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	**: 1**
Semester	**: 4th**
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Lab No	**: 5**

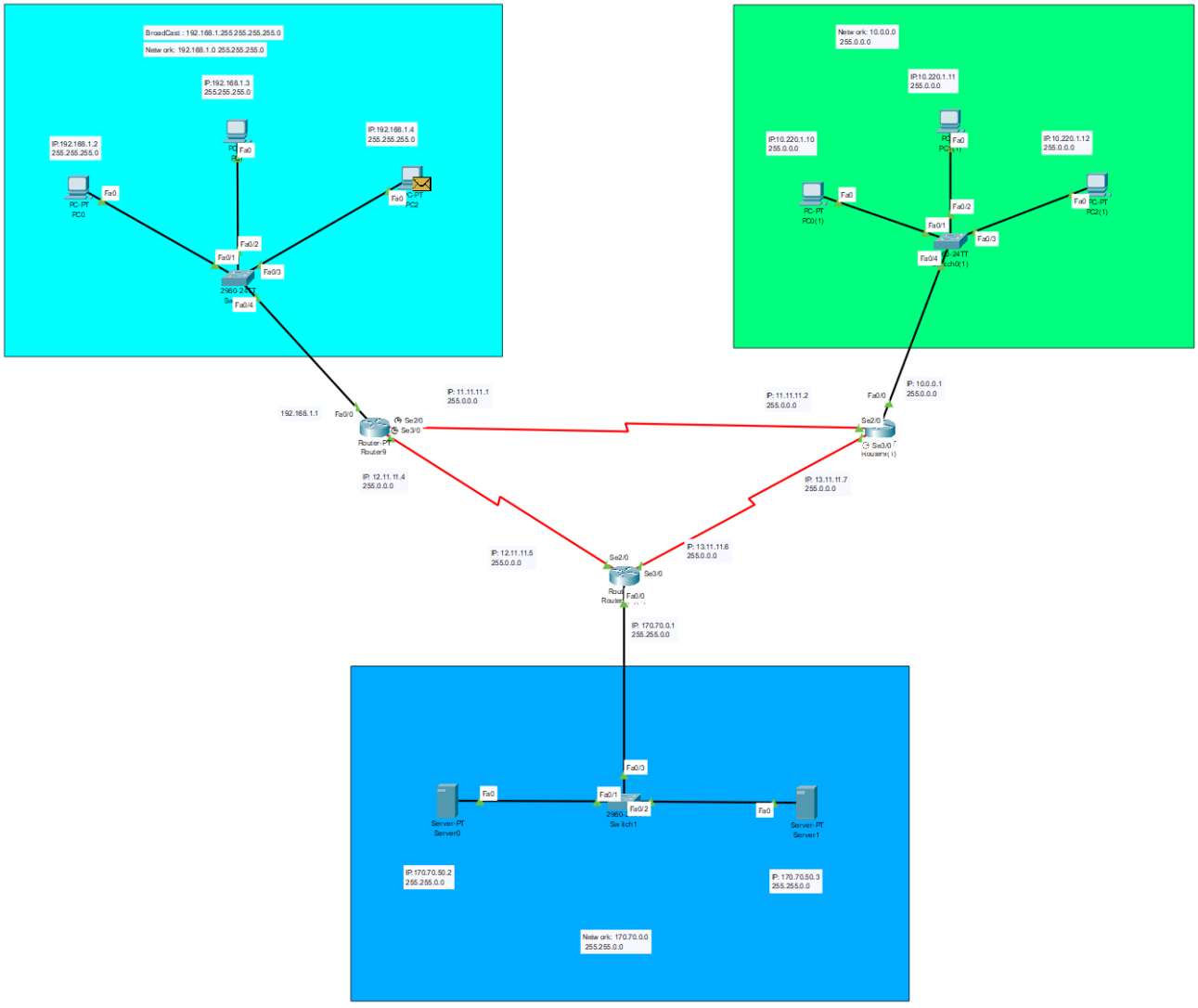
Title: Router Configuration and using static routing to connect multiple LANs in CISCO Packet Tracer.

Objective:

1. Understand Default Gateway
2. Difference between Switch and Router.
3. Router to Router Wiring [Using DCE and DTE Cables]
4. Static Routing Configuration
5. Default Route

Devices/ Software Used: Cisco Packet Tracer: 6 End-User Client PCs, 3 Switches, 2 Web Servers, 3 Routers.

