Department of Computer Science and Engineering

Islamic University of Technology (IUT)

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Laboratory Report

CSE 4412: Data Communication and Networking Lab

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Section	**: BSc in SWE(Group A)**
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Academic Year	**: 2022-23**
Date	**: 13/01/2023**
Lab No	**: 03**

Title: Create a simple basic LAN (Local Area Network)

Objective:

1. Create a simple LAN by connecting multiple end devices.
2. Significance of IP address
3. Difference between Switch and Hub.
4. Configure the given topology (see .pkt file in the attachment) to create LAN.

Devices/ Software:

We used the Cisco Packet Tracer simulated on our laptops for this lab. Cisco Packet Tracer is basically a packet path simulator that can be run on local computers to simulate and understand different network connections.

Working Procedure:

We learned about how IP address and subnet mask work together to identify a device connected to an internal network. In order to find the block address the subnet mask and the IP address are subject to binary 'and' operations. The result of which gives the block address of the device to which the packet is to be delivered. The next idea we were introduced to was the idea of ipconfig for windows systems and ifconfig for Linux systems which when run by the command line or the terminal produces the network configuration of the device. Another thing is the use of the 'ping' command. The 'ping' command helps determine whether it is possible to dispatch a packet to another end device from an end device within a network through a series of hubs, switches, and possibly even routers. The steps of the experment are given below:

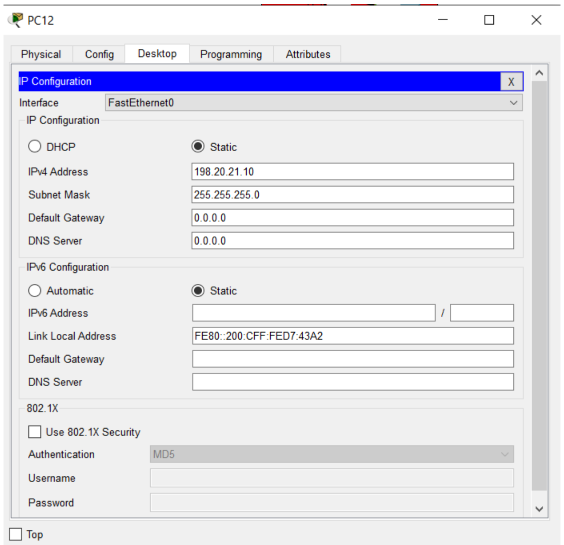
1) Using the Cisco packet tracer, we set up three end devices. Each of the end devices is connected by a copper straight-through cable with a default hub(PT-Hub). Each of the default PC had a FastEthernet0 port. And the PT-Hub had 5 FastEthernet ports. Each of these ports was connected to the PC. After which we had to configure the IP address by selecting the IP Configuration Option in the desktop menu of the PC options obtained by double-clicking on the PC. I first selected the static IP address and gave the IP address as "198.20.21.10" then upon selecting the subnet mask we were provided with a default subnet mask '255.255.255.0' that is for a class C IP address. Similarly, I selected the IP address using the same default subnet mask. The IP address for the second PC was "198.20.21.11" and the third PC was "198.20.21.12". The default subnet mask was conserved across all these devices. After using the simulation option of the cisco packet tracer I used the ping command in the command prompt in the desktop option of the PC to see if packet transfer occurs from the first end device to the third end device. This simulates the packet transfer. Some of the key observations here are that the packet is dispatched from the first PC to the hub. The hub then sends it to both PCs. Both the PCs upon receiving the packets either reject

