Network Topology – 03

This topology is the communication between two different networks using two routers. Each network has its own Layer 2 switch. The routers Layer 3 devices enable communication between the networks, and static routing is configured between the routers to allow end-to-end communication and reachability.

- Fig 3.1 shows the overall topology with two networks, each connected to its own switch, and two routers in between to interconnect the networks.
- The routers provide gateway IP addresses for their directly connected networks.
- Static routes are configured so that traffic can reach the other network via the router

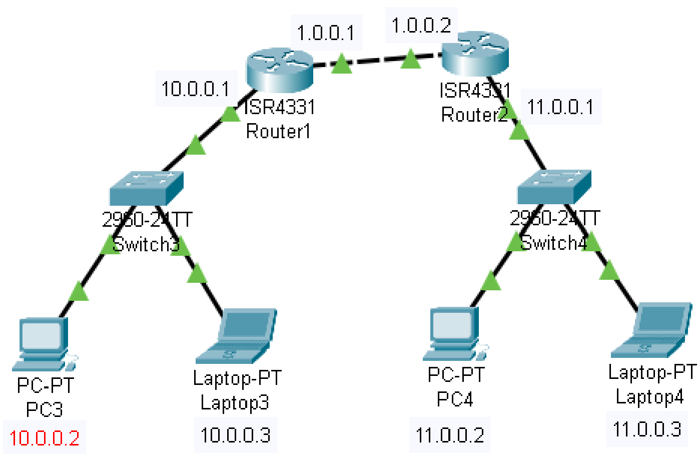


Fig: 3.1

- The default gateway for each host is the first usable IP address in its subnet.
- Host details like IP address and default gateway can be verified using the `ipconfig` command we can see it in Fig 3.2 and Fig 3.3 for both the networks.
- Initially, the ARP cache remains empty because no communication has been initiated yet.

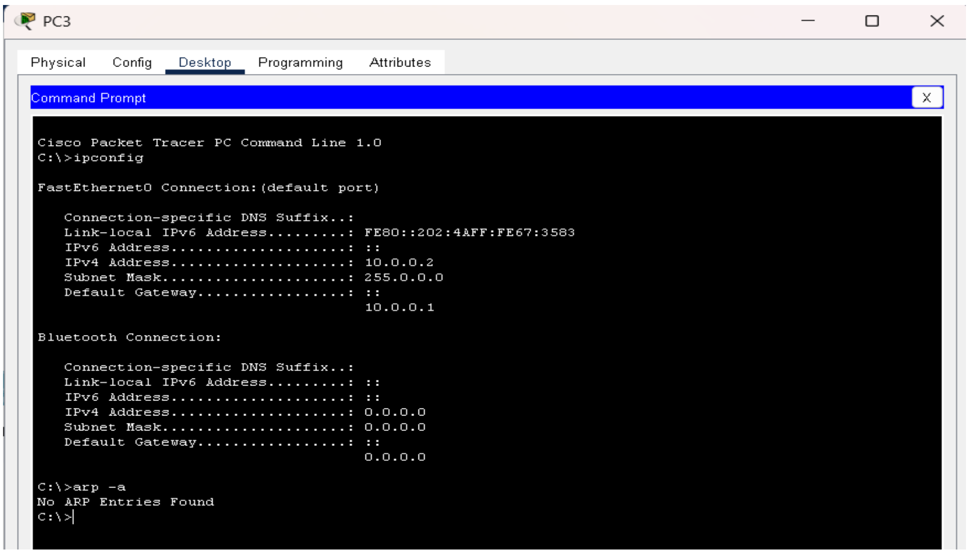


Fig: 3.2

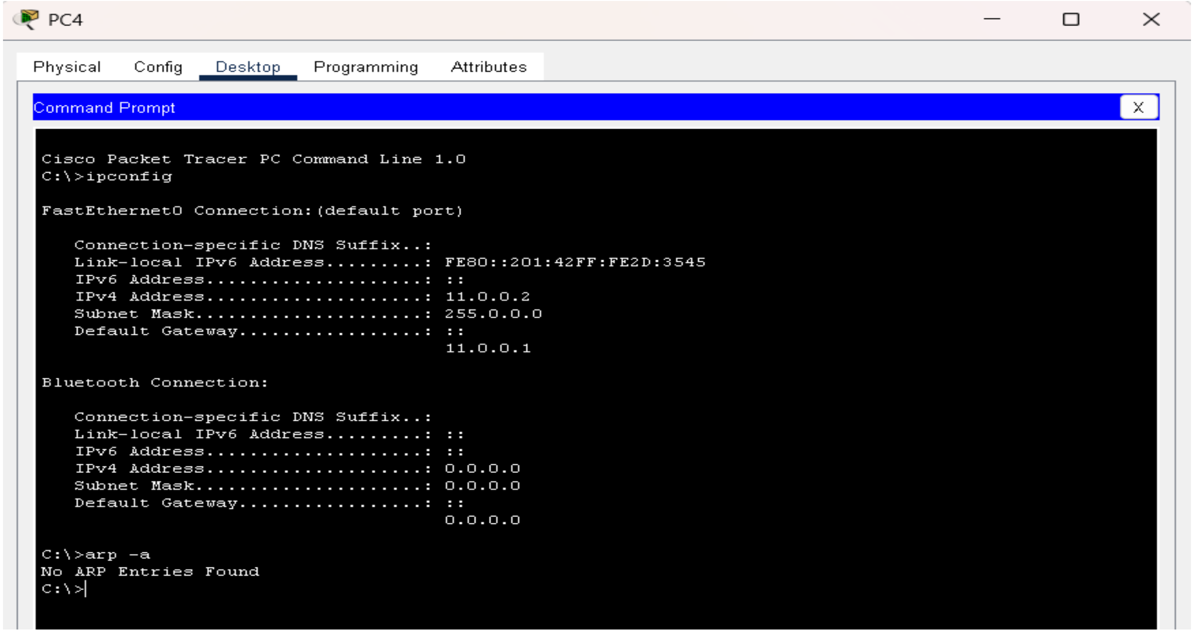


Fig: 3.3

- The hosts in the other network also use their subnet's first IP as the default gateway.
- Their ARP cache is also empty before any communication occurs we can see this in Fig 3.3.

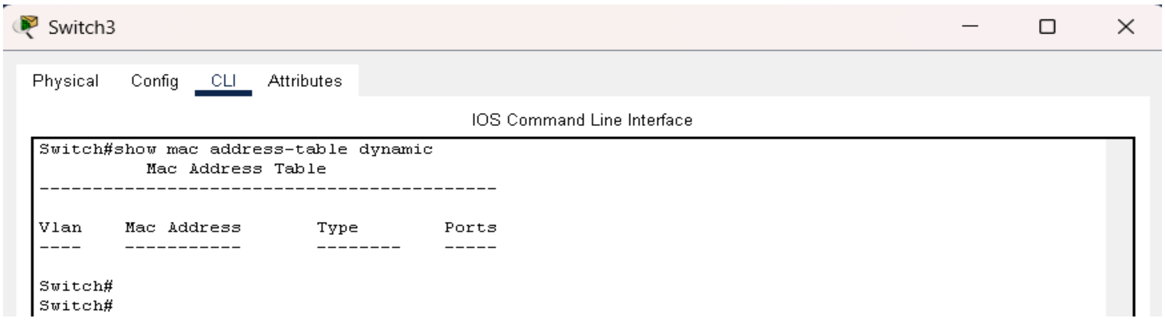


Fig: 3.4

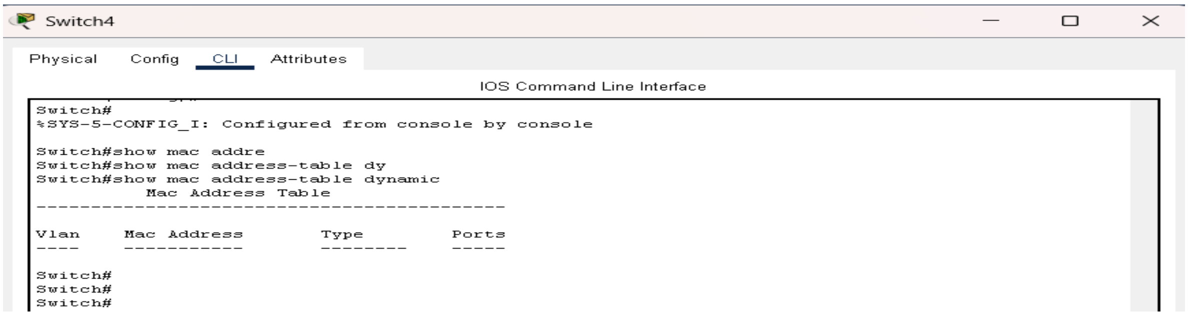


Fig: 3.5

- Both Layer 2 switches start with empty MAC address tables.
- This can be verified with the command `show mac address-table dynamic`.