Diagram of the experiment:



Theory:

Default Gateway:

A Default Gateway is assigned to an end-user so that it can forward data from one network to another. It is the IP address of the router for that network.

It is the address where a packet is sent when no other addresses match the destination IP address. And so, the packet is forwarded to the default address which then hops the address following some route to the destination address on the internet.

If a default gateway is not set, a computer in a network cannot connect to any other network. Packets can be sent within the local network. However, if a packet with a destination address outside the network is created, that packet will never reach the destination.

Difference between Switch and Router

A Switch is a device that works in the data link layer. It connects multiple devices in a Local Area Network and facilitates communication between devices in that LAN. It uses MAC addresses to identify where the frames must be forwarded. Comparatively cheaper. It can be seen as the bridge between multiple devices in a LAN. It can work with both packets and frames.

A Router is a device that works in the Network Layer. It connects multiple Local Area Networks and facilitates communication between devices in different networks. It uses the IP address of the destination device to identify the smallest and most ideal route which the packet should follow. Comparatively more expensive. It can be seen as the bridge between multiple networks. It works with frames.

Router to Router Wiring [Using DCE and DTE Cables]

Data Termination Equipment (DTE) is concerned with the origin or destination of data. They generate data and send it to a DCE device, along with necessary control characters.

Data Communication Equipment (DCE) is a device that acts as an interface between DTE devices. It is concerned with data transmission. It converts data and sends it down the network line in a transmission-ready format.

Generally, a router is a DTE device and a modem is a DCE device. However, modern routers come with built-in modems and switches. So, they are both DCE and DTE devices.

In a serial connection between two routers, one side is seen as the DCE and the other as the DTE device. The DCE device assigns the clock rate and the DTE device accepts the clock rate assigned by the DCE device.

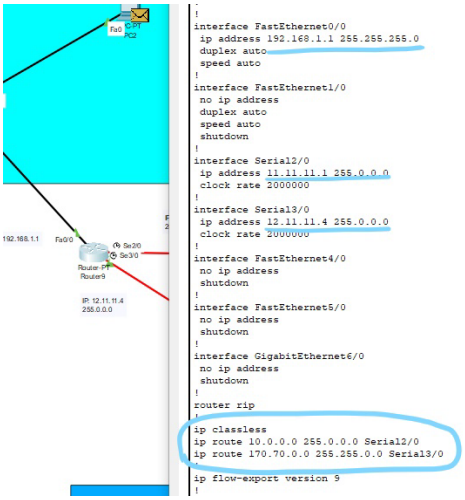
Static Route

Static routes are networking routes that are manually configured by adding them to the routing table. They are fixed and do not change if the network is changed or reconfigured. Static routing is usually used as a backup to dynamic routing to ensure efficiency and low failure. It is a mammoth task to configure all the routes for all the routers present in a large group of networks.

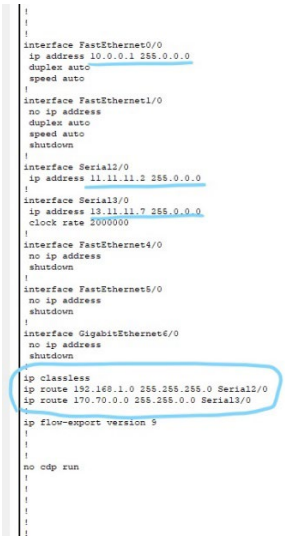
Default Route

Default routing is the route assigned to a router where the packet is forwarded when it doesn't match any other routes available in the routing table. It can also be assigned to a router whose job is to forward the packets through a single route to reach all other networks.