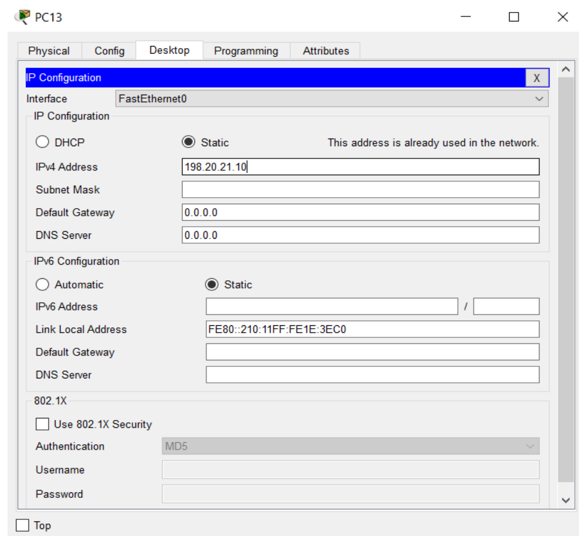
it if the IP address and the subnet mask of the network header don't match their IP address and subnet mask. This sent to both devices is called flooding. Upon receiving the packet. The receiver PC sends back an acknowledgment to the hub to notify the sender PC. The hub again floods the other 2 PCs except the receiver PC to send the acknowledgment back to the sender PC. Another key observation is that for the hub upon observing the PDU information, we see that only layer 1 is active which is why it cannot directly identify the device to which the packet is to be sent and instead sends it to all the devices except the sender device.

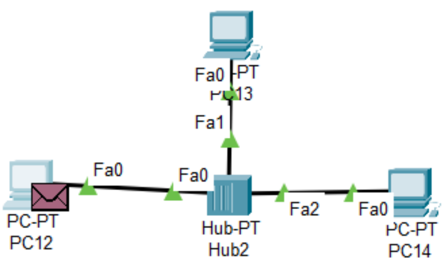
2) Using the same configuration as above, which is essentially a star topology in a sense, we replace the hub with a switch. We use the default switch(PT-Switch). This gives us two very important observations, firstly upon observing the PDU information for the switch you can see that layer-2 is active. The second observation is that the path for the travel is directly from the sender PC to the switch to the expected receiver PC and back. Unlike the hub it does not flood the packet to all the connected PCs but rather intelligently selects and dispatches the packets to the right path. The one thing I did differently here is that I selected the IP address for the first PC to be "20.23.21.10" and the subnet mask used for all 3 PCs was "255.0.0" to establish the class A IP address scheme with the subnet mask being the default subnet for the scheme.
3) In the last stage, we were provided with 3 rooms, each room had a hub and the three hubs were connected by a switch. To connect a computer to a hub we use a straight-through cable but to connect a hub to a switch we use a cross-over cable. The cabling convention is a throwback to Lab 01 where we learned about which connection mechanism to use for which condition. If it is a similar device such as a connection between a computer and a computer then we use a cross-over connection and for different devices, we use a straight-through connection. Since the computer and a hub are considered different devices we use a straight-through cable but a hub and a switch are considered the same devices so we use a cross-over cable. Then similar to steps 1 and 2, I had to configure the PCs with the IP addresses and subnet masks. I tried to maintain consistency in IP addresses ranging from "20.23.21.10" to "20.23.21.21" and the subnet mask for all of them was "255.255.255.0" which is of class C IP address scheme. Then I simulated the connection for pinging IP address "20.23.21.21" in room 103 from "20.23.21.10" in room 101. Here we see an important observation. The PC does send the packet to the hub and the hub still floods to all other connections except the PC itself. But the switch could actually determine in which room the packet is to be sent. In other words, it is new in which room there exists a PC that is connected to a hub that is connected to the switch from which it is to be dispatched. So upon arrival at the switch, the packet travels to the hub for room 103 instead of flooding both rooms in search of the desired IP address. The reason it can do this is that packet-switching technology relies on the 2nd layer which is the data link layer. Also in this layer, there exists a MAC address table the packet is transferred with reference to the MAC address that is mentioned in the packet and the MAC address table helps transfer the packet as per the dedicated route. Since it relies on the MAC address and not the IP address or the subnet mask it can transfer packets even to networks where the IP address of the end devices may be similar to the source network as the MAC address is usually unique for each device provided the NIC of the device has a Universally Administered MAC address.