- Fig 3.4 shows Switch1's MAC address table.
- Fig 3.5 shows Switch2's MAC address table.

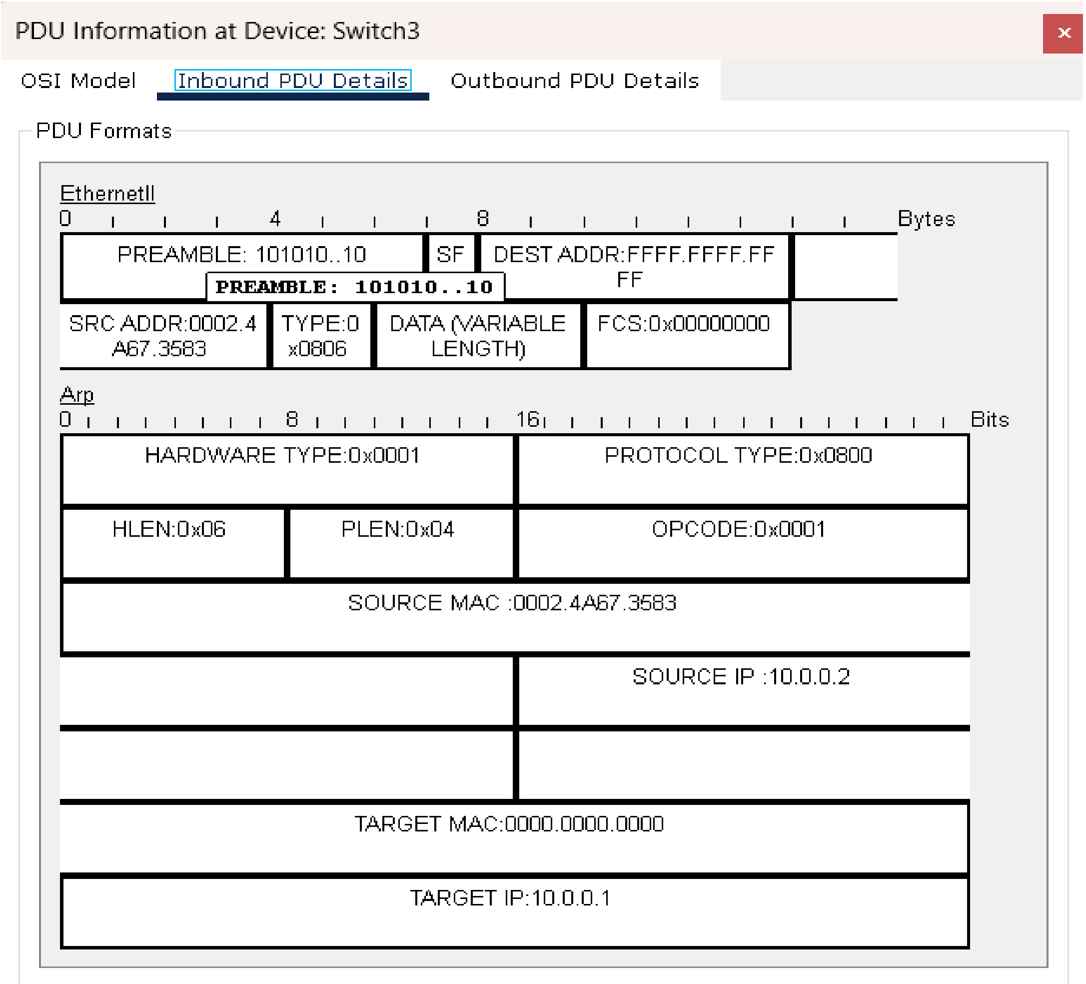


Fig: 3.5

- When a host initiates communication to a remote host, it first checks its ARP cache. Since the destination MAC is unknown, it sends an ARP broadcast see Fig 3.5.
- If a switch does not yet know a MAC address, it forwards the broadcast to all devices in the network. Non-target hosts drop the ARP request, but the switch learns their source MACs from this broadcast see Fig 3.6 and Fig 3.7