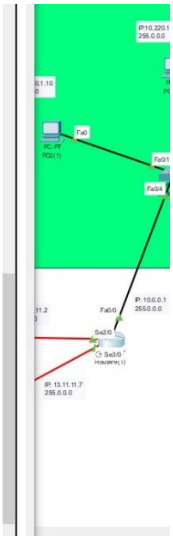
Configuration of Routers:

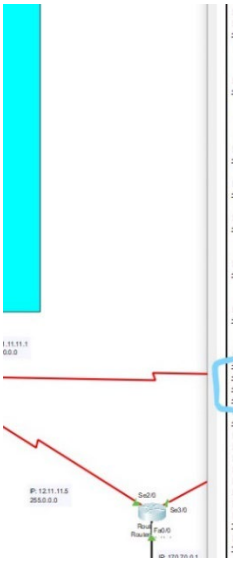


```
!
interface FastEthernet0/0
 ip address 192.168.1.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial2/0
 ip address 11.11.11.1 255.0.0.0
 clock rate 2000000
!
interface Serial3/0
 ip address 12.11.11.4 255.0.0.0
 clock rate 2000000
!
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
 no ip address
 shutdown
!
interface GigabitEthernet6/0
 no ip address
 shutdown
!
router rip
!
ip classless
ip route 10.0.0.0 255.0.0.0 Serial2/0
ip route 170.70.0.0 255.255.0.0 Serial3/0
!
ip flow-export version 9
!
```



```
!
!
!
interface FastEthernet0/0
 ip address 10.0.0.1 255.0.0.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial2/0
 ip address 11.11.11.2 255.0.0.0
!
interface Serial3/0
 ip address 13.11.11.7 255.0.0.0
 clock rate 2000000
!
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
 no ip address
 shutdown
!
interface GigabitEthernet6/0
 no ip address
 shutdown
!
ip classless
ip route 192.168.1.0 255.255.255.0 Serial2/0
ip route 170.70.0.0 255.255.0.0 Serial3/0
!
ip flow-export version 9
!
!
!
no cdp run
!
!
!
!
!
```





```
!
!
interface FastEthernet0/0
 ip address 170.70.0.1 255.255.0.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial2/0
 ip address 12.11.11.5 255.0.0.0
!
interface Serial3/0
 ip address 13.11.11.6 255.0.0.0
!
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
 no ip address
 shutdown
!
interface GigabitEthernet6/0
 no ip address
 shutdown
!
ip classless
ip route 192.168.1.0 255.255.255.0 11.11.11.1
ip route 192.168.1.0 255.255.255.0 Serial2/0
ip route 10.0.0.0 255.0.0.0 Serial3/0
!
ip flow-export version 9
!
!
!
!
!
!
!
line con 0
!
line aux 0
```

Explanation:

First and foremost, there was an error in the connection between the router. All the router-router connection ports were assigned IP addresses under the same network. This was different from what was shown during the lab, it seemed logical to change the IP addresses of the connections. It throws an overlapping error if kept unchanged.

Connection Router A-Router B	Router A port: IP Address	Router B port: IP Address
Router 9 – Router 9 (1)	Router 9 Se2/0: 11.11.11.1	Router 9 (1) Se2/0: 11.11.11.2
Router 9 – Router 9 (1) (1)	Router 9 Se 3/0: 12.11.11.4	Router 9 (1) (1) Se2/0: 12.11.11.5
Router 9 (1) – Router 9 (1) (1)	Router 9(1) Se3/0: 13.11.11.7	Router 9 (1) (1) Se3/0: 13.11.11.6

These changes can be made by using the CLI commands:

- enable
- configure terminal
- interface “port no”
- ip address “ip address” “subnet mask”

Then, to allow packets to be sent between networks, the IP routes had to be defined at each router. The routes defined at each router were:

Router	Network ID	Subnet Mask	Forwarding Port
Router 9	10.0.0.0	255.0.0.0	Serial 2/0
	170.70.0.0	255.255.0.0	Serial 3/0

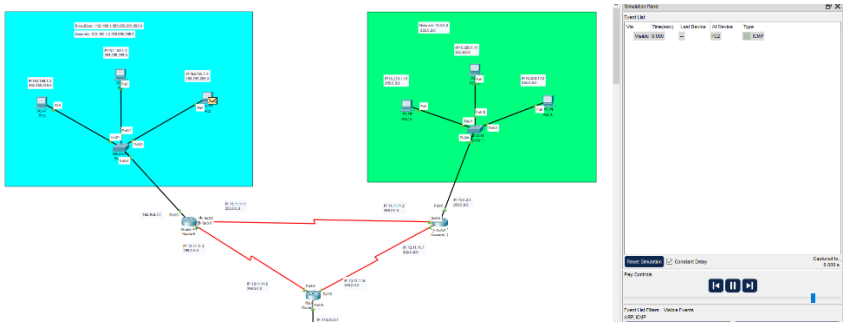
Router	Network ID	Subnet Mask	Forwarding Port
Router 9 (1)	192.168.0	255.0.0.0	Serial 2/0
	170.70.0.0	255.255.0.0	Serial 3/0

