switch(config)# *hostname SW1*

➤ SW1(config#)

➤ Router(config)# *hostname R1*

➤ R1(config)#

# Erasing RAM

➤ Switch# *reload*

➤ Router# *reload*

# Erasing NVRAM

➤ Switch# *erase startup-config*

or

➤ Switch# *write erase*

or

➤ Switch# *write nvram*

# Erasing NVRAM

➤ Router# *erase startup-config*

or

➤ Router # *write erase*

or

➤ Router # *erase nvram*

# Password Configuration for User Mode

- Switch(config)# *line console 0*
- Switch(config-line)# *password Name*
- Switch(config-line)# *login*
  
- Router(config)# *line console 0*
- Router(config-line)# *password Name*
- Router(config-line)# *login*

# Password Configuration for Enable Mode

➤ Switch(config)# *enable password NAME*

or

➤ Switch(config)# *enable secret NAME*

➤ Router(config)# *enable password NAME*

or

➤ Router(config)# *enable secret NAME*

# SHOW Command

- Router# *show running configuration*

# Cisco Routers Series

- Cisco 800 Series Router
- Cisco 1600 Series Router
- Cisco 1700 Series Router
- Cisco 1800 Series Router
- Cisco 2500 Series Router
- Cisco 2800 Series Router
- Cisco 3600 Series Router
- Cisco 3800 Series Router
- Cisco 7200 Series Router
- Cisco 7300 Series Router
- Cisco 7500 Series Router
- Cisco 7600 Series Router
- Cisco 10000 Series Router
- Cisco 12000 Series Router

# Cisco Switches Series

- Blade SW
- Data Center SW
- LAN SW:
  - Core SW
  - Distribute SW
  - Access SW
- Cisco 1900 Series Switch
- Cisco 2300 Series Switch
- Cisco 2900 Series Switch
- Cisco 3500 Series Switch
- Cisco 3700 Series Switch
- Cisco 4500 Series Switch
- Cisco 6500 Series Switch

# Packet Tracer

# Basic Configuration Laboratory

- Requirement Devices:

- Cisco 2811 Router: 1
- Cisco 2960 Switch 1

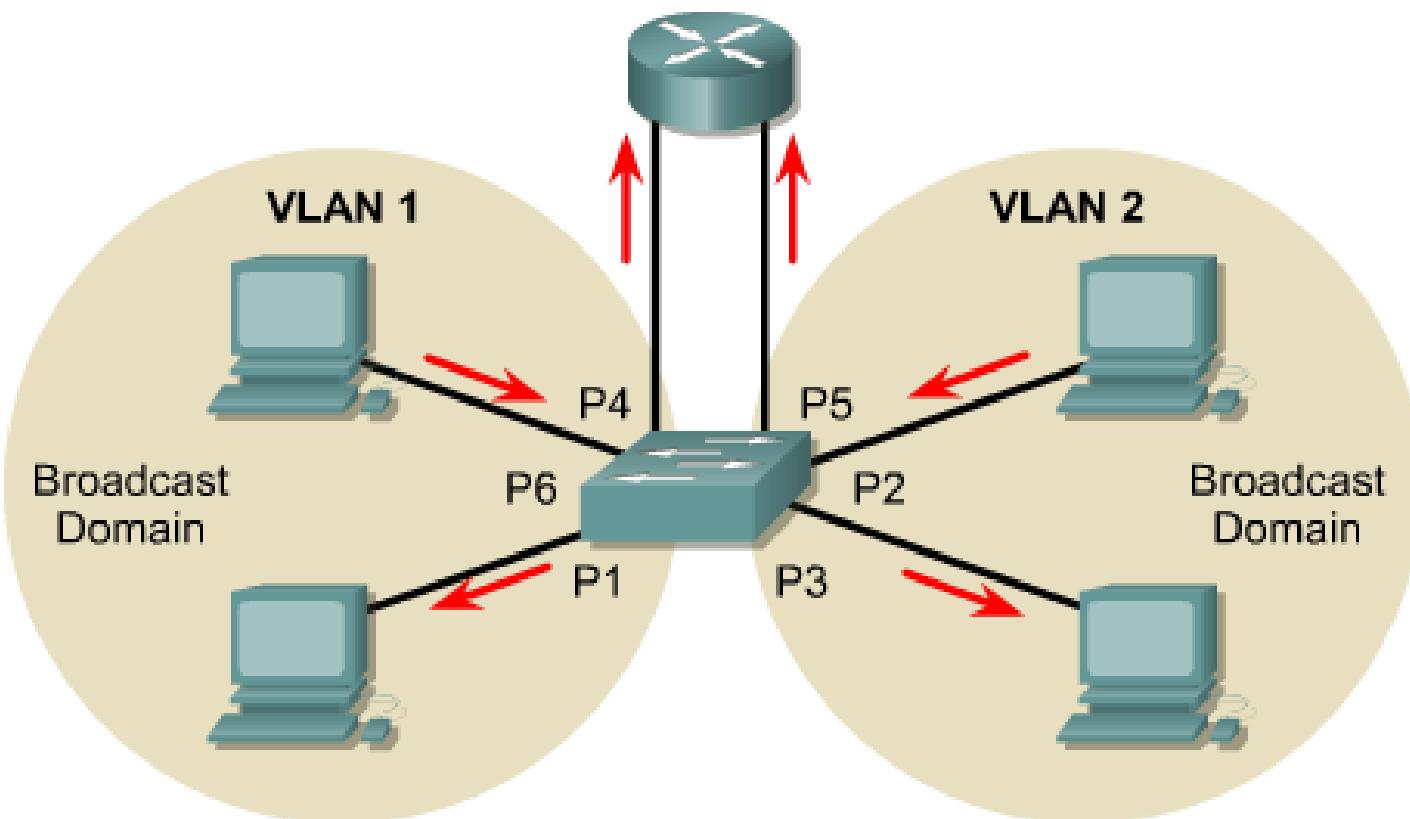
# Basic Configuration Laboratory

- Do these setting on the Router:
  - Naming: R1
  - User Mode Password: pnu
  - Privilege Mode Password: unp
  - Save Changes

