ENCS4130
Computer Networks Laboratory

EXP#7 Switching and VLANs 1 Router on Stick

Slides By: Eng.Tariq Odeh

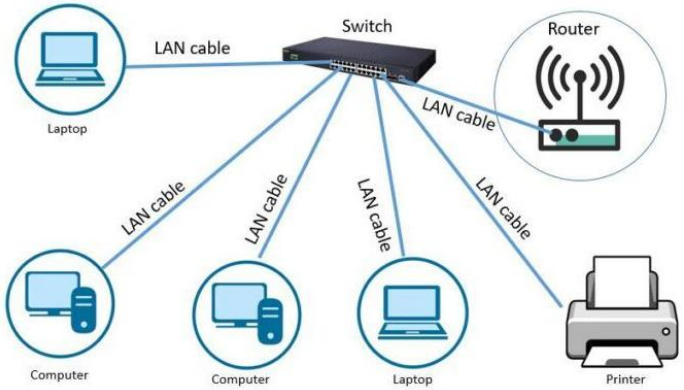
Objectives

- Learn how to configure a Cisco IOS Switch using the IOS command-line interface (CLI).
- Learn how to use switch simulator.
- Learn how to split Cisco router interface into sub interfaces.
- Learn how to split Cisco switches into multiple virtual ones and create VLANS.

Introduction

- **What is LAN?**
  - A LAN (Local Area Network) connects devices within a small area for sharing resources and communication **(Single Broadcast Domain).**
- **What is VLAN?**
  - VLANs (Virtual Local Area Networks) create isolated networks within the same physical network for better management and security.
- **Router on a Stick:**
  - A technique where a single router port handles traffic between multiple VLANs, enabling inter-VLAN communication.

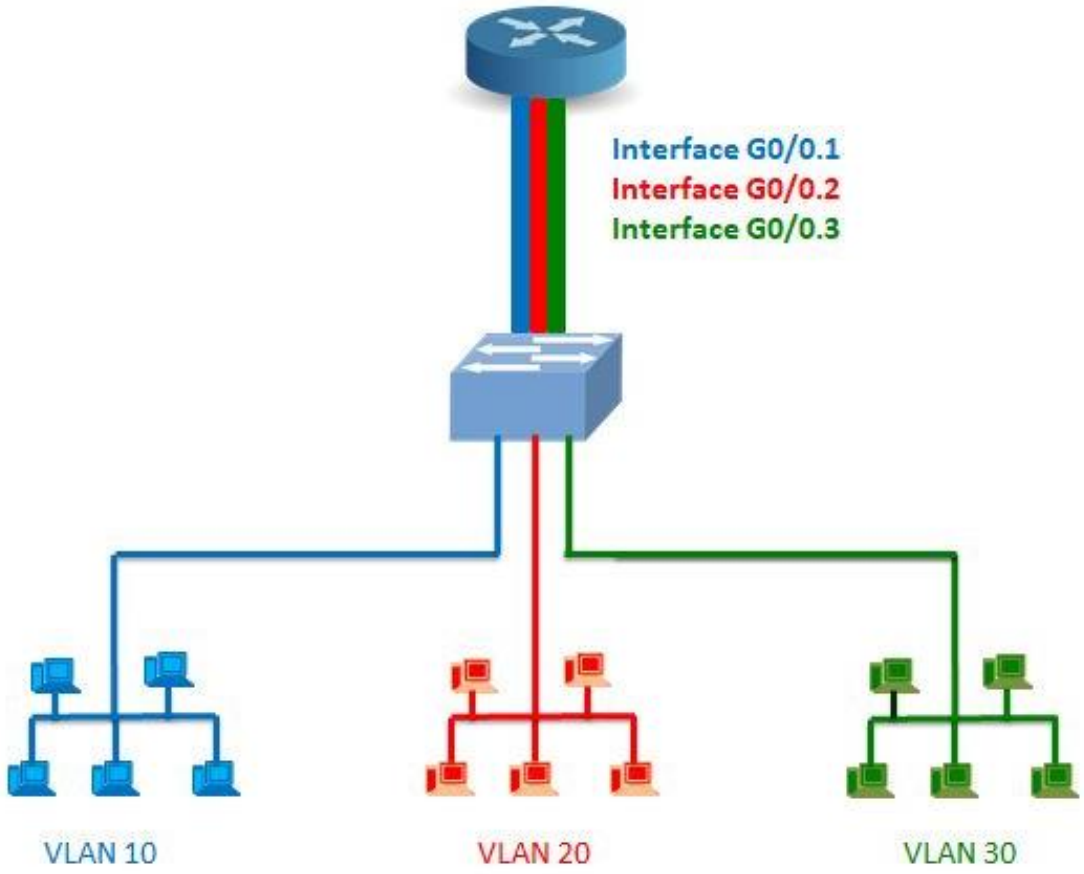
How Does a Switch Work?