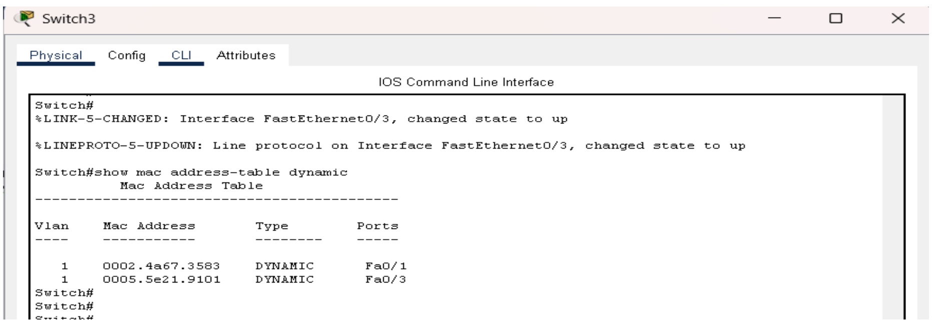


Fig: 3.6

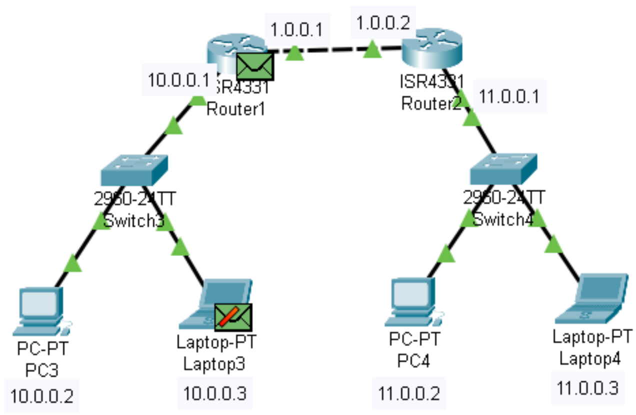


Fig: 3.7

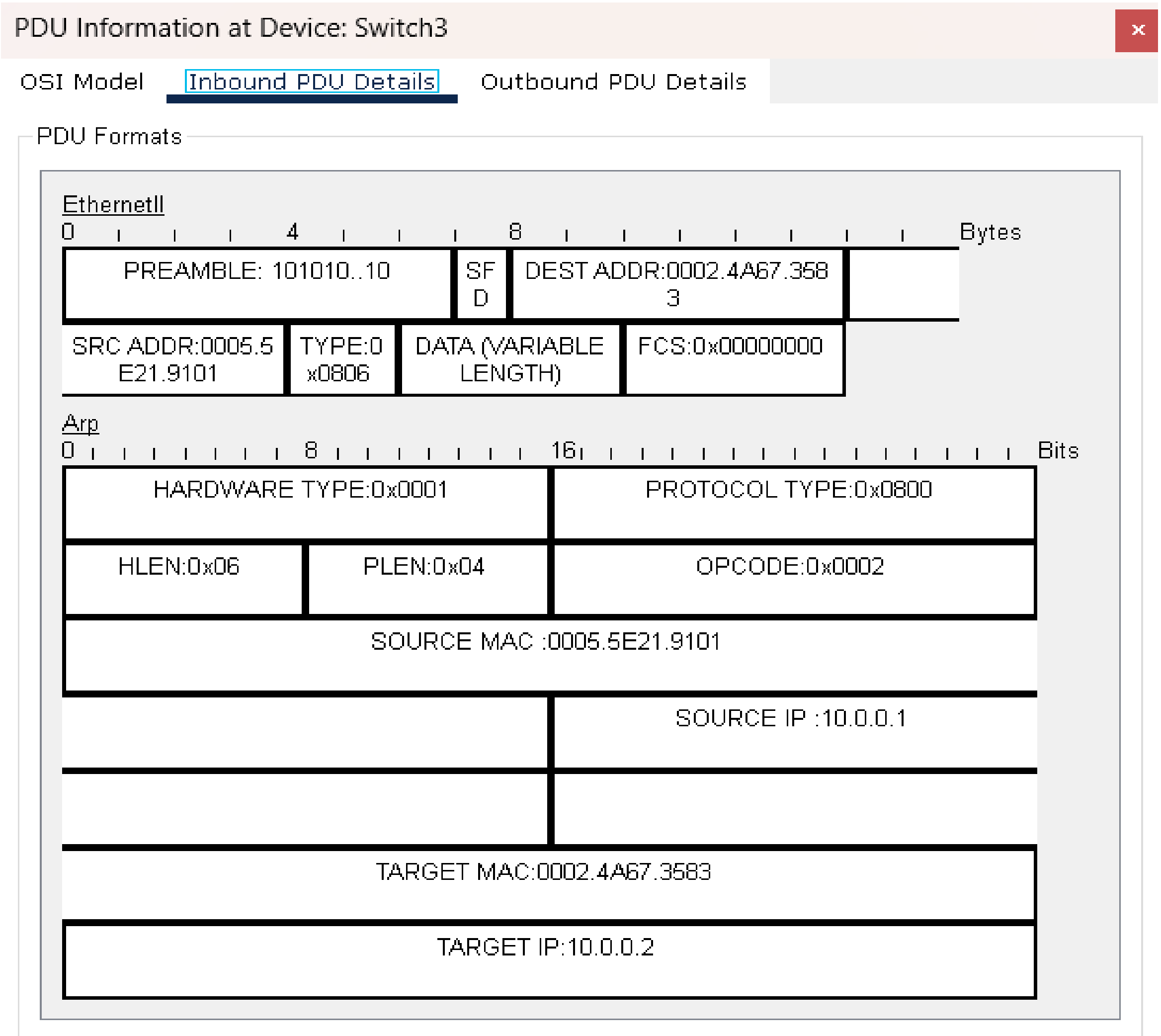


Fig: 3.8

- The ARP response from the router’s default gateway to the requested host.

- The host sends the ICMP packet to its default gateway the local router. If the router does not yet know the MAC address of the next hop toward the destination network, it performs an ARP request on its outgoing interface.
- ARP requests may be seen by multiple hosts on that segment. Non-target hosts drop the request.
- Since here we have 2 networks we have to configure the routing either it can be static routing or using the routing protocols.
- Till that the further communication won't happen the packets will drop in that default gateway itself.
- We can see that in the Fig.3.9

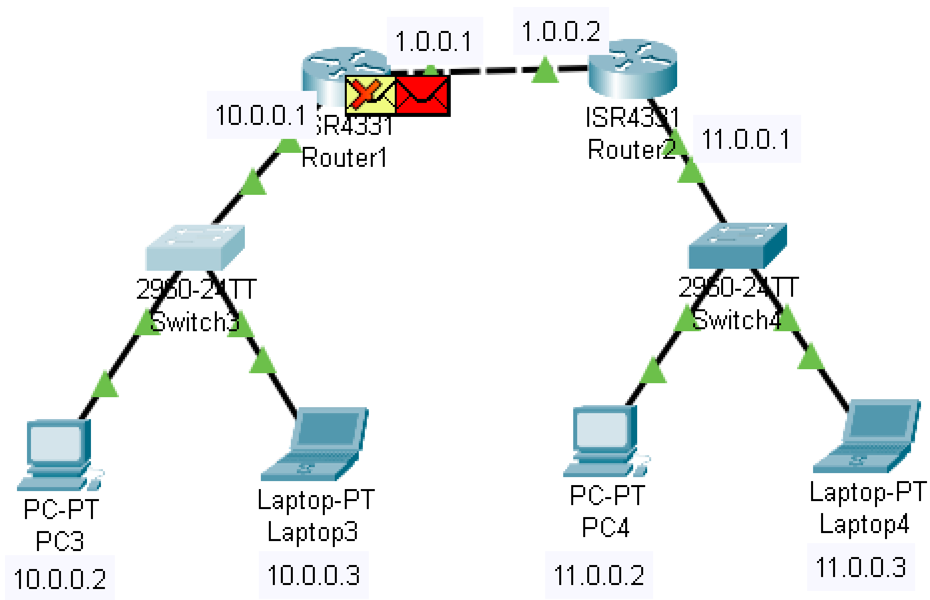


Fig: 3.9

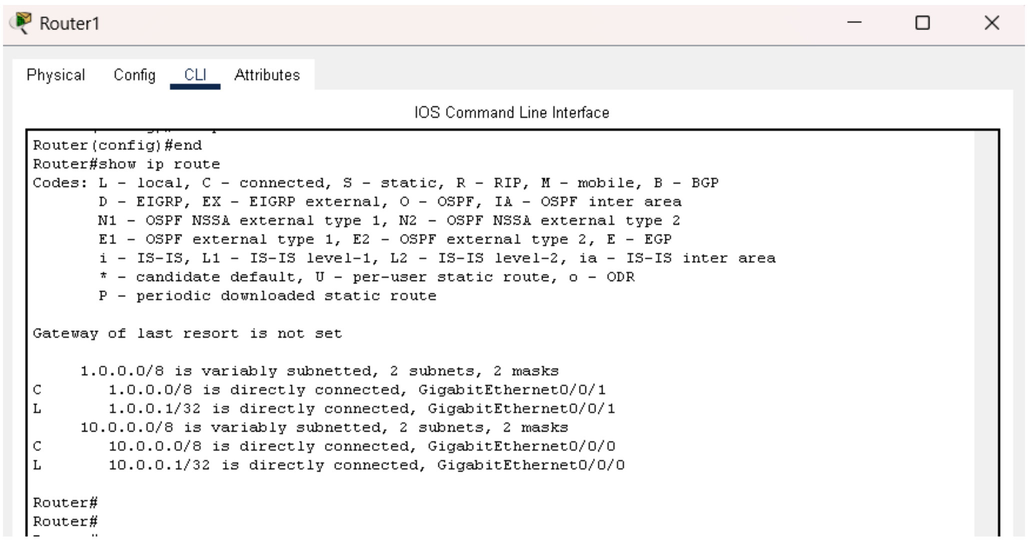


Fig: 3.10

- Fig: 3.10 is the routing table of the first router and we can see that there is no routing for the network 11.0.0.0 only the 10.0.0.0 and the 1.0.0.0 is connected so the router will not send packets further.