# Basic Configuration Laboratory

- Do these setting on the Switch:
  - Naming: SW1
  - User Mode Password: CCNA
  - Privilege Mode Password: CCNP
  - Save Changes

# Virtual LAN



# VLAN Configuration

- Step 1: Create New VLAN
  - Switch> *enable*
  - Switch# *configure terminal*
  - Switch(config)# *vlan N*
  - (Optional) Switch(config-vlan)# *name NAME*

# VLAN Configuration

➤ Step 2: Interface Membership in the VLANs

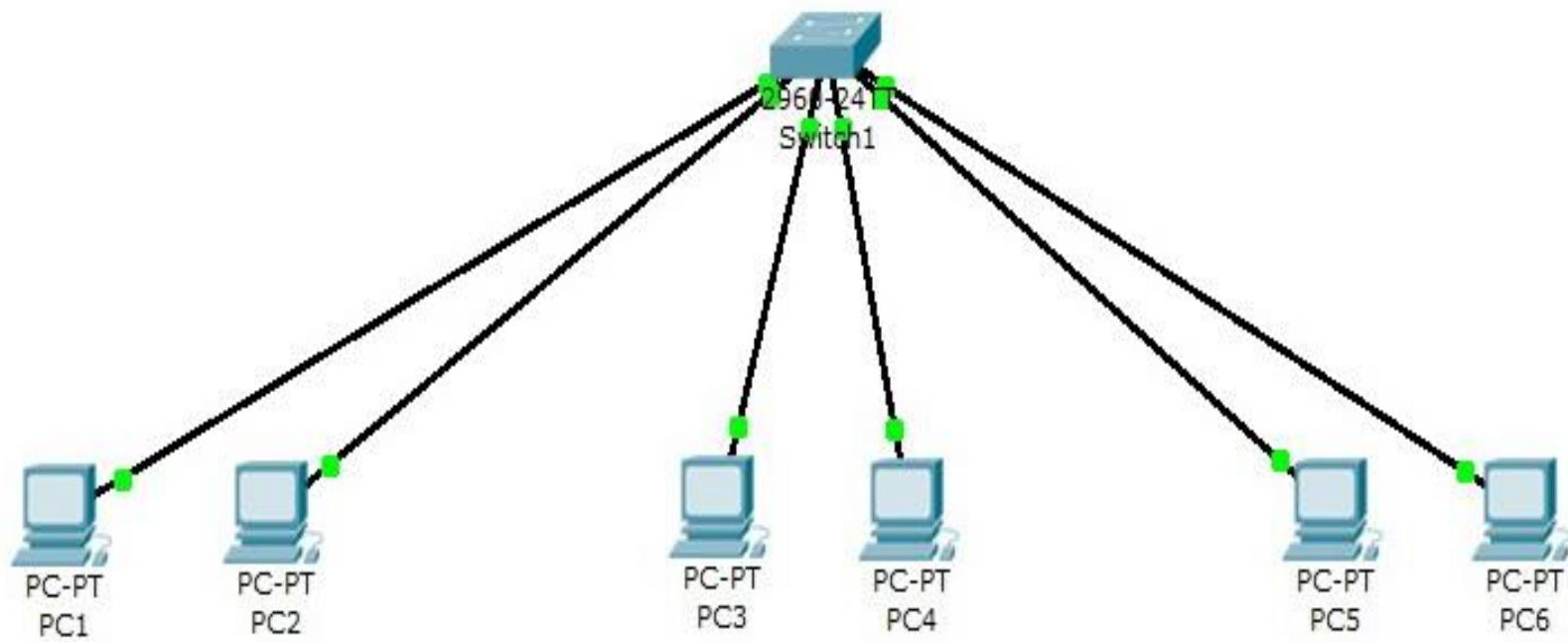
➤ Switch(config)# *interface { ethernet / fastethernet / gigabitetherent }* N / N

➤ Switch(config-if)# *switchport access vlan* N

➤ SHOW Command:

➤ Switch# *show vlan*

# VLAN Laboratory



# VLAN Laboratory

- Required Devices:
  - Cisco 2960 Switch: 1
  - PC: 6

# VLAN Laboratory

- Setting:
  - VLAN2 (Accounting):      PC1, PC2
  - VLAN3 (Sales):                PC3, PC4
  - VLAN4 (Warehousing):        PC5, PC6
  
- PC1: 192.168.1.1                ➤ PC4: 192.168.1.4
- PC2: 192.168.1.2                ➤ PC5: 192.168.1.5
- PC3: 192.168.1.3                ➤ PC6: 192.168.1.6

# VLAN Laboratory

- According to the Shape and Settings, make three VLAN that just Computers in the same VLAN could ping other one

# Multi VLAN Configuration

➤ Switch Port Modes:

- Access Mode
- Trunk Mode

# Multi VLAN Configuration

- Trunk use two way for data encapsulation:
  - ISL
    - Cisco Priority
    - Encapsulate data with a 26 bytes Header and 4 bytes Trailer
  - IEEE.1Q
    - Standard
    - Add 4 bytes to the frame and don't re-encapsulate