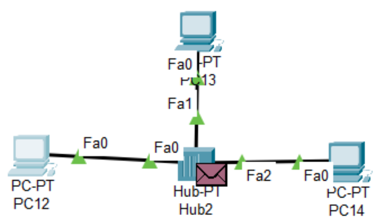
Diagram of the experiment:

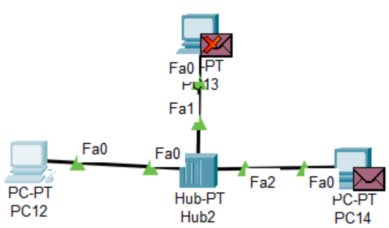
Step-1

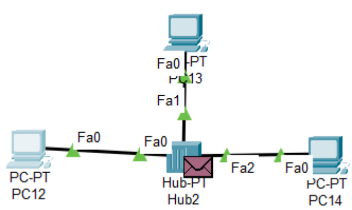


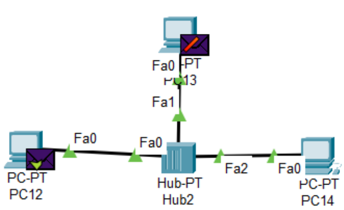


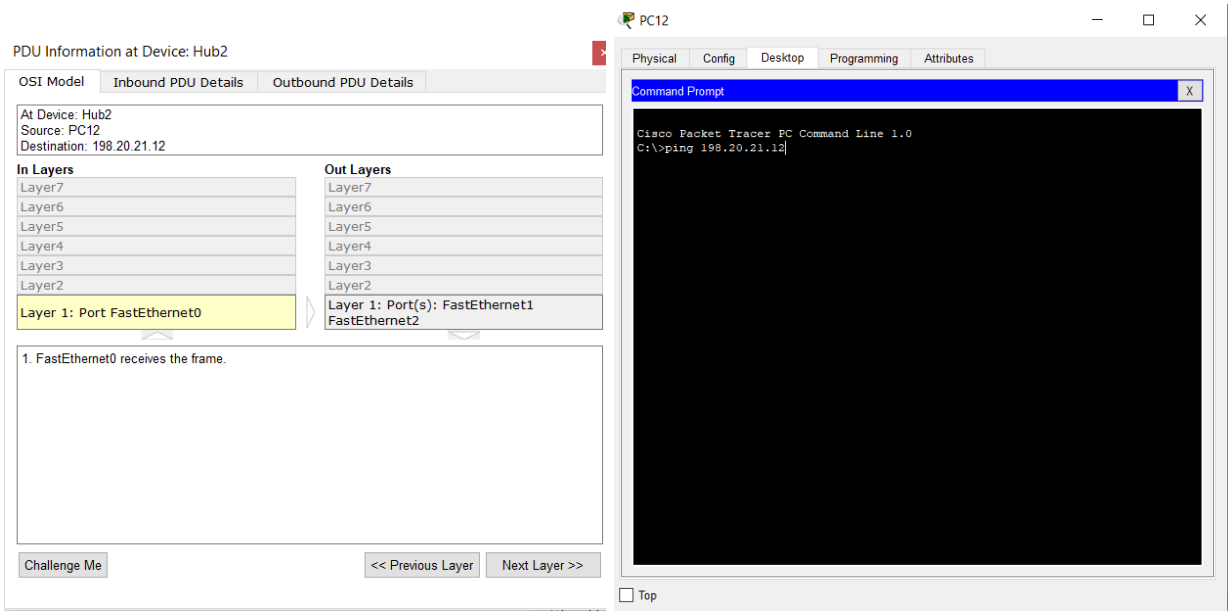




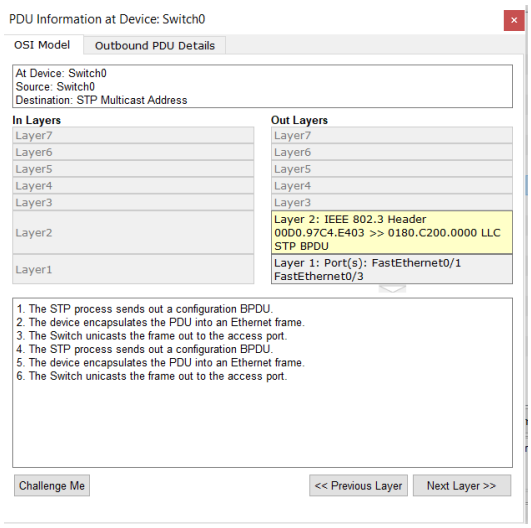


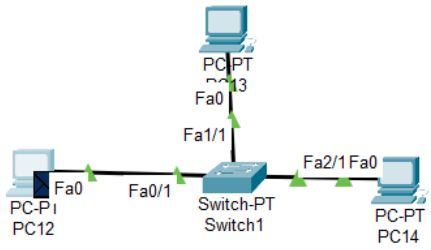


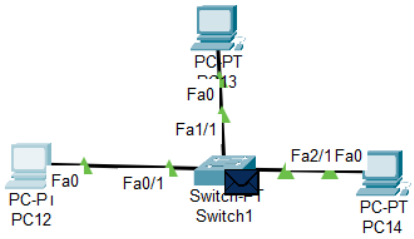


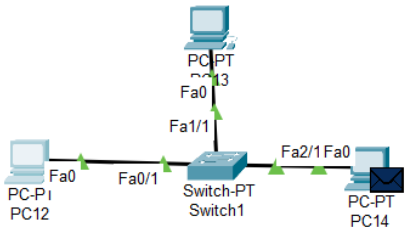

PDU Information at Device: Hub2
OSI Model
Inbound PDU Details
Outbound PDU Details
At Device: Hub2
Source: PC12
Destination: 198.20.21.12
In Layers
Out Layers
Layer7
Layer6
Layer5
Layer4
Layer3
Layer2
Layer 1: Port FastEthernet0
Layer 1: Port(s): FastEthernet1
FastEthernet2
1. FastEthernet0 receives the frame.
Challenge Me
<< Previous Layer
Next Layer >>
PC12
Physical
Config
Desktop
Programming
Attributes
Command Prompt