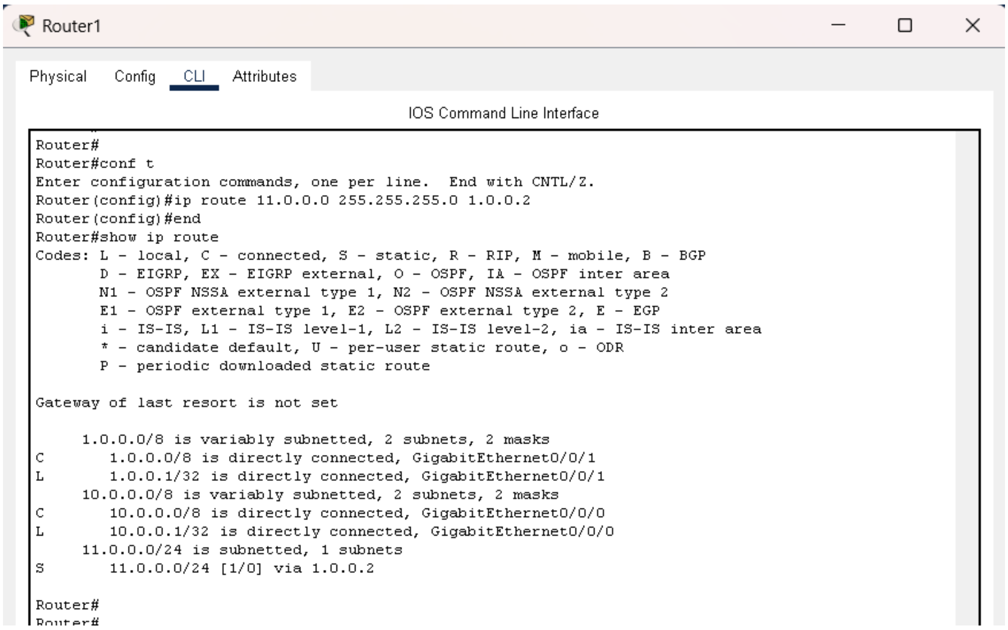


Fig: 3.11

- Now the static configuration is done and the routing for the destination network is available.
- In the Fig: 3.11 we can see that configuration is done and the command used is "ip route destination network subnet mask via" this is the syntax for configuring the static routing
- In our case it is ip route 11.0.0.0 255.0.0.0 1.0.0.2
- Now the ARP request will be sent to the 1.0.0.0 network to get the mac address of that router then the ICMP packet will be sent.
- The Fig: 3.12 shows the ICMP packet details.
- The ICMP packet will be dropped at the next hop because it don't know the mac address of the destination
- The ARP request will happen and then the ICMP packet will be sent.
- In the Fig:3.12 and 3.13 we can see this ICMP packet drop and the ARP request.

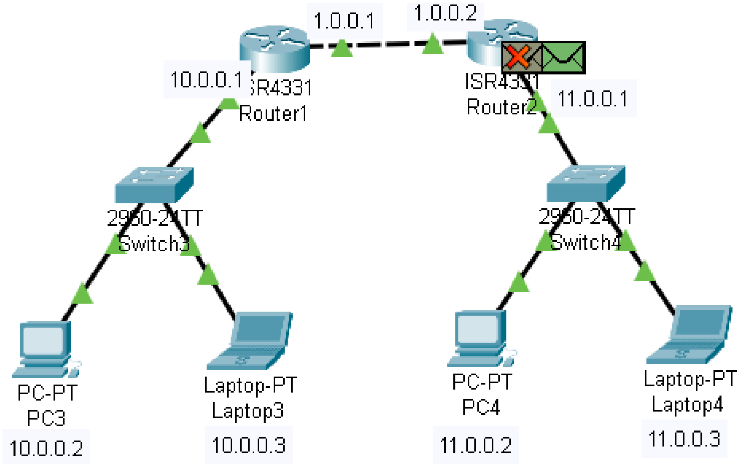


Fig: 3.12

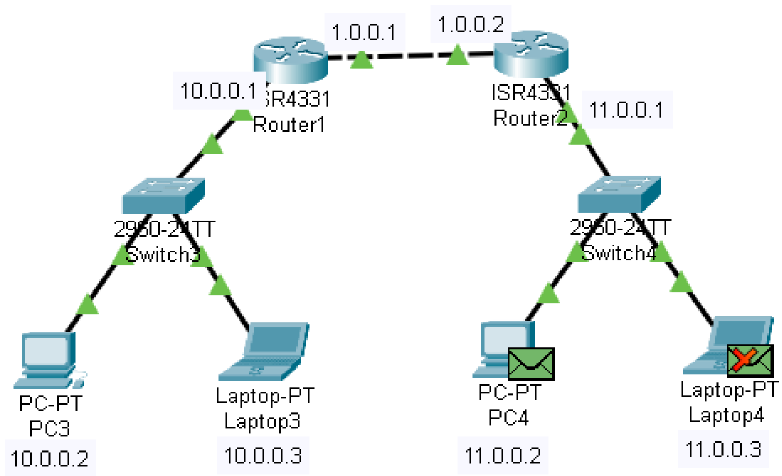
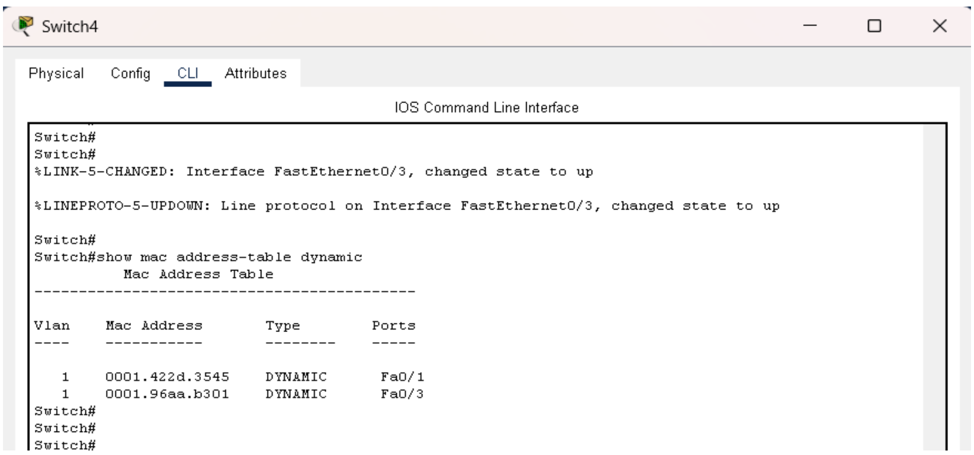


Fig: 3.13




```
Switch#
Switch#
%LINK-5-CHANGED: Interface FastEthernet0/3, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to up

Switch#
Switch#show mac address-table dynamic
          Mac Address Table
-------------------------------------------

Vlan    Mac Address       Type        Ports
----    -----------       --------    -----

   1    0001.422d.3545    DYNAMIC      Fa0/1
   1    0001.96aa.b301    DYNAMIC      Fa0/3
Switch#
Switch#
Switch#
```

Fig: 3.14

- In the switch we can see that the table is updated because pf the ARP request by router
- Fig: 3.14 shows the updated table of the switch
- In Fig: 3.15 we can see that the ICMP type field we have 0x03 where it means the destination unreachable and it occurs before the static routing configuration.