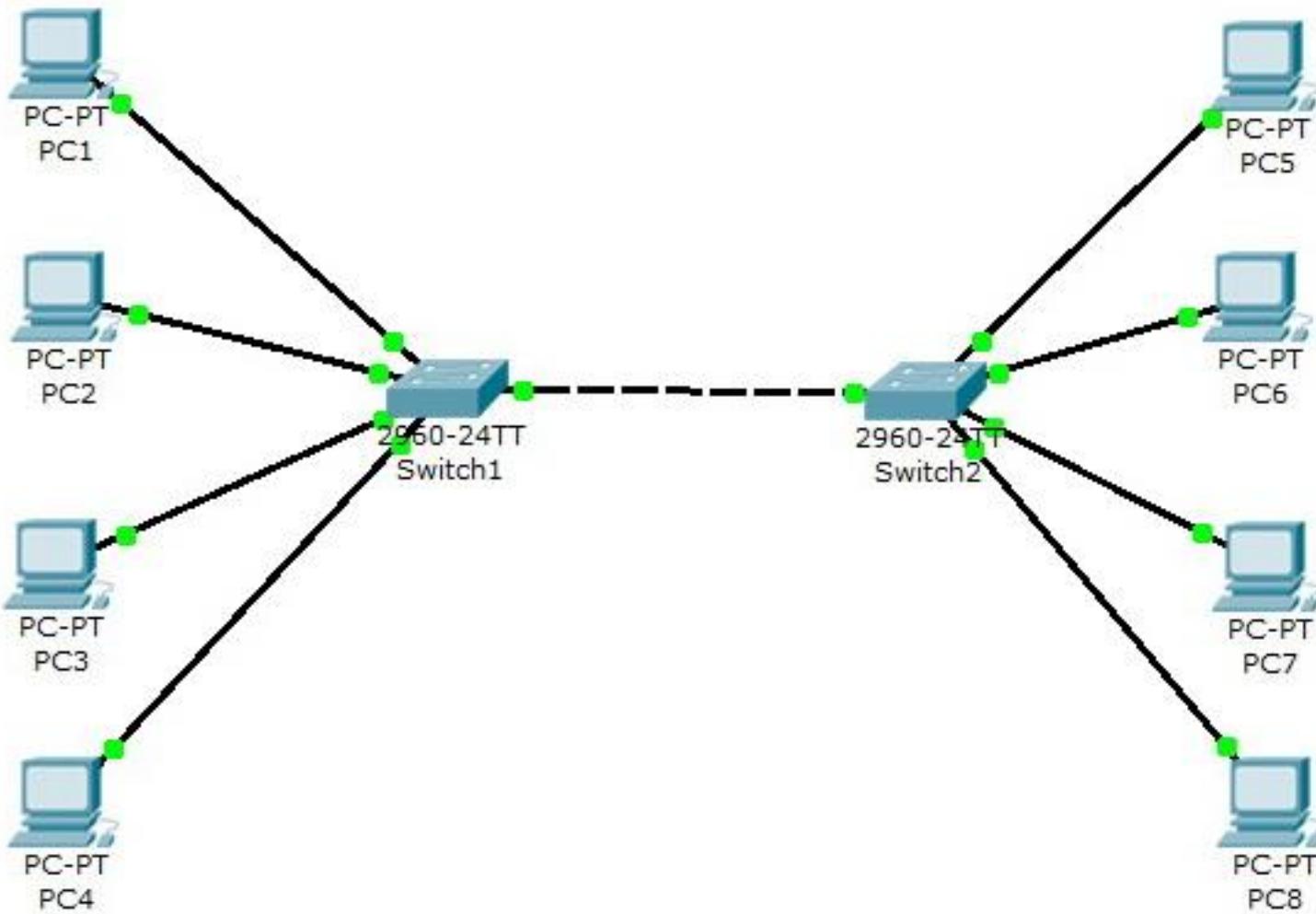
# Multi VLAN Configuration

- Trunk encapsulation:
  - Switch(config)# *interface { gigabitethernet / fastethernet / ethernet }* N / N
  - Switch(config-if)# *switchport mode trunk*
- SHOW Command:
  - Switch# *show interface trunk*

# Multi VLAN Configuration

- Configuring Encapsulation:
  - *Switch(config-if)# switchport trunk encapsulation { isl / dot1q / negotiate }*

# Multi Switch VLAN Laboratory (Advanced VLAN)



# Multi VLAN Laboratory

- Required Devices:
  - Cisco 2960 Switch: 2
  - PC: 8

# Multi VLAN Laboratory

➤ Setting:

➤ PC1:

- IP Address: 192.168.1.1
- VLAN2
- (Connected to Switch1)

➤ PC2:

- IP Address: 192.168.1.2
- VLAN2
- (Connected to Switch1)

➤ PC3:

- IP Address: 192.168.1.3
- VLAN3
- (Connected to Switch1)

➤ PC4:

- IP Address: 192.168.1.4
- VLAN3
- (Connected to Switch1)

# Multi VLAN Laboratory

➤Setting:

➤PC5:

➤IP Address: 192.168.1.5

➤VLAN2

➤(Connected to Switch2)

➤PC6:

➤IP Address: 192.168.1.6

➤VLAN2

➤(Connected to Switch2)

➤PC7:

➤IP Address: 192.168.1.7

➤VLAN3

➤(Connected to Switch2)

➤PC8:

➤IP Address: 192.168.1.8

➤VLAN3

➤(Connected to Switch2)

# Multi VLAN Laboratory

- According to the Shape and Settings, all computers in the same VLAN should ping another one

# **VLAN Trunking Protocol (VTP)**

- With this protocol, all VLANs create in a Switch and implement on other Switches

# VLAN Trunking Protocol (VTP)

➤ Main parts of VTP:

- VTP Modes
- VTP Domain
- VTP Password

# VLAN Trunking Protocol (VTP)

- VTP Modes:
  - VTP Server
  - VTP Client
  - VTP Transparent

# Requirements for VTP to Work Between Two Switches

- The link between the switches must be operating as a VLAN trunk (ISL or 802.1Q)
- The two switches' case-sensitive VTP domain name must match
- If password configured on at least one of the switches, the two switches' case-sensitive VTP password must match