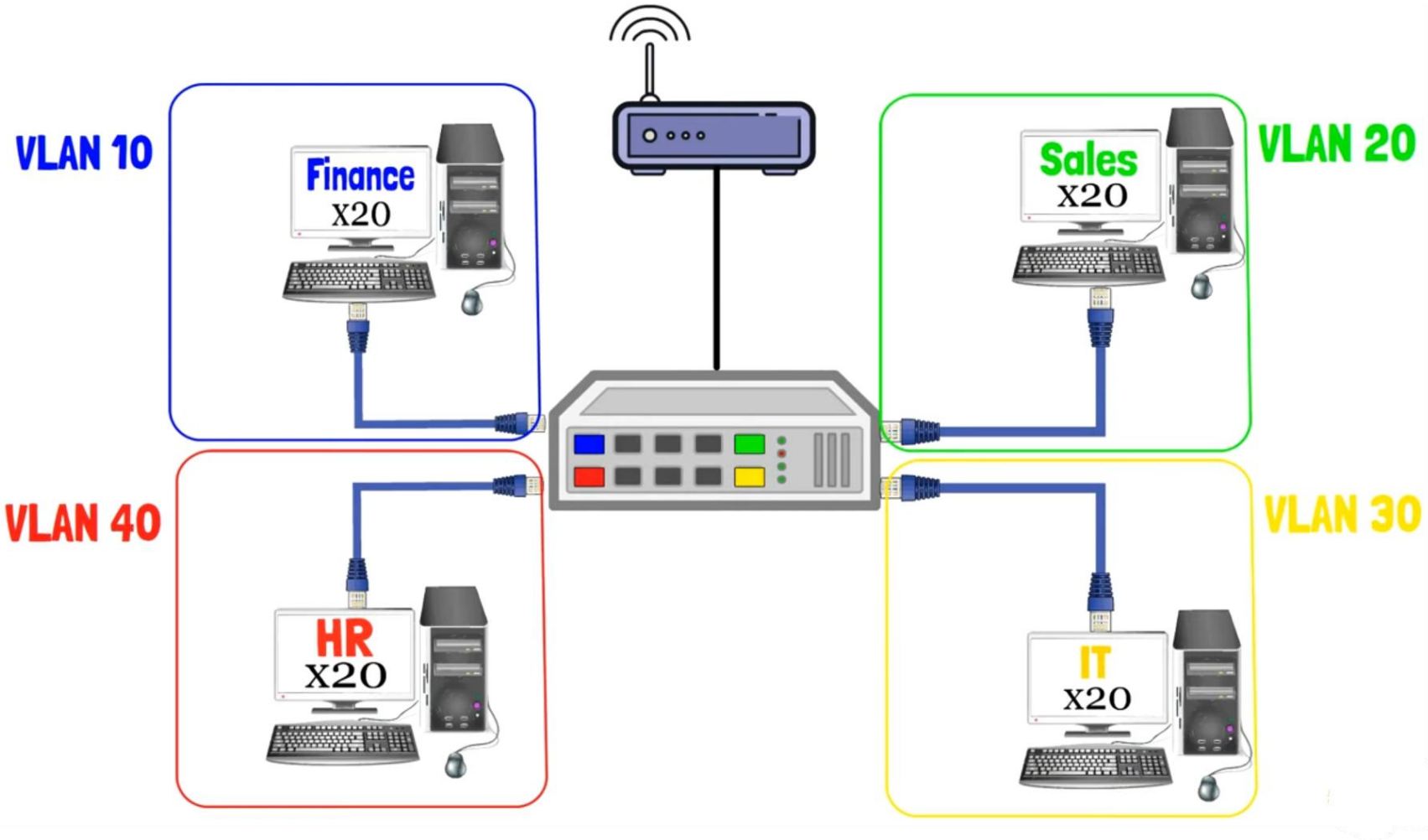
- **Powering On:**
  - A switch begins working as soon as it’s plugged into a power source.
- **Learning MAC Addresses:**
  - When a device sends a frame, the switch extracts the device’s MAC address from the frame.
  - The switch links this MAC address to the specific port the device is connected to.
- **Building the MAC Address Table:**
  - The switch creates a table that maps each MAC address to its corresponding port.
  - This table allows the switch to efficiently forward packets to the correct destination.