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 198.20.21.12
Top

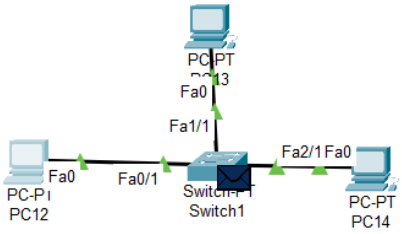
Step-2

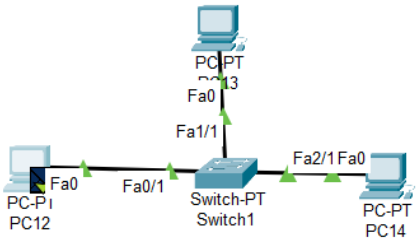

PDU Information at Device: Switch0
OSI Model
Outbound PDU Details
At Device: Switch0
Source: Switch0
Destination: STP Multicast Address
In Layers
Out Layers
Layer7
Layer6
Layer5
Layer4
Layer3
Layer2
Layer1
Layer 2: IEEE 802.3 Header
00D0.97C4.E403 >> 0180.C200.0000 LLC
STP BPDU
Layer 1: Port(s): FastEthernet0/1
FastEthernet0/3
1. The STP process sends out a configuration BPDU.
2. The device encapsulates the PDU into an Ethernet frame.
3. The Switch unicasts the frame out to the access port.
4. The STP process sends out a configuration BPDU.
5. The device encapsulates the PDU into an Ethernet frame.
6. The Switch unicasts the frame out to the access port.
Challenge Me
<< Previous Layer
Next Layer >>