# VLAN Trunking Protocol (VTP)

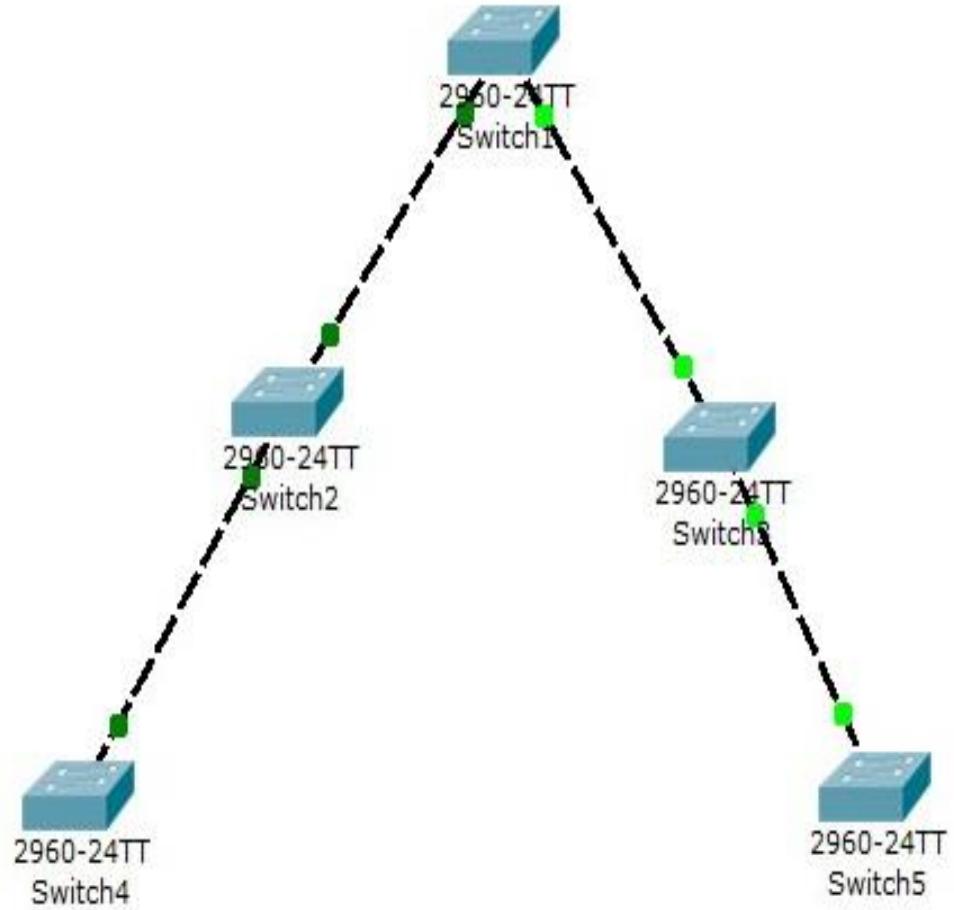
- VTP Mode Configuration:
  - Switch(config)# *vtp mode { server / client / transparent }*
- VTP Domain Configuration:
  - Switch(config)# *vtp domain NAME*
- VTP Password Configuration:
  - Switch(config)# *vtp password NAME*

# SHOW Commands

- Switch# *show vtp status*
- Switch# *show vtp password*

# VTP Laboratory

- Switch1: Server
- Switch2&4: Client
- VTP Domain: PNU
- VTP Password: 123
- VLANs on Server:  
VLAN32, 523, 741,
- You should see all  
VLANs on Switch4



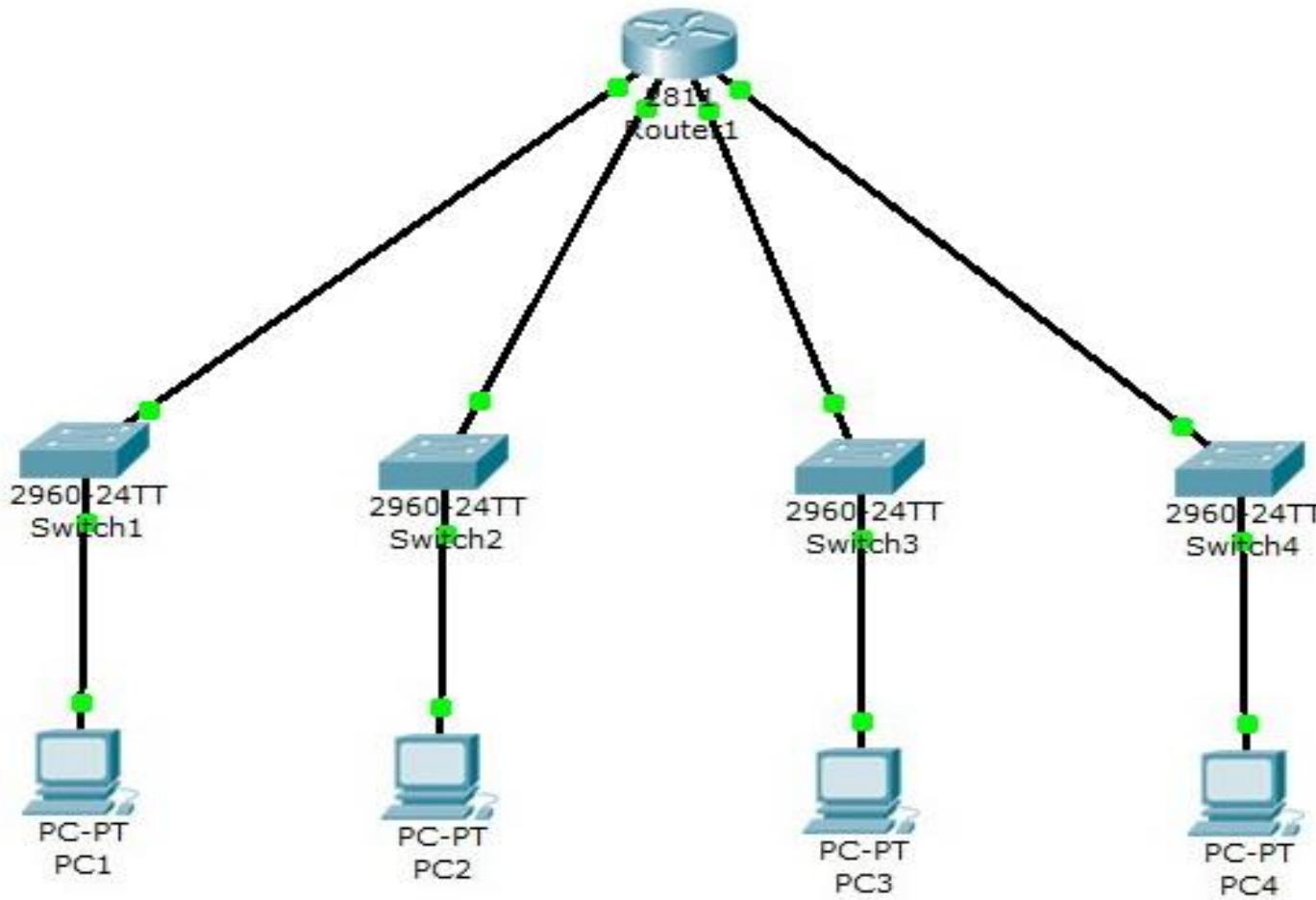
# Some Differences Between Router and Switch