Understand the VLANs

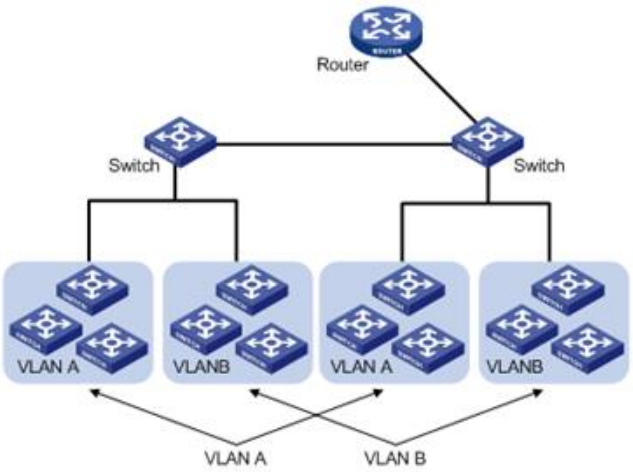
1. **Decrease broadcast traffic.**
2. **Separate broadcast domain.**
3. **Enhance network performance.**
4. **Scalable.**
5. **Security.**



Example



IEEE 802.1Q VLAN Protocol

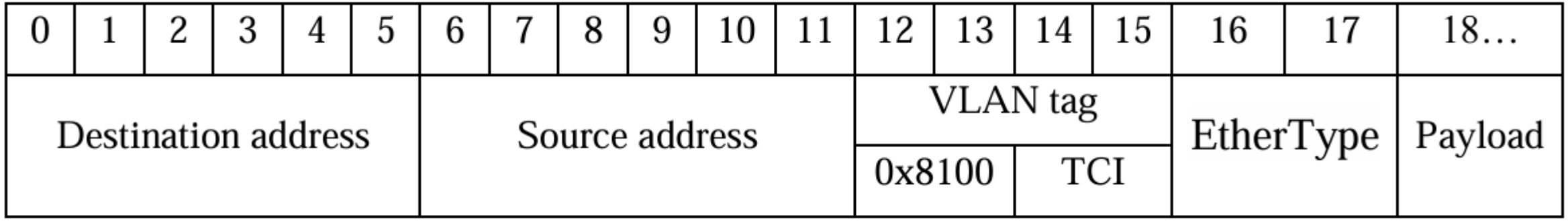


- **What is IEEE 802.1Q?**
  - Purpose: IEEE 802.1Q is a protocol for carrying VLAN traffic on Ethernet.
  - How it Works: Encapsulates VLAN traffic, allowing multiple logical VLANs to share the same physical LAN infrastructure.
  - Use Case: VLANs are ideal for segregating traffic at the link layer.
- **Best Practices for VLANs in IP Networks:**
  - Assign separate VLANs for each IP subnet to enhance security and reduce broadcast traffic.
  - **Benefits:**
    - Prevents devices from joining unintended subnets by simply changing IPs.
    - Reduces unnecessary broadcast traffic between subnets.