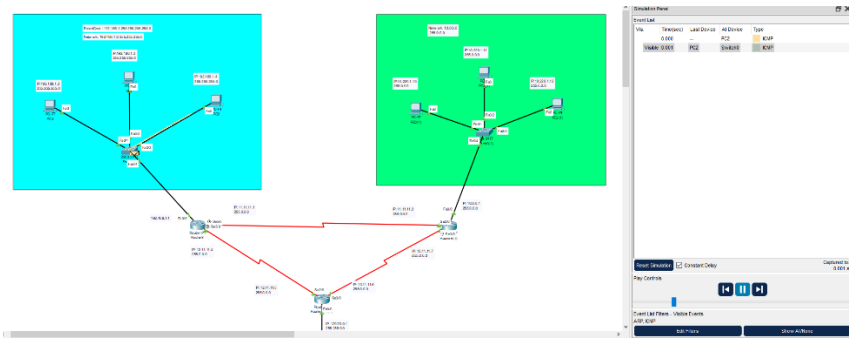
Router	Network ID	Subnet Mask	Forwarding Port
Router 9 (1) (1)	192.168.0.0	255.0.0.0	Serial 3/0
	10.0.0.0	255.255.0.0	Serial 2/0

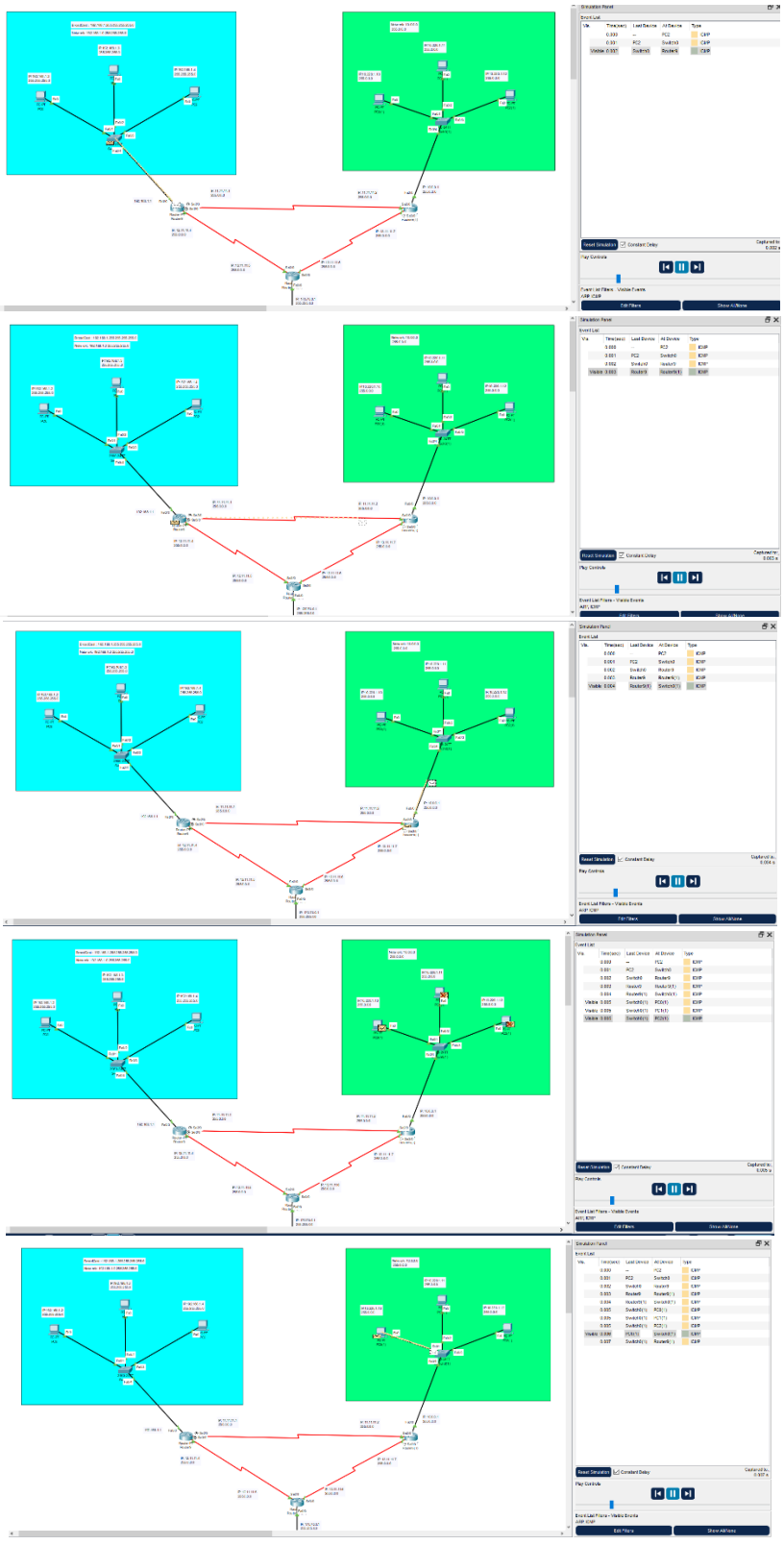
These routes can be assigned to each router using the following commands:

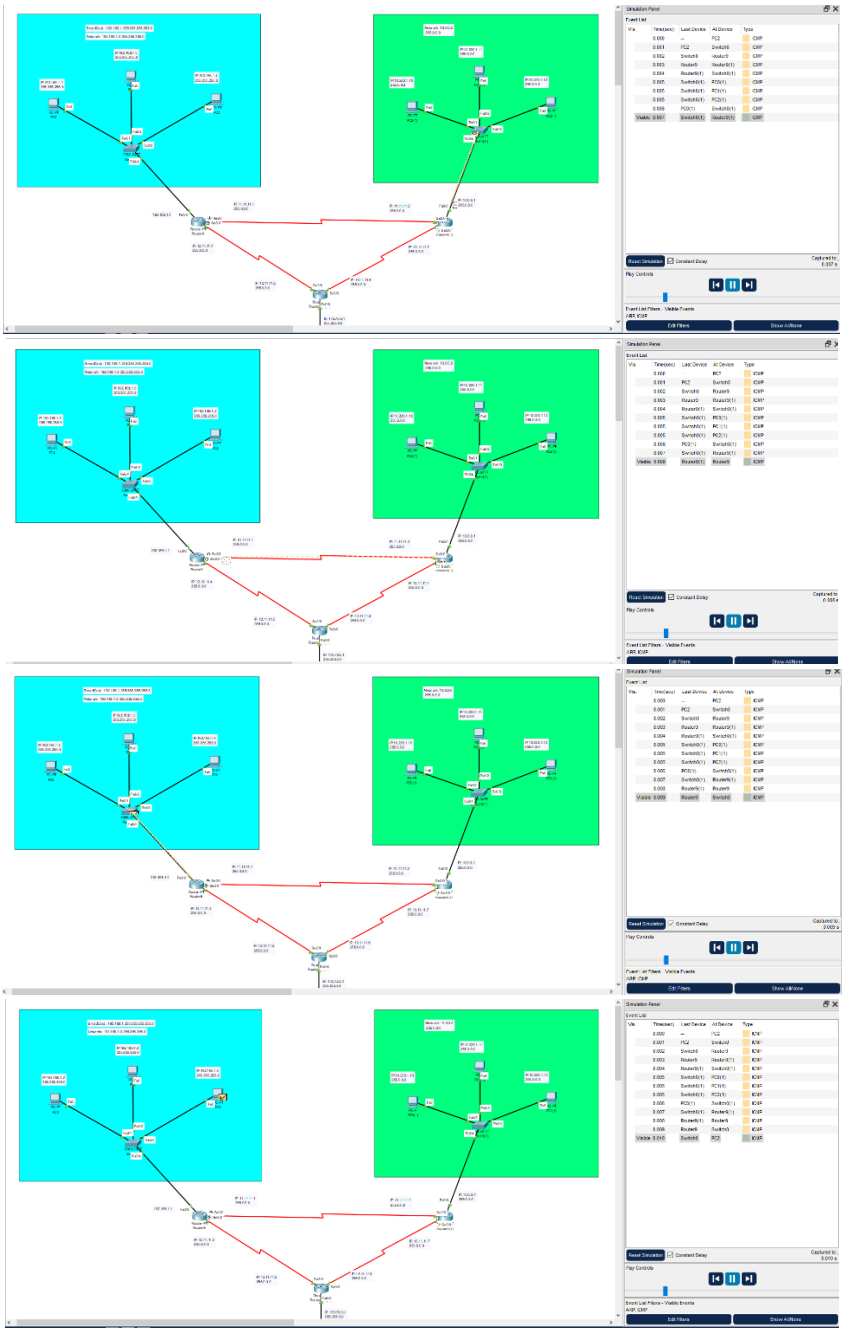
- enable
- ip route “network id” “subnet mask” “forwarding port”.