- Switch is a Layer 2 Device but Router is a Layer 3 Device
- Switch no have power on/off button
- All Switch ports are Up by default
- Configuring IP is differ in some ways
- Router has Serial interface but Switch no have

# Configuring IP on Router Interfaces

- Router(config)# *interface { ethernet / fastethernet / gigabitethernet / serial }* N/N
- Router(config-if)# *ip address* IP Address Subnet Mask
- Router(config-if)# *no shutdown*

# Router Configuration Laboratory



# Router Configuration Laboratory

- Required Devices:
  - Cisco 2811 Router: 1
  - NM-2FE2W Module for Router: 1
  - Cisco 2960 Switch: 4
  - PC: 4

# Router Configuration Laboratory

➤ Setting:

➤ Router:

- Fast Ethernet 0/0: 192.168.1.1/24
- Fast Ethernet 0/1: 192.168.2.1/24
- Fast Ethernet 1/0: 192.168.3.1/24
- Fast Ethernet 1/1: 192.168.4.1/24

# Router Configuration Laboratory

- PC1:
  - IP Address: 192.168.1.2/24
  - Default Gateway: 192.168.1.1
- PC2:
  - IP Address: 192.168.2.2/24
  - Default Gateway: 192.168.2.1
- PC3:
  - IP Address: 192.168.3.2/24
  - Default Gateway: 192.168.3.1
- PC4:
  - IP Address: 192.168.4.2/24
  - Default Gateway: 192.168.4.1

# Router Configuration Laboratory

- According to the Shape and Settings, configure devices in a way all Computers can Ping each other

# Configuring IP on DCE Router Interfaces

- Router(config)# *interface serial N/N*
- Router(config-if)# *ip address IP Address Subnet Mask*
- Router(config-if)# *clock rate 64000*
- Router(config-if)# no shutdown