IEEE 802.1Q VLAN Tagging

- **What is VLAN Tagging?**
  - Purpose: VLAN tagging allows VLAN frames to be distinguished from standard Ethernet frames by adding a 4-byte VLAN tag to the Ethernet header.
  - Placement: This tag is inserted between the source MAC address and the EtherType fields.
- **VLAN Tag Structure (4 Bytes):**
  - TPID (2 bytes): 0x8100, identifies the frame as tagged.
  - TCI (2 bytes): Contains:
    - PCP (3 bits): Priority Code Point.
    - CFI (1 bit): Canonical Format Indicator.
    - VID (12 bits): VLAN ID.

IEEE 802.1Q VLAN Tagging (Cont.)

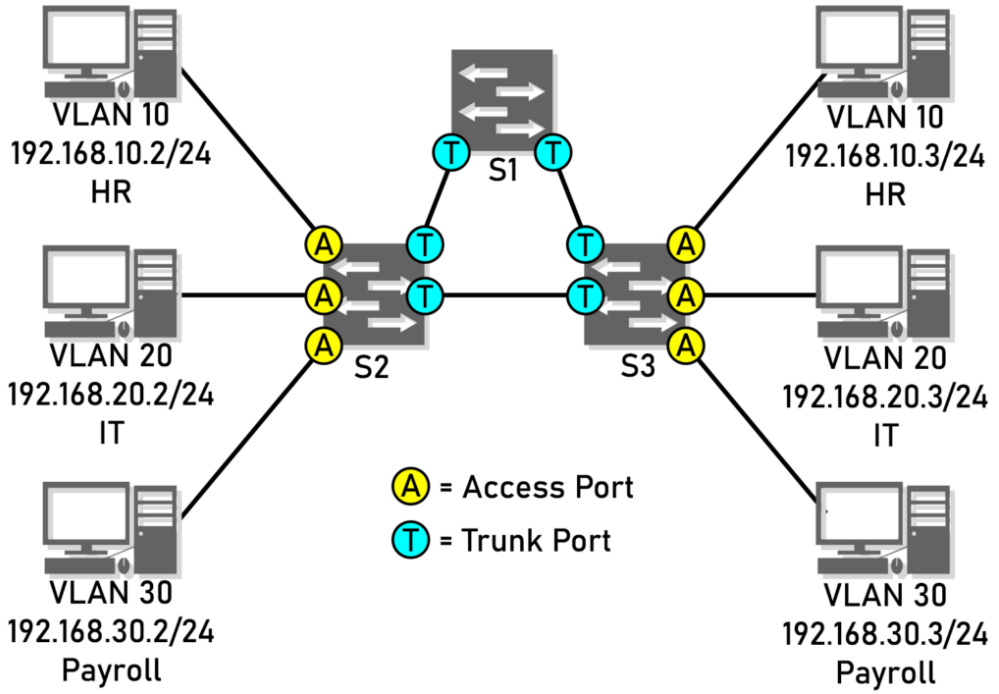


VLAN Numbering (802.1Q)

- **VLAN Identifier (VID):**
  - Each VLAN is identified by a 12-bit VID in the range 1 to 4094.
  - Reserved Values: 0 and 4095 are reserved and cannot be used.
- **Default VLAN:**
  - VID 1 is the default VLAN for unconfigured ports.
  - Best Practice: Move traffic off the default VLAN for better security and segmentation.
- **Usage Limits:**
  - Although 4094 VIDs are available, many devices limit the number of configurable VLANs.

Trunk and Access Ports

- **Trunk Port (tagged port):**
  - Purpose: Manages VLAN traffic with tagging.
  - Usage: Connects switches and routers, between switches.
  - Traffic: Carries 802.1Q-tagged frames.
- **Access Port (untagged port):**
  - Function: Connects end devices.
  - Traffic: Sends untagged frames.
- **Hybrid Mode:**
  - Combines access and trunk functions.
  - Caution: Risk of VLAN hopping; not recommended.