PC-PT
Fa0
Fa1/1
Fa0
PC-PT
PC12
Fa0/1
Switch-PT
Switch1
Fa2/1
Fa0
PC-PT
PC14

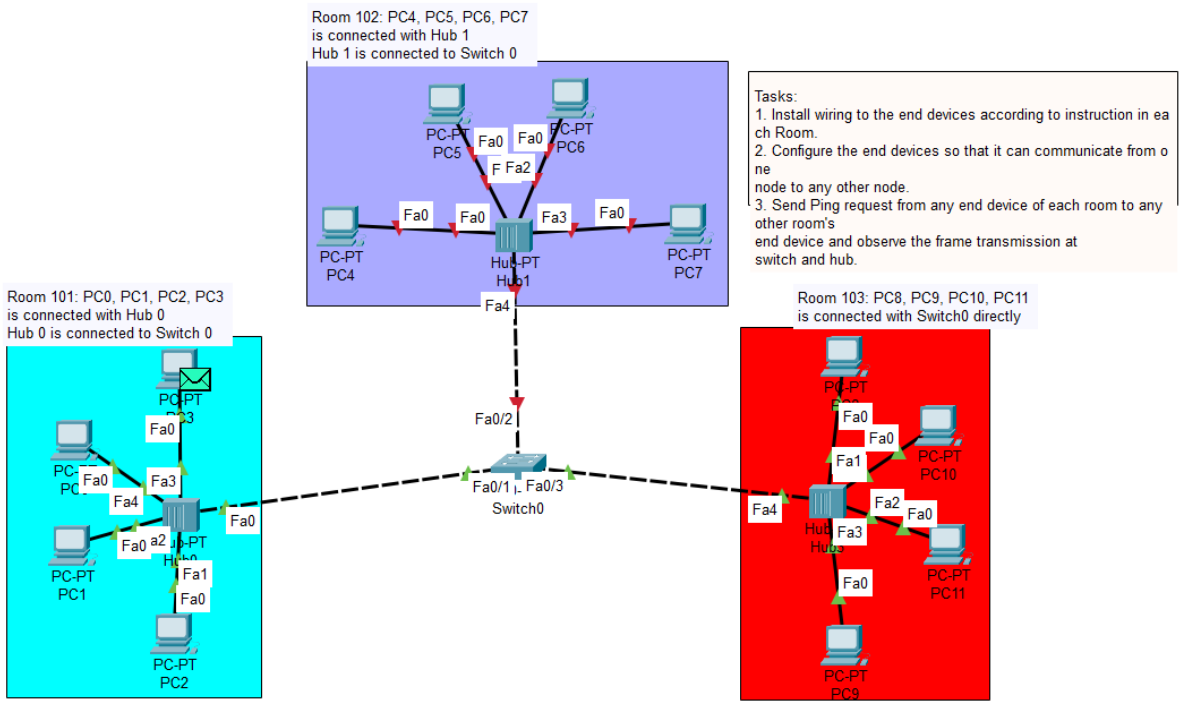

PC-PT
Fa0
Fa1/1
Fa0
PC-PT
PC12
Fa0/1
Switch1
Fa2/1
Fa0
PC-PT
PC14

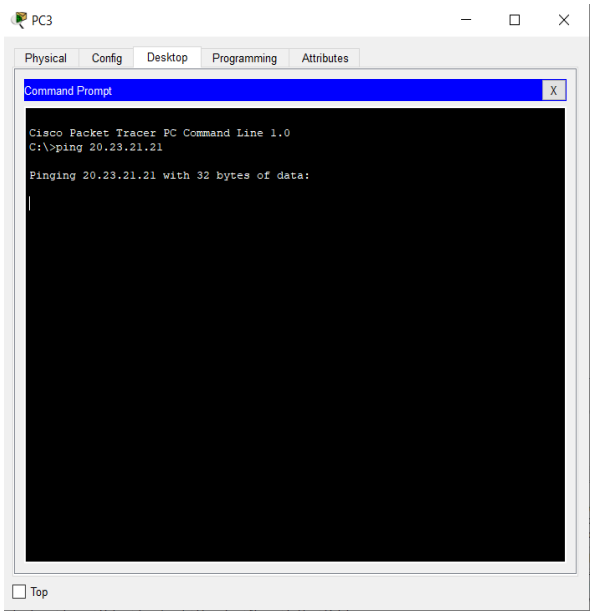

PC-PT
Fa0
Fa1/1
Fa0
PC-PT
PC12
Fa0/1
Switch-PT
Switch1
Fa2/1
Fa0
PC-PT
PC14

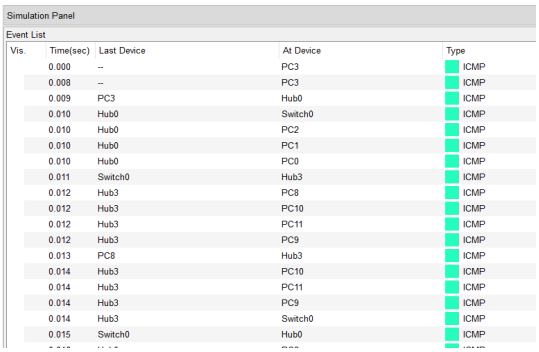

PC-PT
Fa0
Fa1/1
Fa0
PC-PT
PC12
Fa0/1
Switch1
Fa2/1
Fa0
PC-PT
PC14


PC-PT
Fa0
Fa1/1
Fa0
PC-PT
PC12
Fa0/1