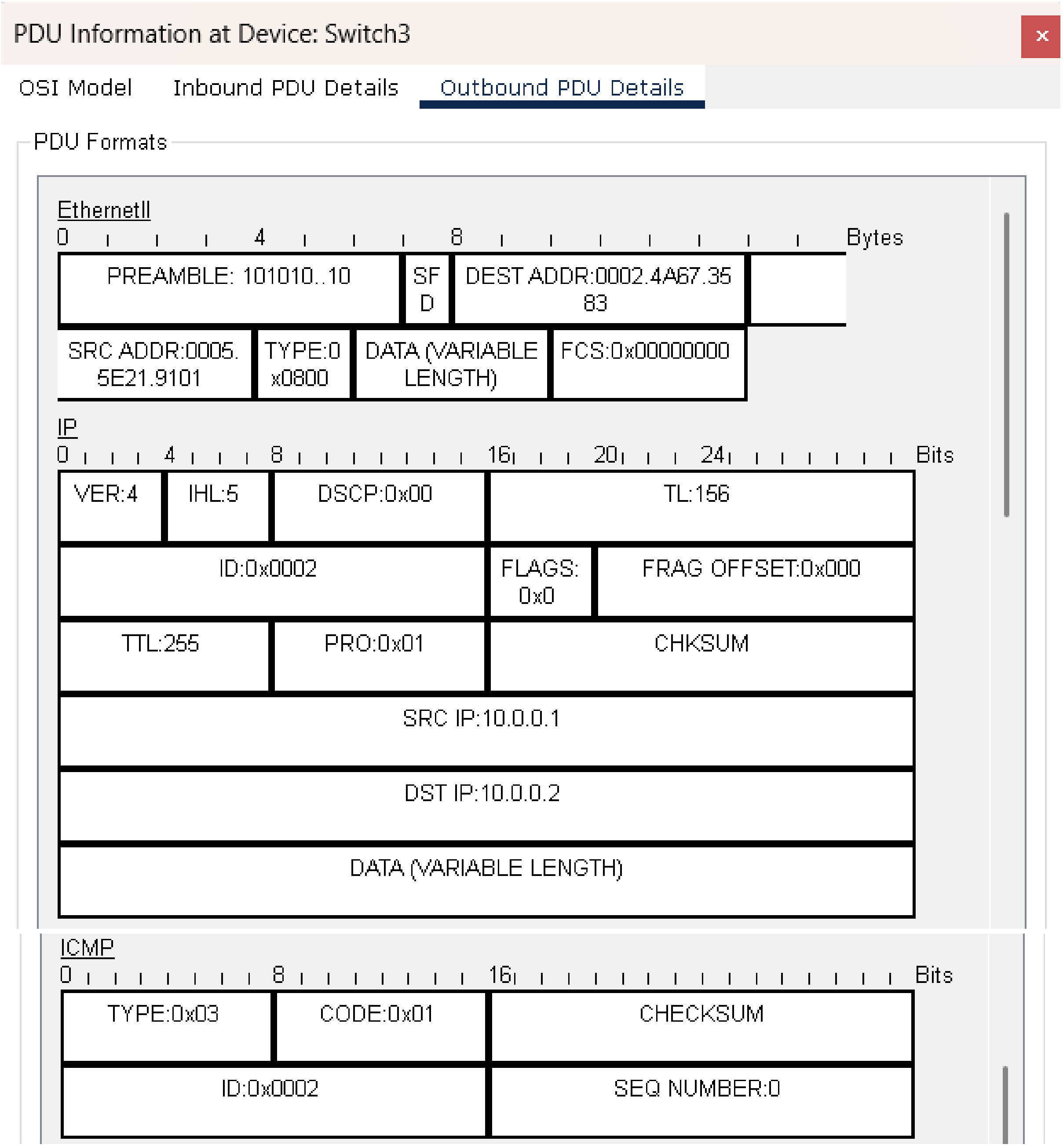


Fig: 3.15

- Also even though we did the static routing configuration we need in the first router the to reach 11.0.0.0 we haven't done the routing configuration in the router 2 to reach the 10.0.0.0 network so we need to do.
- The figure 3.16 and 3.17 shows the routing configurations of the second router before doing the static routing configuration and the after the static router configuration.

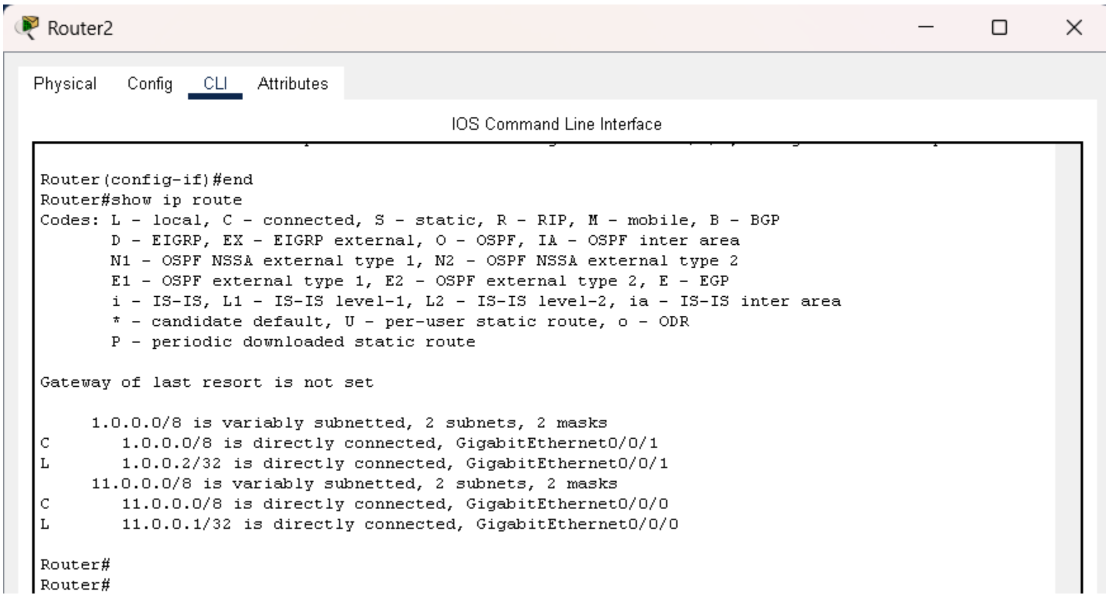


Fig: 3.16

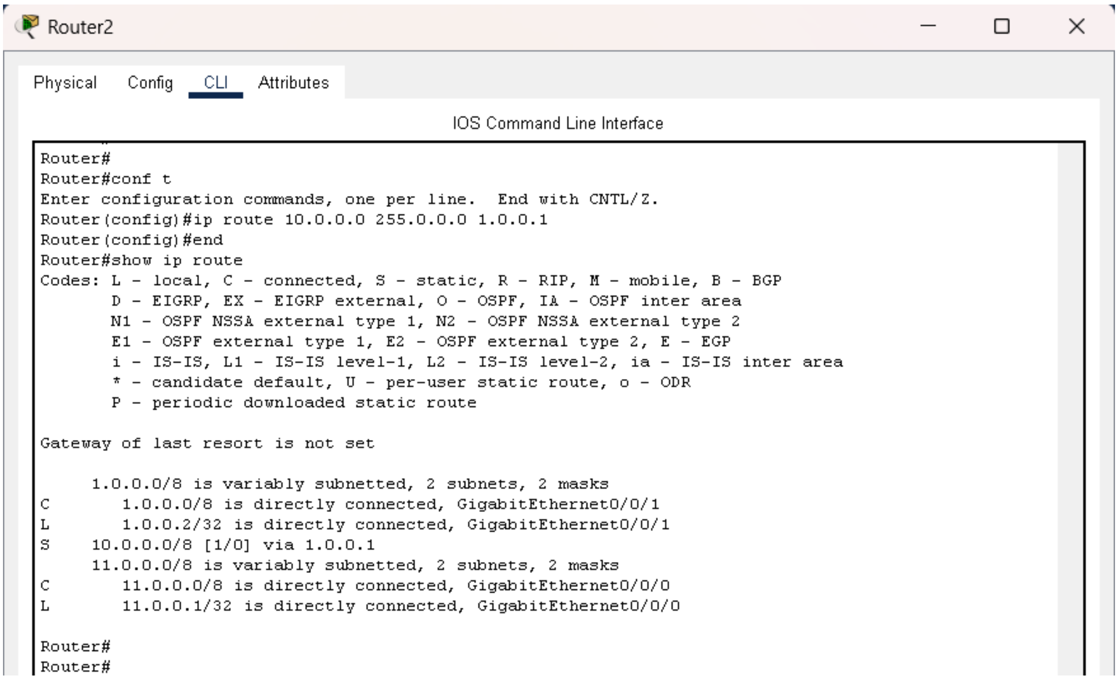


Fig: 3.17

- Now the successful communication will happen successfully because we have configured the static routing in both the routers.
- The TTL value will be decreased for each hop we can see that in the below figures