Creating a VLAN & Switch Port Initialization

- **Creating a VLAN:**
  - **Switch(config)# VLAN <VLAN-NUMBER>**
  - **Switch# show VLAN**

- **Switch Port as Trunk:**
  - **Switch(config-if)# switchport mode trunk**
  - *(Other end automatically switches to trunk mode)*

- **Switch Port as Access:**
  - **Switch(config-if)# switchport access VLAN <VLAN-NUMBER>**
  - **Assigning a Range of Interfaces:**
    - **Switch(config)# interface range <TYPE> <SLOT>/<START-PORT> - <END-PORT>**

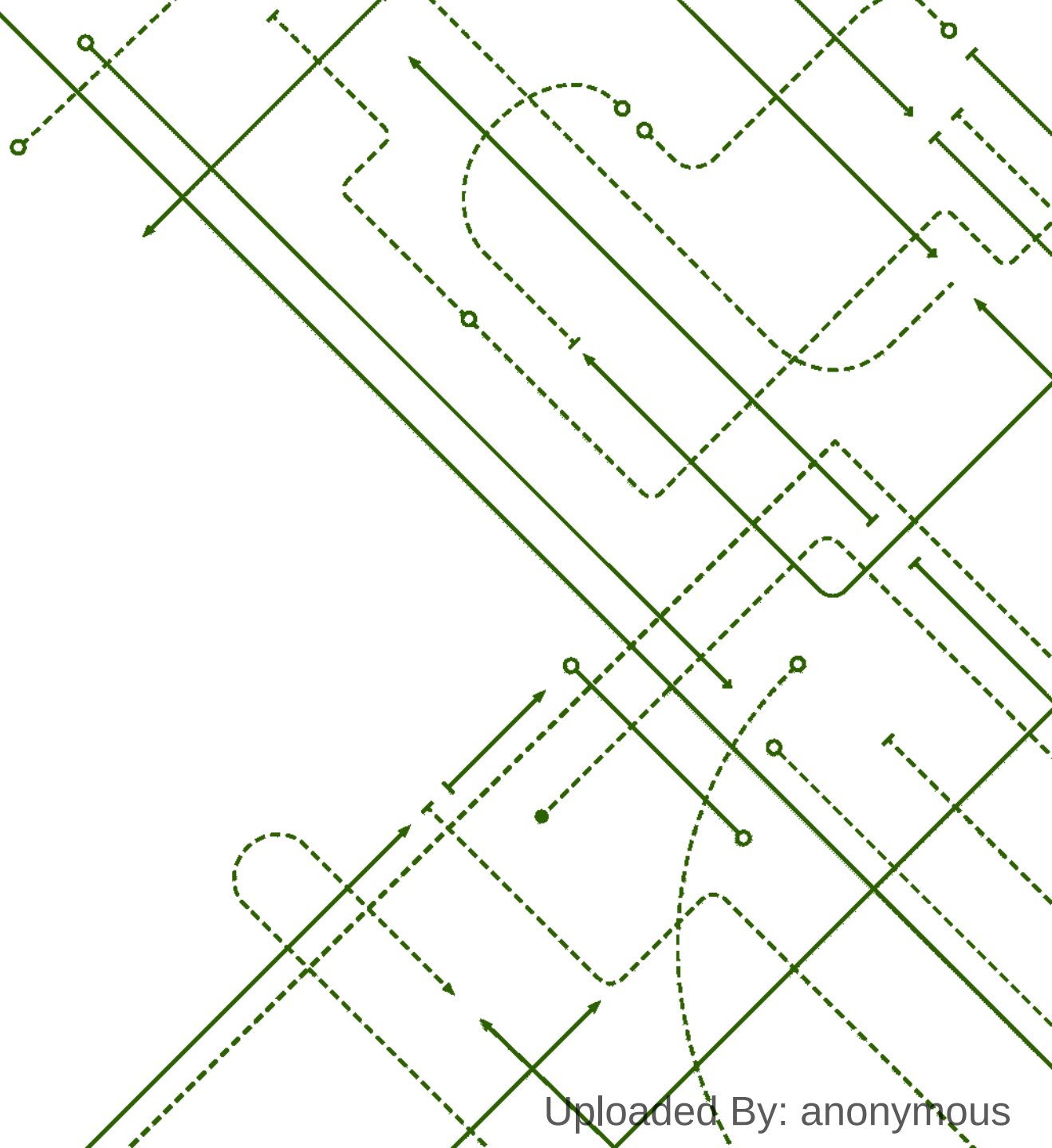
Sub-interfaces on Routers

- **What is a Sub-interface?**
  - A virtual interface on a router's main interface.
  - Has its own IP address and encapsulation for tagged traffic.

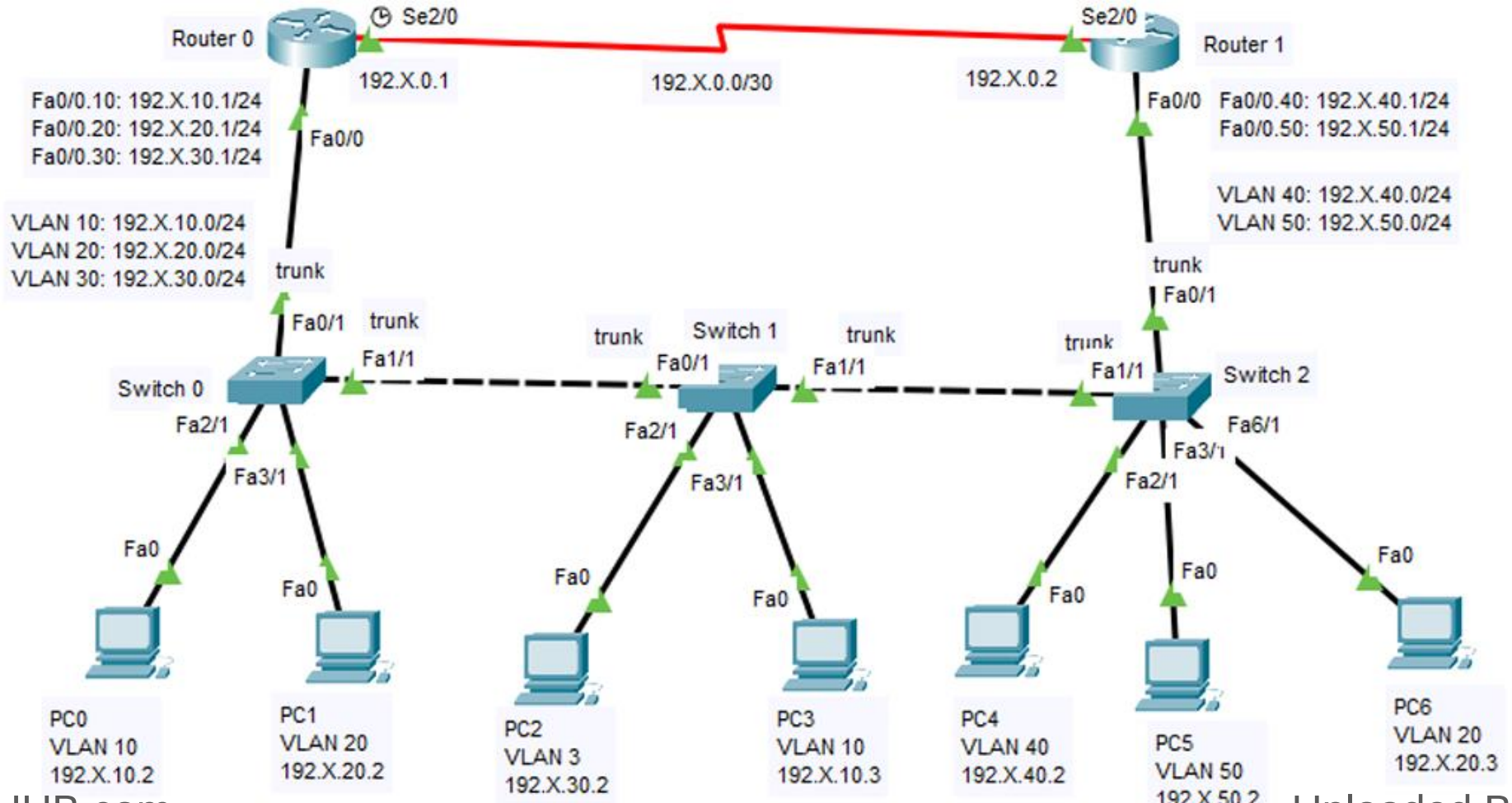
- **Initializing a Sub-interface:**
  - **Router(config)# interface <TYPE> <SLOT>/<PORT>.<SUB-INTERFACE-NUMBER>**