# Types of Routing Protocols

- Static Routing Protocol
- Dynamic Routing Protocol

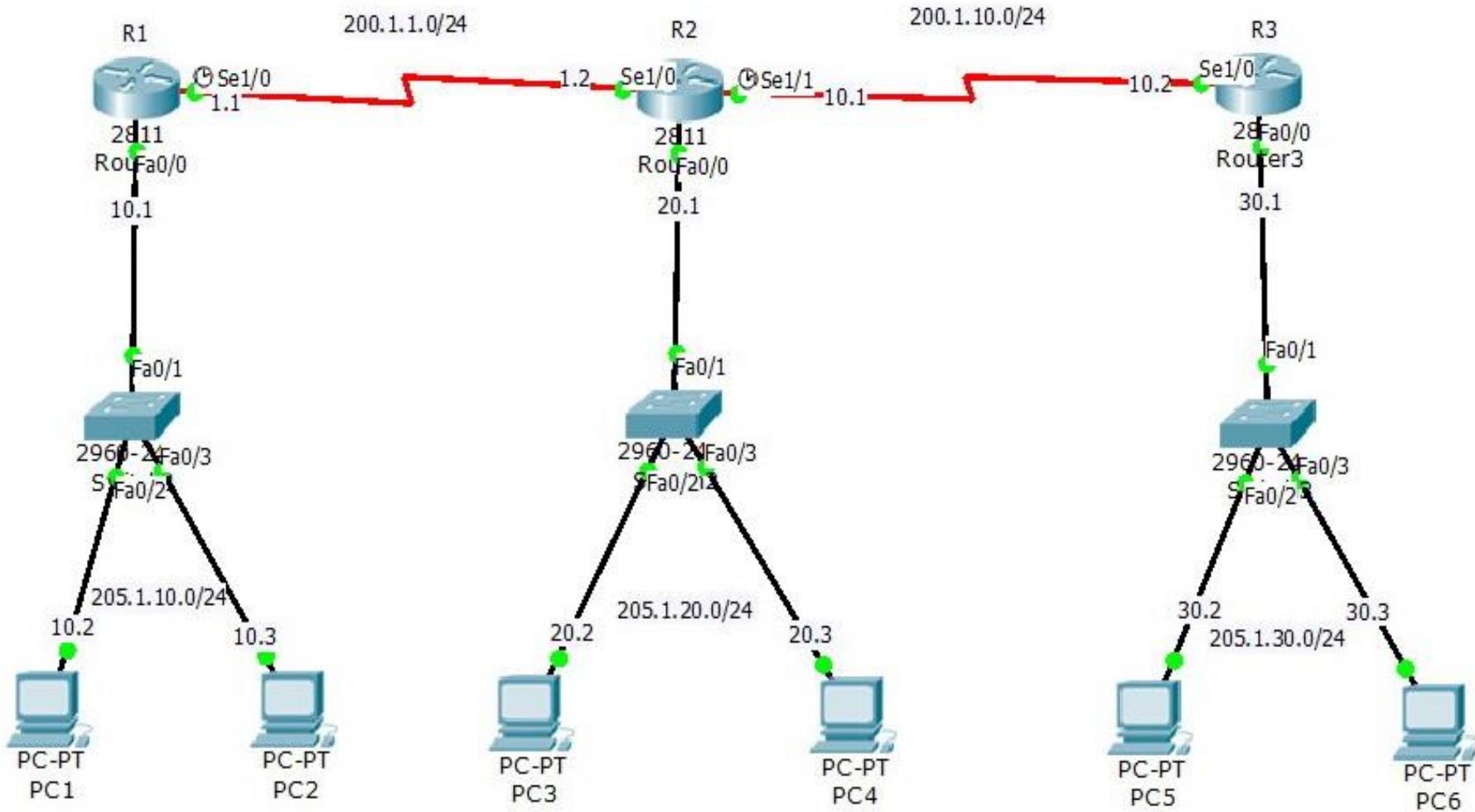
# Dynamic Routing Protocols

- IGP (Interior Gateway Protocols):
  - RIP (Routing Information Protocol)
  - OSPF (Open Shortest Path First)
  - EIGRP (Enhanced Interior Gateway Routing Protocol)
- EGP (Exterior Gateway Protocols):
  - BGP (Border Gateway Protocol)

# Static Route

➤ Router(config)# *ip route* Destination Subnet Number  
Destination Subnet Mask Gateway IP Address  
(Outgoing Interface Type)

# Static Route Laboratory



# Static Route Laboratory

- Required Devices:
  - Cisco 2811 Router: 3
  - NM-4A/S Module for Router: 3
  - Cisco 2960 Switch: 3
  - PC: 6

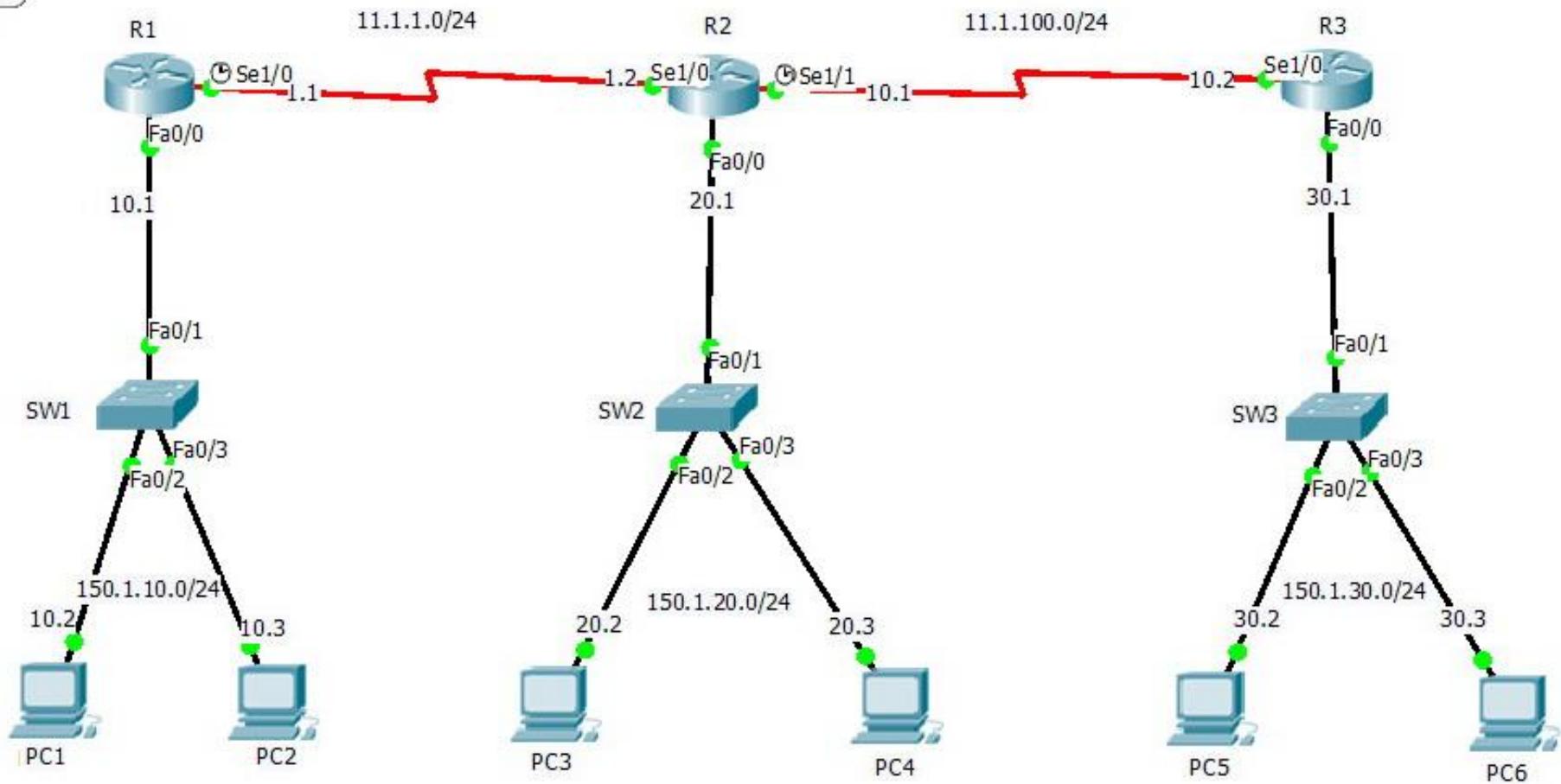
# Static Route Laboratory

- According to the Shape and Settings configure Static Route on all Routers that all Computers could ping another one