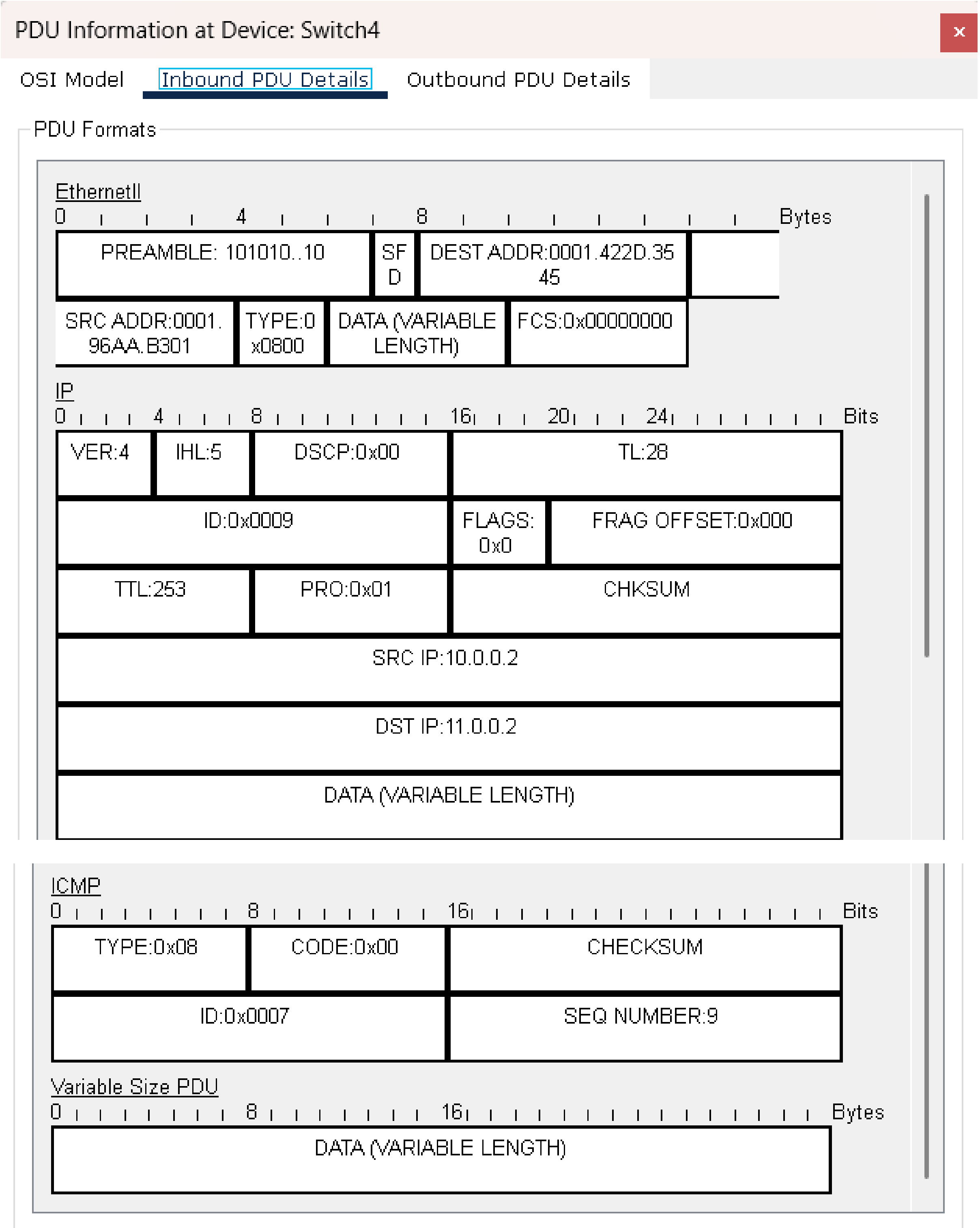


Fig: 3.18

- We can see that TTL is decreased to 253 because we have 2 routers so the TTL value is reduced by 2.

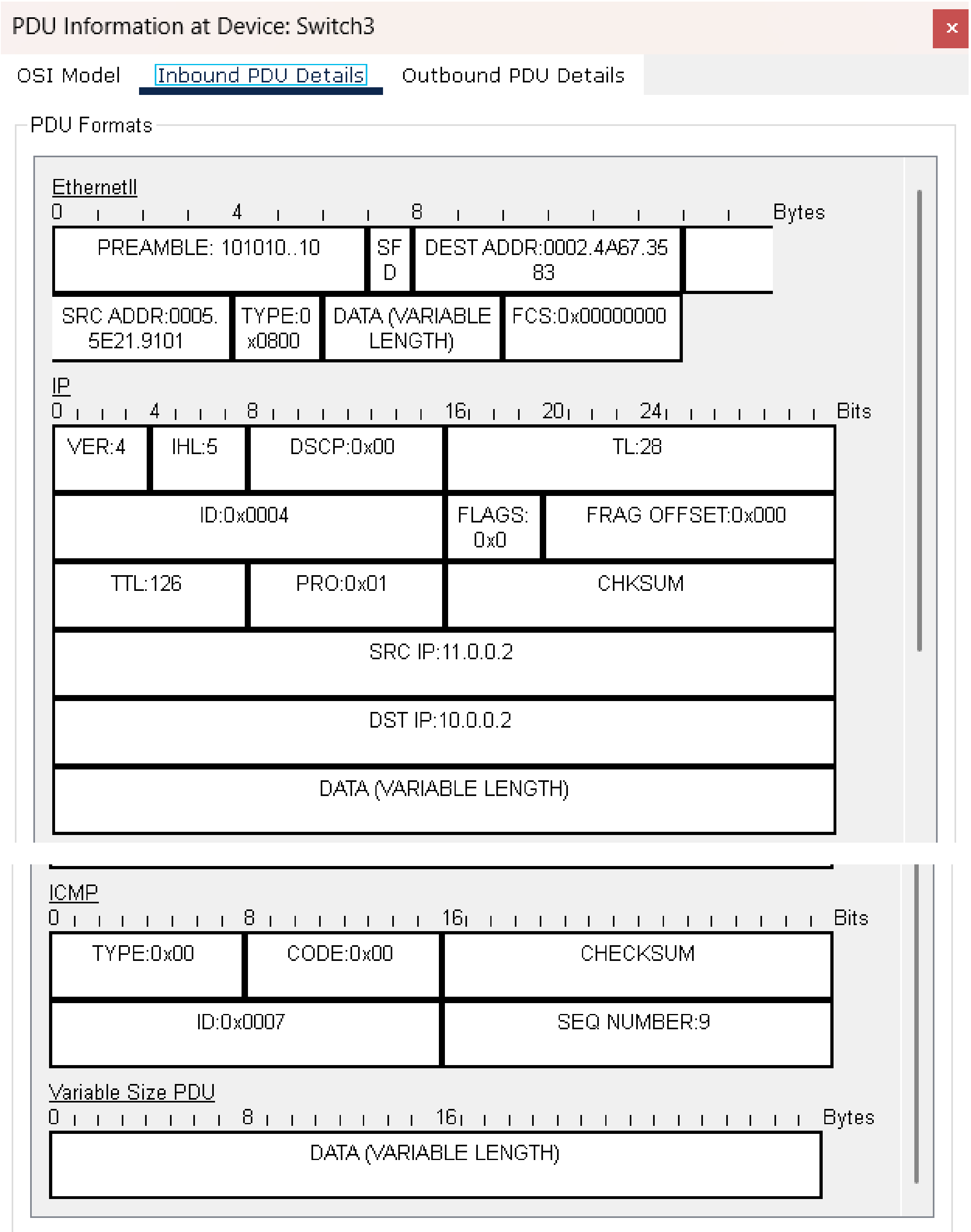


Fig: 3.19

- Here we can see the TTL value is decreased by 2 from 128 to 126 to respond to the source 10.0.0.2 as we know the ip packet will change it's source and destination once it gets the response.

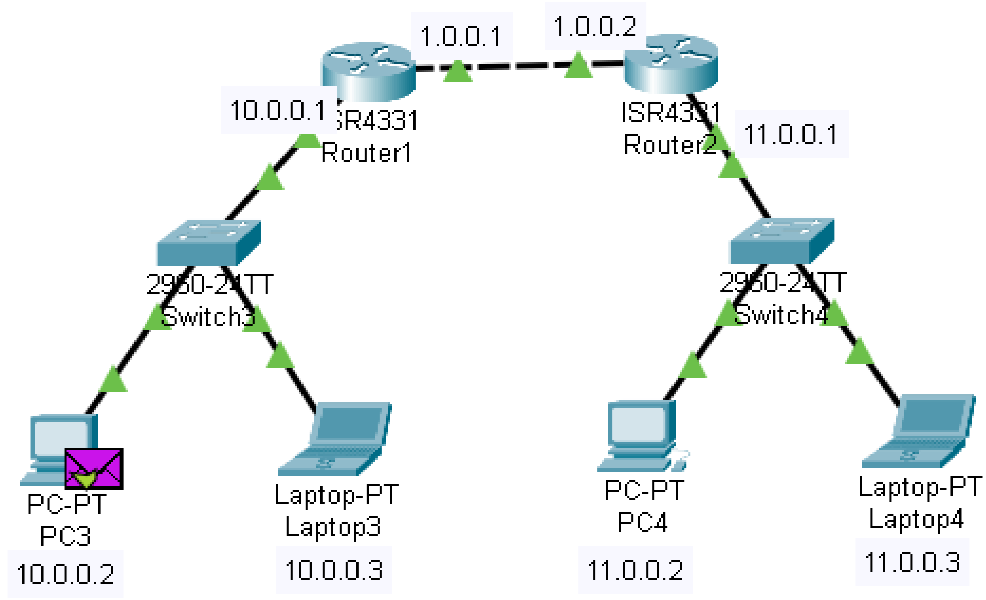


Fig: 3.20

- This is how we do static routing and the packet flow will happen between different hops.