Observation:





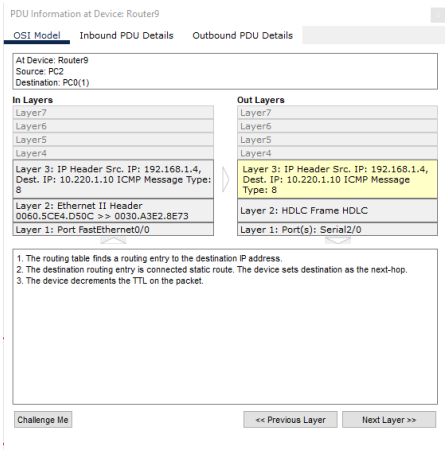




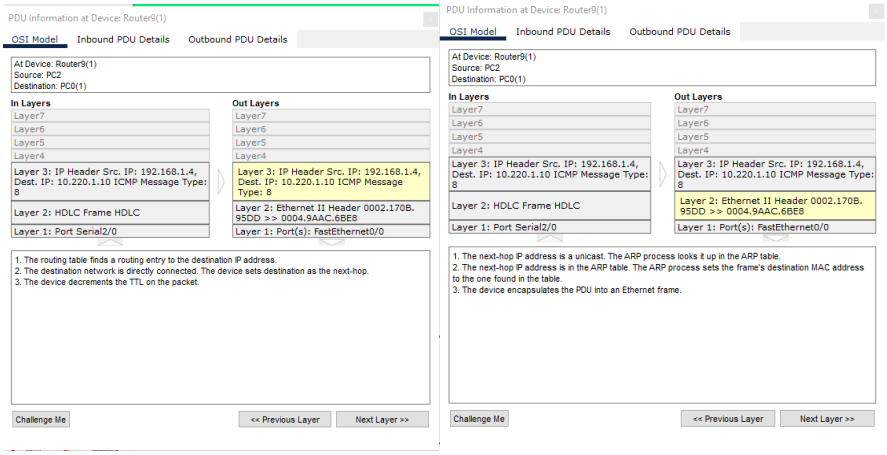
The images provided showed a request being sent from a device in network 192.168.0 to a device in another network 10.0.0.0.

First, the device creates a frame and sends it toward the switch. The switch doesn't find the destination IP address in the network, so it forwards it to the Default Gateway address, Router 9.

It goes through the routing table and finds a static routing entry. It sets the next destination hop and reduces the Time To Live (TTL) so that the packet doesn't remain in the network for too long without reaching the destination and is discarded at some point. The packet is converted to an HDLC frame and is sent out through Se 2/0 port, towards Router 9 (1).



Router 9 (1) receives the frame and goes through the routing table. It finds that the destination network is connected directly to the network. It sets the next destination hop and reduces the Time To Live (TTL). The packet is sent out through Fa 0/0 port, towards the switch in Network 10.0.0.0.



The Switch finds the destination MAC address in the ARP table and sends the frame directly toward the destination PC.

Similar to the steps previously mentioned, a reply is sent back to the PC which first made the request in reverse. Since all the routers have been configured correctly, sending packets between any device work properly.

Challenges:

The IP addresses in the router-router connections all had the same Network Id. This resulted in an overlapping error. So, the IP addresses at those connections were manually changed to 12.xx.xx.xx or 13.xx.xx.xx.

Understanding the difference between routing via port no and routing via IP addresses was a hassle. For routing with port no, the port no of the configuring device had to be used. For routing with an IP address, the IP address of the port of the router where the packet will be forwarded had to be used.

There was an error at Server2 in network 170.70.0.0 where the Default Gateway was wrongly set to 170.70.50.1. After changing it to 170.70.0.1, that also worked properly.