- **Setting IP Address for Sub-interface:**
  - **Router(config-subif)# encapsulation dot1Q <VLAN-ID>**
  - **Router(config-subif)# ip address <IP-ADDRESS> <SUBNET-MASK>**

Procedure



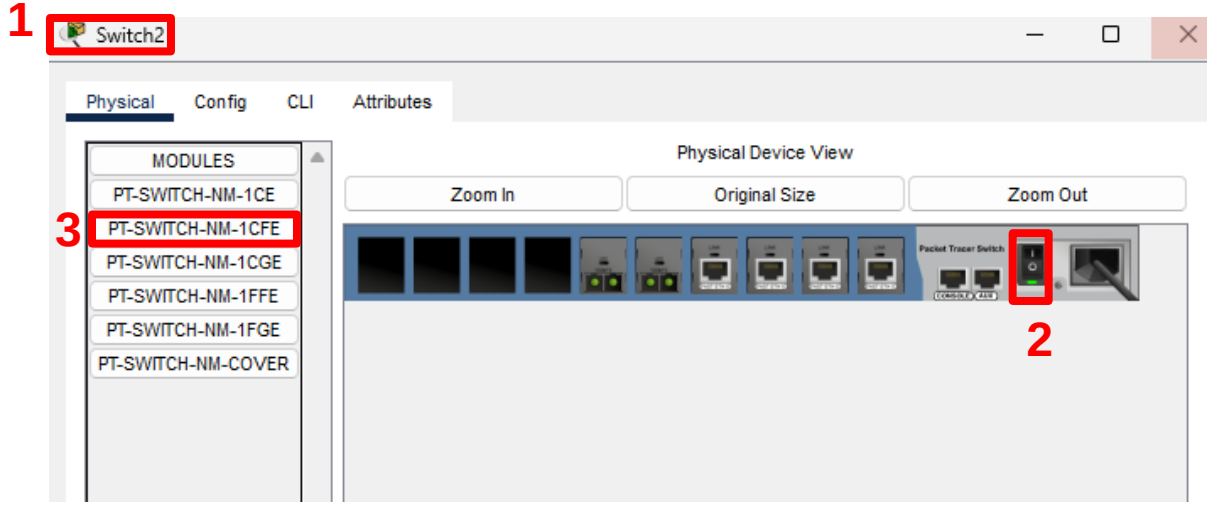
Topology

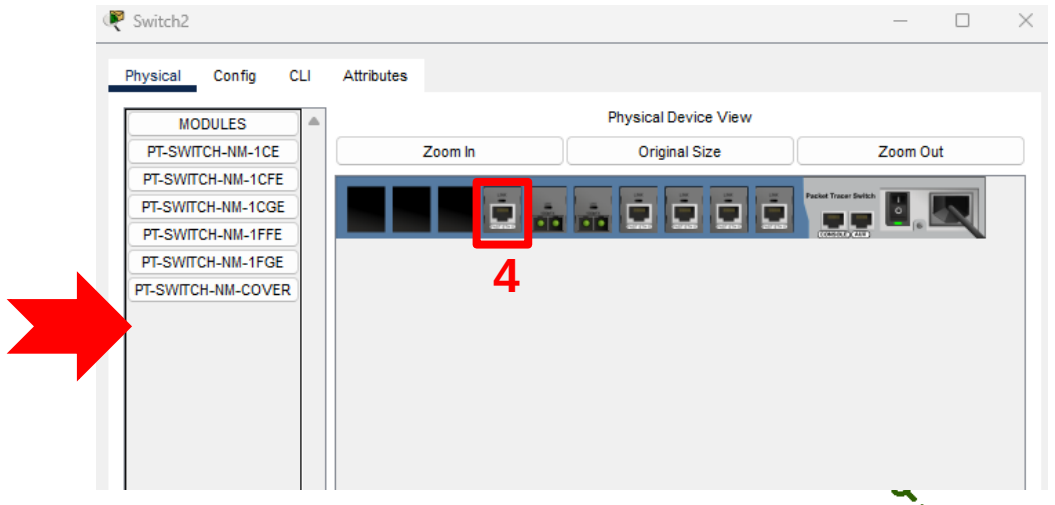


Steps of Configurations

1. **Build the topology.**

2. **Add an extra interface physically.**





Steps of Configurations (Cont.)

3. Configuring Routers Sub Interfaces.

- ***Turn on the interface***
- **Router(config)# interface Fa0/0.10**
- **Router(config-subif)# encapsulation dot1Q 10**
- **Router(config-subif)# ip address 192.X.10.1 255.255.255.0**

Steps of Configurations (Cont.)

4. **Assign the IPs:** To Routers & PCs.

5. **Configuring OSPF Routing.**