Network Topology: Routing with RIP

- This is a same network topology as similar to the previous topology but instead of using static routing I used RIP
- RIP-Routing information protocol is used to find the best path for routing the best path based on the hop count.
- The maximum hop count is 15 and it will do it by changing the routing information between routers

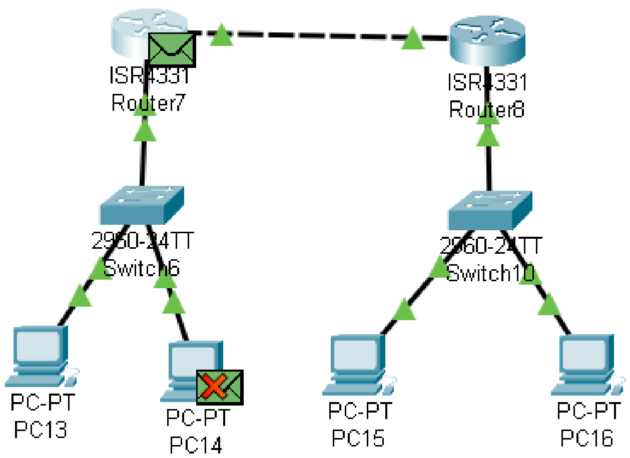


Fig:3.1.1- ARP request By Host

- **IN Fig 3.11** we can see the host did the ARP request because it don't the default gateway mac because the destination we are looking is in different network.
- **In** the below Fig:3.1.2 we can see the ARP response that is the default gateway mac to the source and now ICMP packet will send.

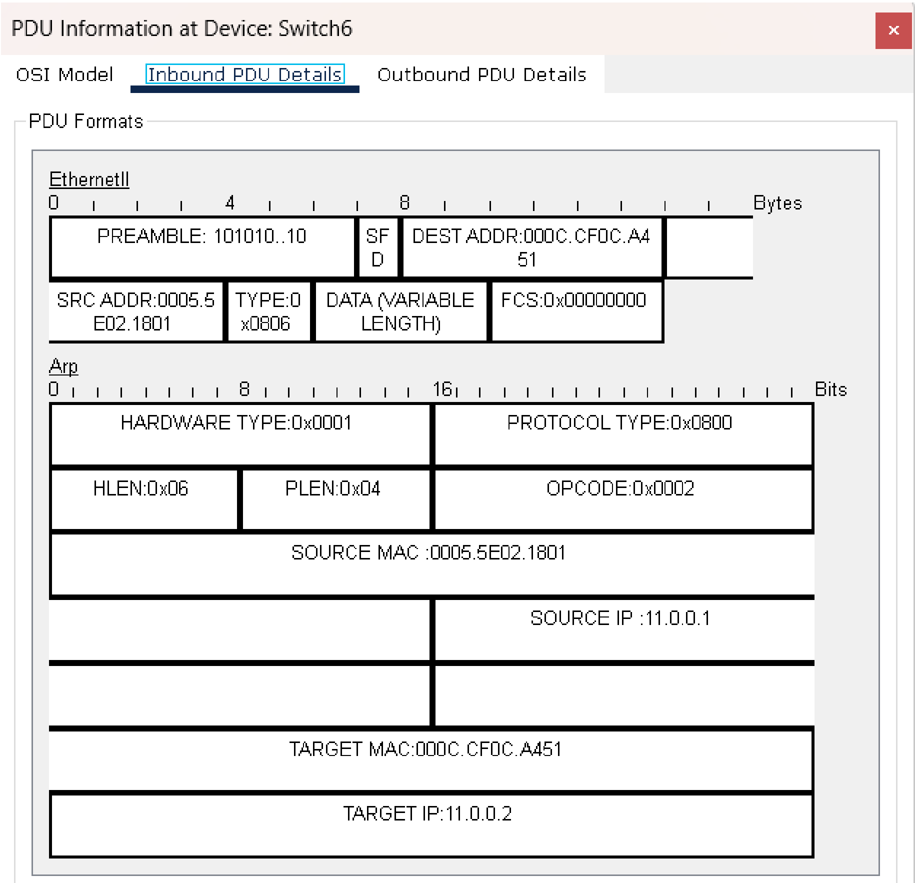


Fig: 3.1.3 - ARP Response from Router

In the **Fig:3.1.4** we can see the ICMP packet details from source to destination.

Also we can it's a echo request and the type is 0x08 and we can see the source and destination address .