Switch-PT
Switch1
Fa2/1
Fa0
PC-PT
PC14

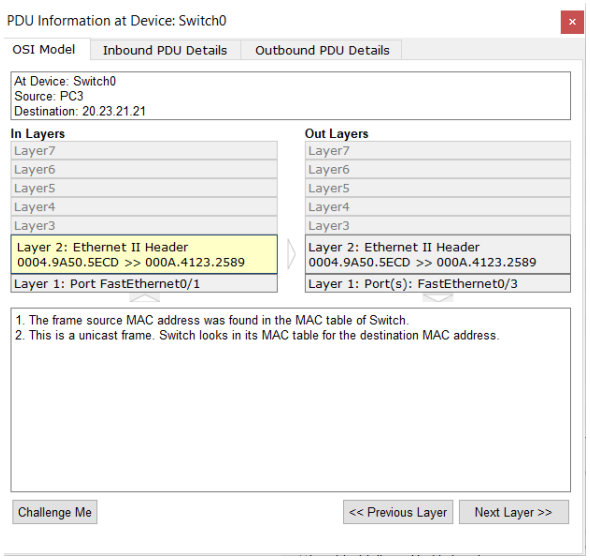
Step-3

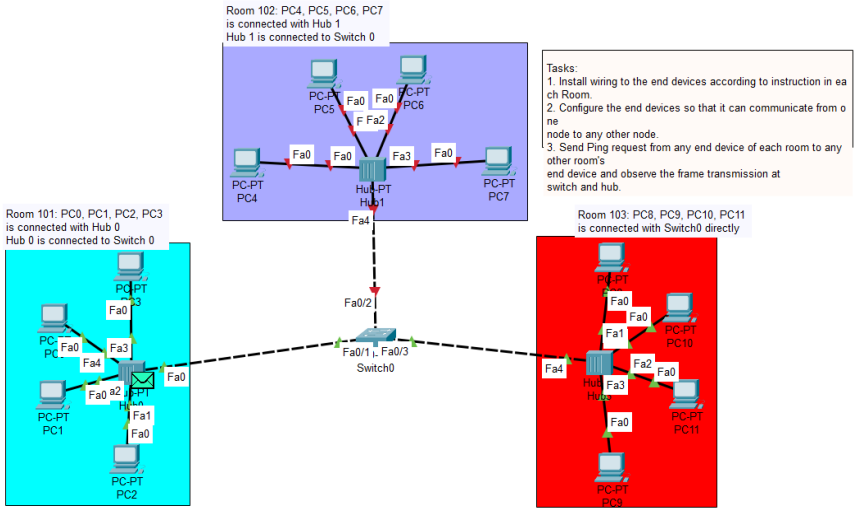


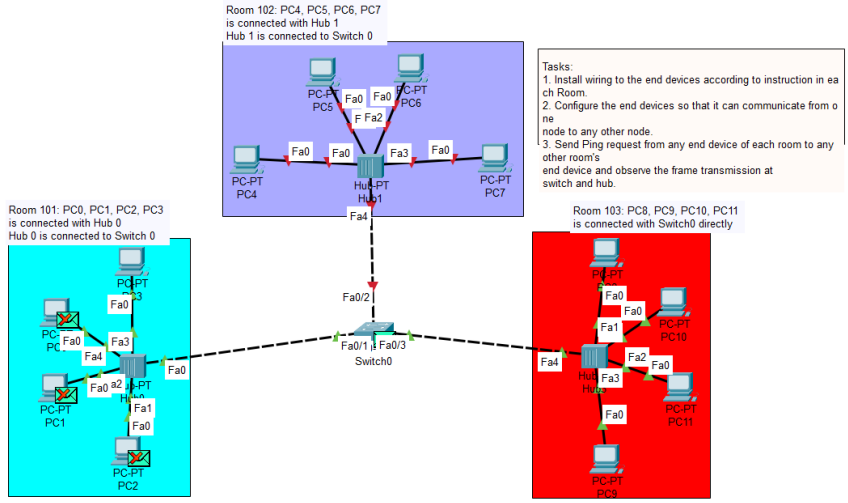


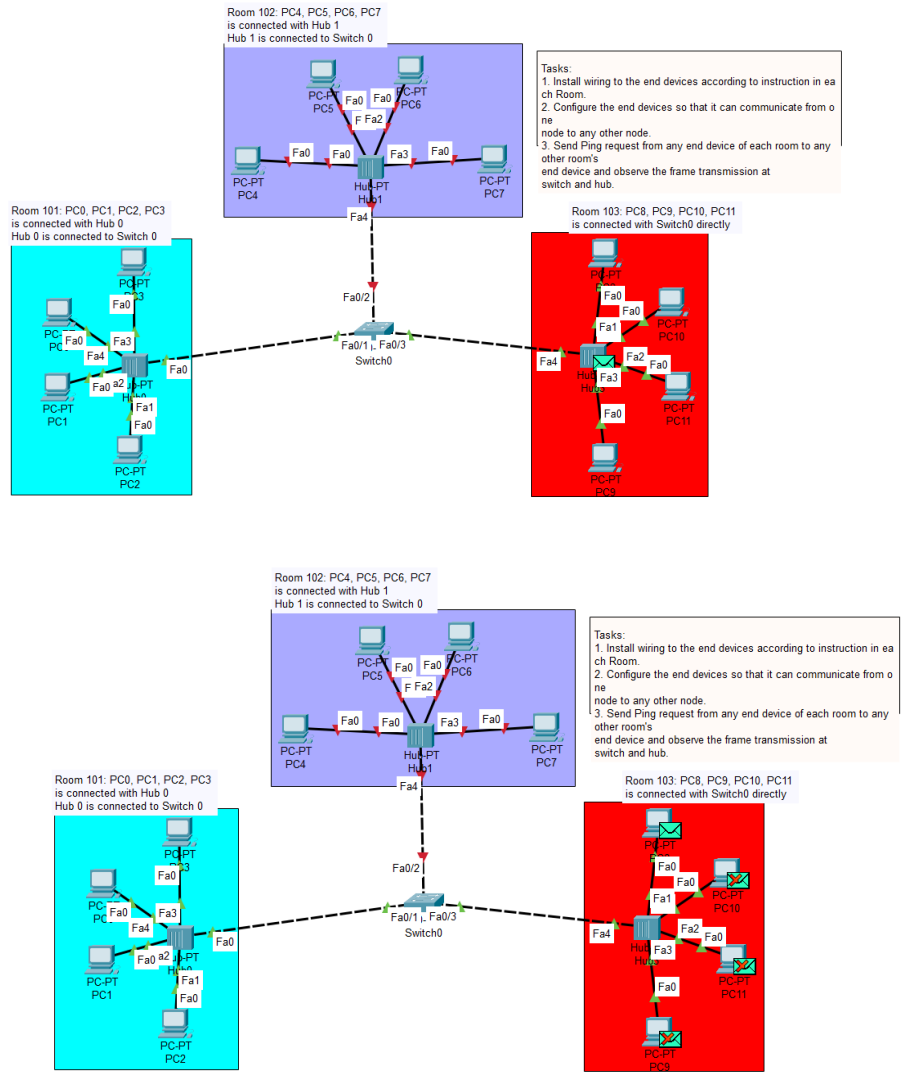


0.015	Switch0	Hub0	ICMP
0.016	Hub0	PC2	ICMP
0.016	Hub0	PC1	ICMP
0.016	Hub0	PC3	ICMP
0.016	Hub0	PC0	ICMP


PDU Information at Device: Switch0
OSI Model
Inbound PDU Details
Outbound PDU Details
At Device: Switch0
Source: PC3
Destination: 20.23.21.21
In Layers
Out Layers
Layer7
Layer6
Layer5
Layer4
Layer3
Layer 2: Ethernet II Header
0004.9A50.5ECD >> 000A.4123.2589
Layer 1: Port FastEthernet0/1
Layer 2: Ethernet II Header
0004.9A50.5ECD >> 000A.4123.2589
Layer 1: Port(s): FastEthernet0/3
1. The frame source MAC address was found in the MAC table of Switch.
2. This is a unicast frame. Switch looks in its MAC table for the destination MAC address.
Challenge Me
<< Previous Layer
Next Layer >>