# RIP v.2 Configuration

- Router(config)# *router rip*
- Router(config-router)# version 2
- Router(config-router)# *network* Connected Subnet Number
- Router(config-router)# *network* Connected Subnet Number
- . . .
- Attention: RIP uses HOP Count to calculate best path

# RIP Laboratory



# RIP Laboratory

- Required Devices:
  - Cisco 2811 Router: 3
  - NM-4A/S Module for Router: 3
  - Cisco 2960 Switch: 3
  - PC: 6

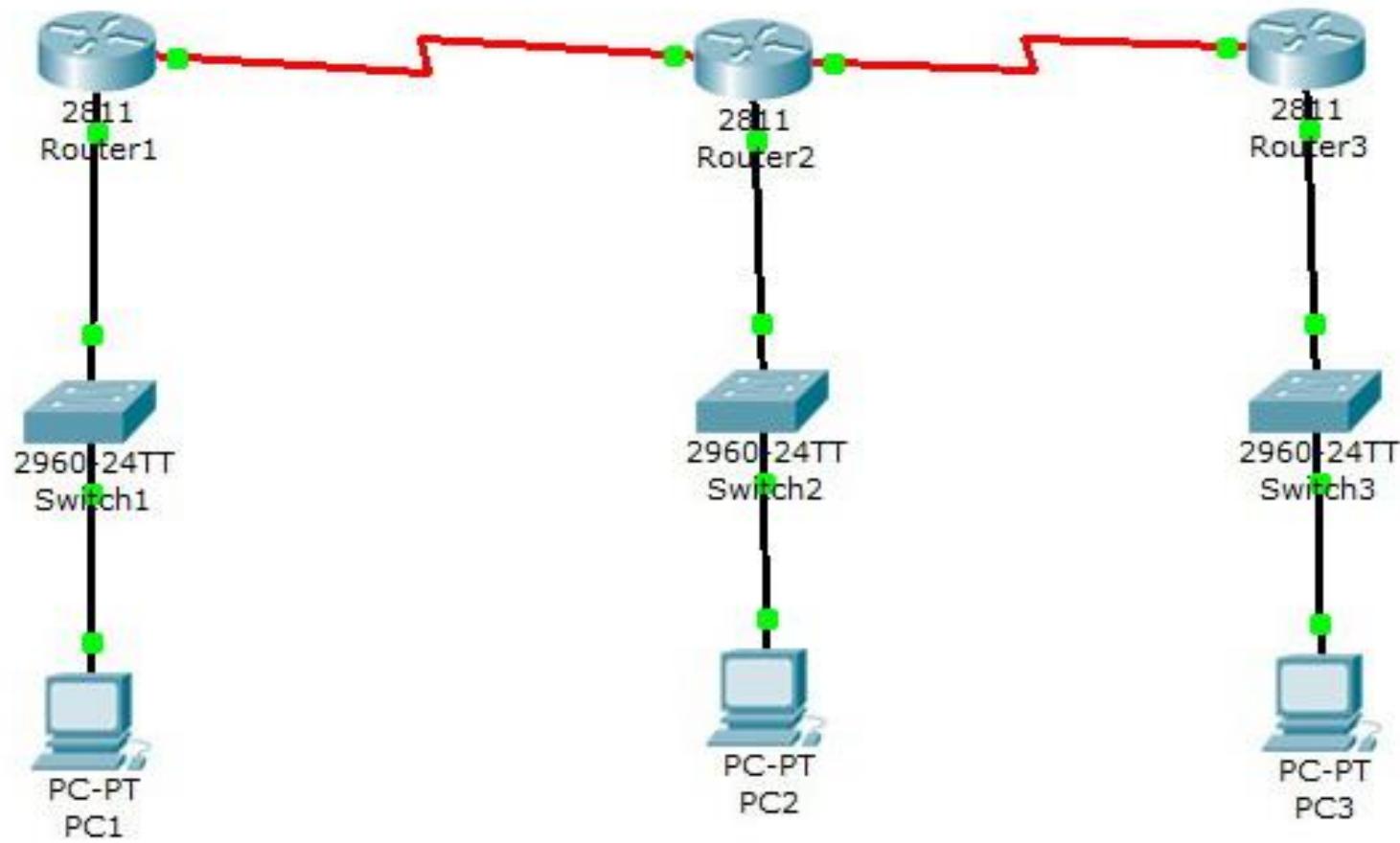
# RIP Laboratory

- According to the Shape and Settings configure RIP V.2 on all Routers that all Computers could ping another one

# OSPF Configuration

- Router(config)# *router ospf* Process ID
- (Optional) Router(config-router)# *router-id* ID Value
- Router(config-router)# *network* Connected Subnet Number Wildcard Mask *area* N
- ...

# OSPF Laboratory



# OSPF Laboratory

- Required Devices:
  - Cisco 2811 Router: 3
  - NM-4A/S Module for Router: 3
  - Cisco 2960 Switch: 3
  - PC: 6

# OSPF Laboratory

➤ Router1 (DCE):

- Fast Ethernet 0/0: 172.16.1.1
- Serial 1/0 (DCE): 192.168.1.1
- Clock Rate: 64000
- (Connected to Switch1)

➤ Router3 (DTE):

- Fast Ethernet 0/0: 172.16.3.1
- Serial 1/0: 192.168.10.2
- (Connected to Switch3)

➤ Router2 (DTE) (DCE):

- Fast Ethernet 0/0: 172.16.2.1
- Serial 1/0 (DTE) : 192.168.1.2
- Serial 1/1 (DCE): 192.168.10.1
- Clock Rate: 64000
- (Connected to Switch2)

# OSPF Laboratory

➤ PC1:

- IP Address: 172.16.1.2
- Default Gateway: 172.16.1.1
- (Connected to Switch1)

➤ Switch1: دلخواه

➤ PC2:

- IP Address: 172.16.2.2
- Default Gateway: 172.16.2.1
- (Connected to Switch2)

➤ Switch2: دلخواه

➤ PC3:

- IP Address: 172.16.3.2
- Default Gateway: 172.16.3.1
- (Connected to Switch3)

➤ Switch3: دلخواه

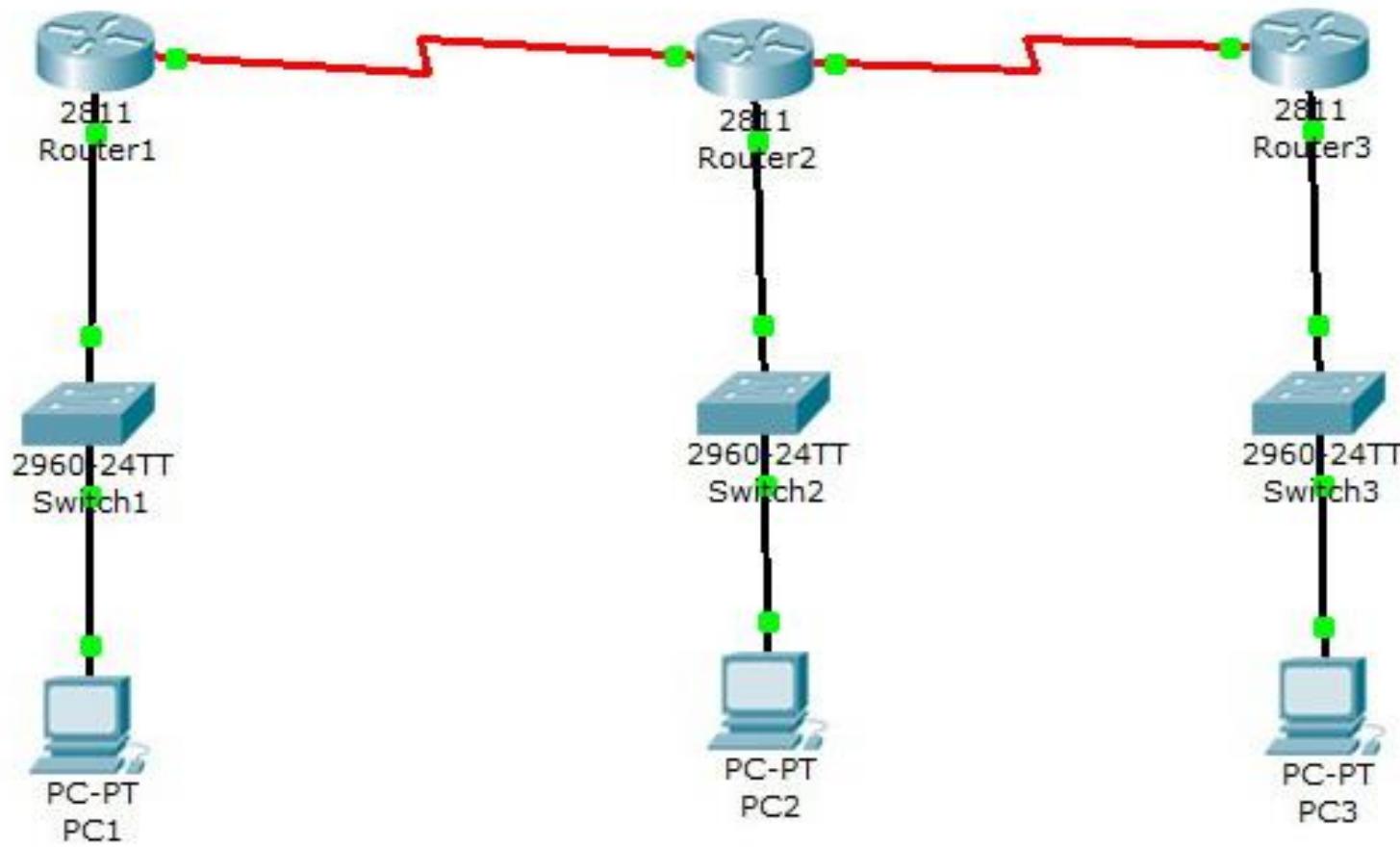
# OSPF Laboratory

- According to the Shape and Settings configure OSPF on all Routers that all Computers could

# EIGRP Configuration

- Router(config)# *router eigrp AS Number*
- Router(config-router)# *network* Connected Subnet Number  
Wildcard Mask
- Router(config-router)# *network* Connected Subnet Number  
Wildcard Mask
- . . .
- Router(config-router)# no auto-summary

# EIGRP Laboratory



# EIGRP Laboratory

- Required Devices:
  - Cisco 2811 Router: 3
  - NM-4A/S Module for Router: 3
  - Cisco 2960 Switch: 3
  - PC: 6

# EIGRP Laboratory

➤ Router1 (DCE):

- Fast Ethernet 0/0: 192.168.10.1
- Serial 1/0 (DCE): 172.16.10.1
- Clock Rate: 64000
- (Connected to Switch1)

➤ Router3 (DTE):

- Fast Ethernet 0/0: 192.168.30.1
- Serial 1/0: 172.16.100.2
- (Connected to Switch3)

➤ Router2 (DTE) (DCE):

- Fast Ethernet 0/0: 192.168.20.1
- Serial 1/0 (DTE) : 172.16.10.2
- Serial 1/1 (DCE): 172.16.100.1
- Clock Rate: 64000
- (Connected to Switch2)

# EIGRP Laboratory

➤ PC1:

- IP Address: 192.168.10.2
- Default Gateway: 192.168.10.1
- (Connected to Switch1)

➤ PC2:

- IP Address: 192.168.20.2
- Default Gateway: 192.168.20.1
- (Connected to Switch2)

➤ PC3:

- IP Address: 192.168.30.2
- Default Gateway: 192.168.30.1
- (Connected to Switch3)

➤ Switch1: دلخواه

➤ Switch2: دلخواه

➤ Switch3: دلخواه

# EIGRP Laboratory

- According to the Shape and Settings configure EIGRP on all Routers that all Computers could ping another one