   - **Router(config)# router ospf 1**
   - **Router(config-router)# network 192.X.10.0 0.0.0.255 area 0**

6. **Creating a VLAN.**
   - **Switch(config)# VLAN 10**
   - **Switch(config-vlan)# exit**

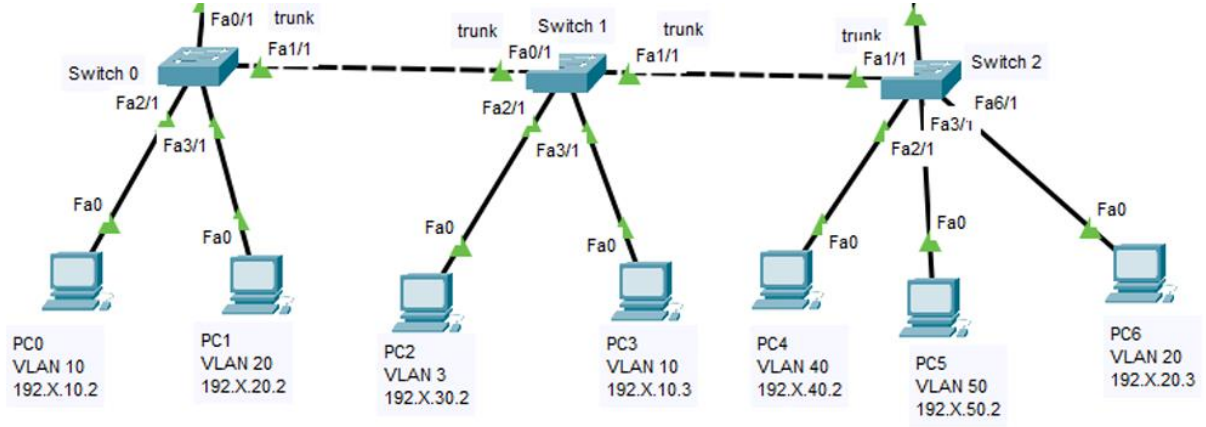
Steps of Configurations (Cont.)

7. Configuring Switch Access.

- Switch(config)# interface Fa2/1
- Switch(config-if)# switchport access VLAN 10

8. Configuring Switch Trunk.

- Switch(config)# interface Fa1/1
- Switch(config-if)# switchport mode trunk



Saving Configurations

- **Don't forget to save the configurations on your router and switch.**

  → **Router# write**

  → **Switch# write**

Video explaining the experiment

--Soon--

References

- **Manual for ENCS4130 Computer Networks Laboratory.**