Room 102: PC4, PC5, PC6, PC7
is connected with Hub 1
Hub 1 is connected to Switch 0
Tasks:
1. Install wiring to the end devices according to instruction in ea
ch Room.
2. Configure the end devices so that it can communicate from o
ne
node to any other node.
3. Send Ping request from any end device of each room to any
other room's
end device and observe the frame transmission at
switch and hub.
Room 101: PC0, PC1, PC2, PC3
is connected with Hub 0
Hub 0 is connected to Switch 0
Room 103: PC8, PC9, PC10, PC11
is connected with Switch0 directly
Fa0/2
Fa0/1
Fa0/3
Switch0


Room 102: PC4, PC5, PC6, PC7
is connected with Hub 1
Hub 1 is connected to Switch 0
Tasks:
1. Install wiring to the end devices according to instruction in ea
ch Room.
2. Configure the end devices so that it can communicate from o
ne
node to any other node.
3. Send Ping request from any end device of each room to any
other room's
end device and observe the frame transmission at
switch and hub.
Room 101: PC0, PC1, PC2, PC3
is connected with Hub 0
Hub 0 is connected to Switch 0
Room 103: PC8, PC9, PC10, PC11
is connected with Switch0 directly
Fa0/2
Fa0/1
Fa0/3
Switch0



After this step, the reverse happens to send an acknowledgment regarding the packet received it follows a similar path with the packet being dispatched to the hub, and then the hub floods all its ports and one of its ports being the switch receives the packet and intelligently transfers it to the hub in room 1 and then that hub again floods and transfers the packets to the sender PC which receives the acknowledgment and thus stops it from sending another packet. The cross mark on the envelopes in the images indicates that the packet isn't supposed to go to them.

Observation:

- **Significance of IP address configuration to different end devices:**

The first idea that we were introduced to was the idea of IP addresses and how they are used to transfer a packet to a receiver in an internal network. Here we aren't introduced to the idea of routing packets over the internet but rather working with transferring packets using at max a layer-2 device such as a switch.

IP addresses or internet protocol address are addresses usually provided by the ISP(Internet Service Provider). This IP address can be static that has to be manually assigned or dynamic and assigned via DHCP. The IP address which is still in use is the IP address version 4 or IPv4 which uses a 32-bit address with each segment represented separated by dots and each segment has an 8-bit number ranging from 0 to 255. The other essential idea is the idea of subnet masks. Subnet masks can uniquely identify devices within the same internal network. A subnet mask is a 32-bit string of numbers used to divide an IP address into two parts: the network address and the host address. The subnet mask is used to determine which portion of the IP address belongs to the network and which portion belongs to the host. It allows a network administrator to divide a larger network into smaller subnetworks, which can improve network security and organization. IP addresses and subnet masks are usually provided as the header for network layer packets that help regulate how the data in the packets are to be transmitted.

- **Difference between Switch and Hub**
  The next important idea is the idea of hubs and switches. Switches are layer-2 devices that can intelligently transfer packets from a sender to a receiver using intelligent packet-switching technology. Unlike switches, hubs are layer-1 devices that cannot intelligently transfer packets and instead rely on flooding all the sent packets to all the connected devices, only the dedicated device will accept the packet. The intelligent packet-switching makes switches both faster and more secure.

Challenges:

The core challenge I faced while performing this experiment was setting the IP address manually as I had to remember the sequence of the IP address and recall if the same IP address has already been used before which made my PC IP addresses inconsistent with some extent, especially in room 3 where the IP address for the last segment should be between 14 and 17 but instead it is 14 to 16 with a 21. It would be easier in a sense, to use the DHCP or the Dynamic Host Configuration Protocol where the IP address is automatically assigned but the underlying concept is slightly more difficult. There were many screenshots but I didn’t attach all of them I only showed the PDU for the hub and the switch to explain the basic differences that lie between the two and the lair architecture they follow. Since the basic overview of the layers was mentioned in the previous lab I skipped it here.