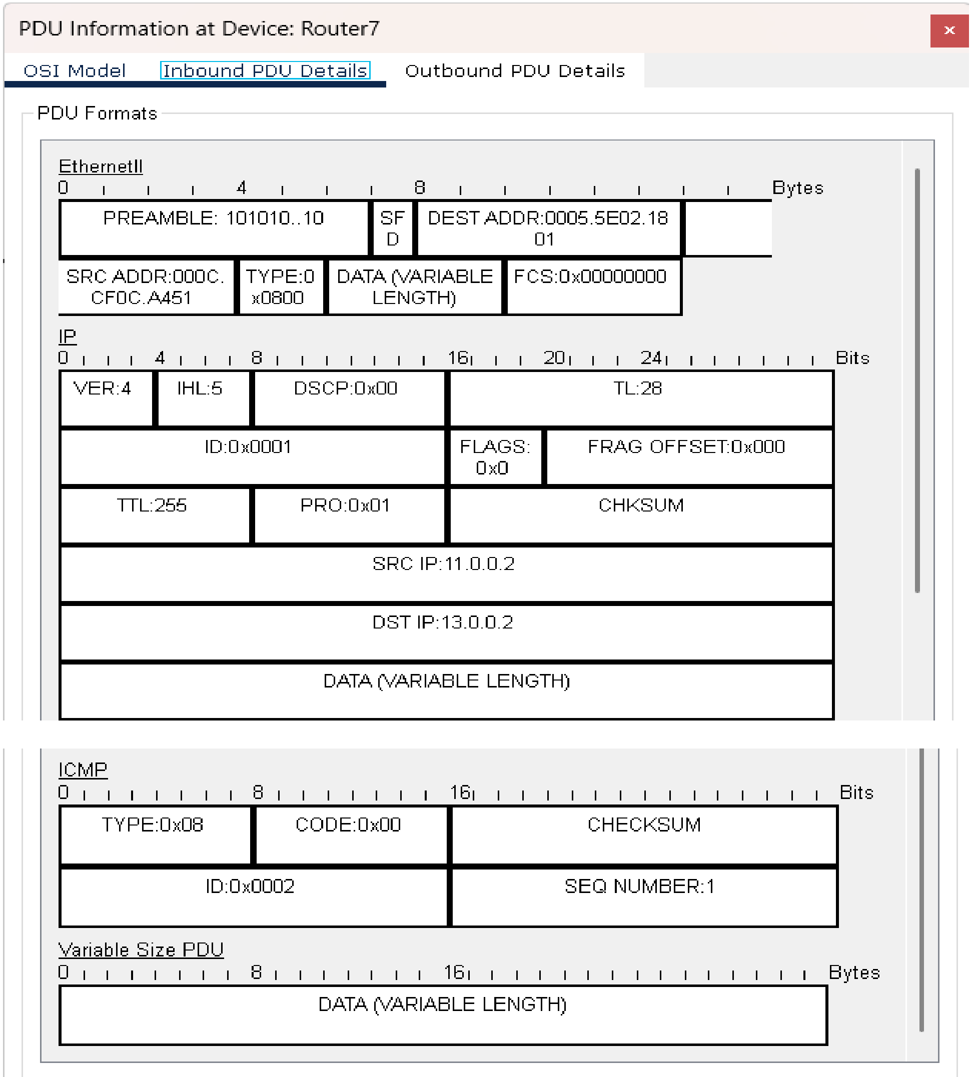


Fig: 3.1.4 – The ICMP echo Request

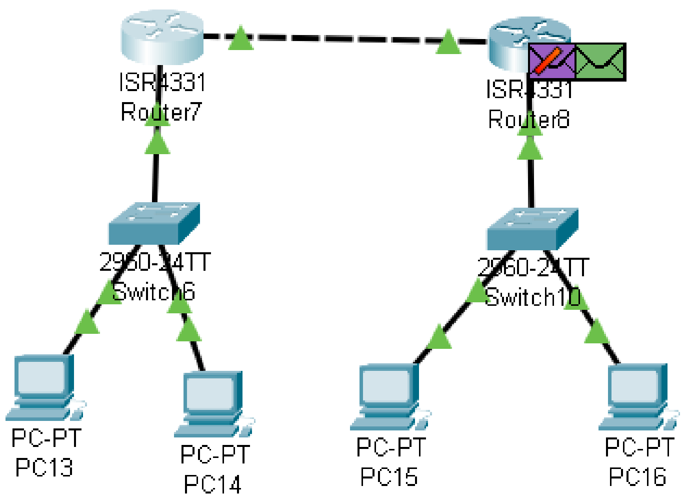
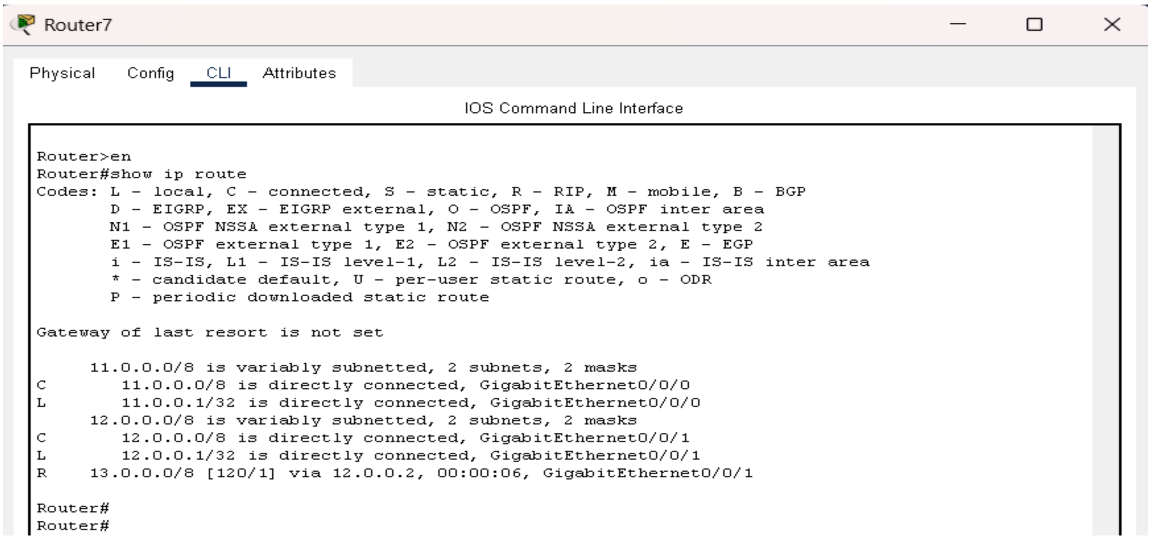


Fig: 3.1.5 – The ICMP Packet drop

- We can see that the packet is dropped at the second router in Fig: 3.15
- ICMP packet reachd that network directly because it learned it with the help of the routing protocol
- And in images we can see the R in routing table because it learned that route with the RIP.
- Then why it is dropped because it don't knoe the mac address that's why it is dropped.



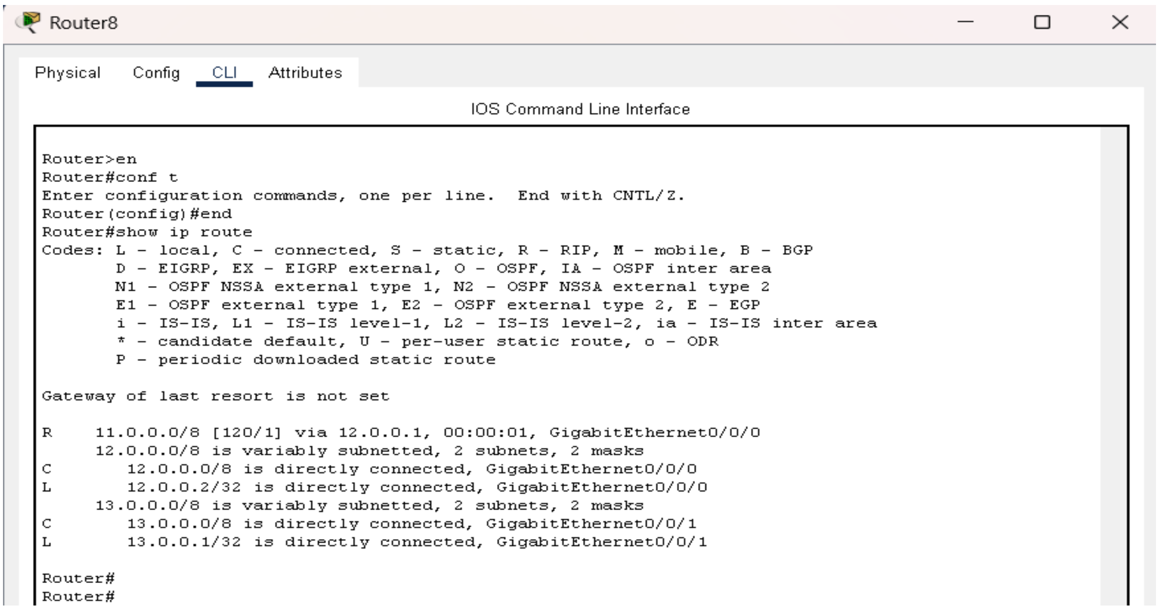

```
Router>en
Router#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     11.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       11.0.0.0/8 is directly connected, GigabitEthernet0/0/0
L       11.0.0.1/32 is directly connected, GigabitEthernet0/0/0
     12.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       12.0.0.0/8 is directly connected, GigabitEthernet0/0/1
L       12.0.0.1/32 is directly connected, GigabitEthernet0/0/1
R    13.0.0.0/8 [120/1] via 12.0.0.2, 00:00:06, GigabitEthernet0/0/1

Router#
Router#
```

Fig:3.1.6 – Routes in the first router




```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#end
Router#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

R    11.0.0.0/8 [120/1] via 12.0.0.1, 00:00:01, GigabitEthernet0/0/0
     12.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       12.0.0.0/8 is directly connected, GigabitEthernet0/0/0
L       12.0.0.2/32 is directly connected, GigabitEthernet0/0/0
     13.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       13.0.0.0/8 is directly connected, GigabitEthernet0/0/1
L       13.0.0.1/32 is directly connected, GigabitEthernet0/0/1

Router#
Router#
```

Fig:3.1.7 – Routes in the second router

- In the **Fig:3.1.8 and 3.1.9** we can see the details of the ARP request from the second router and the source and destination is the source is the default gateway not the host.
- This is how this mac address will keep on changing from hop to hop till it reaches the destination and it will make it sure from the ip address.

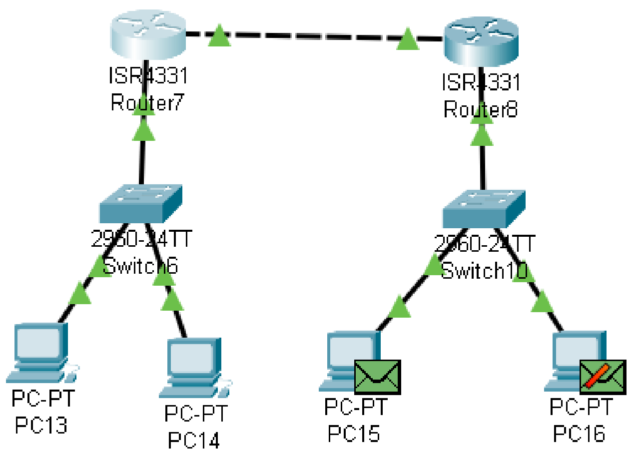


Fig:3.1.8

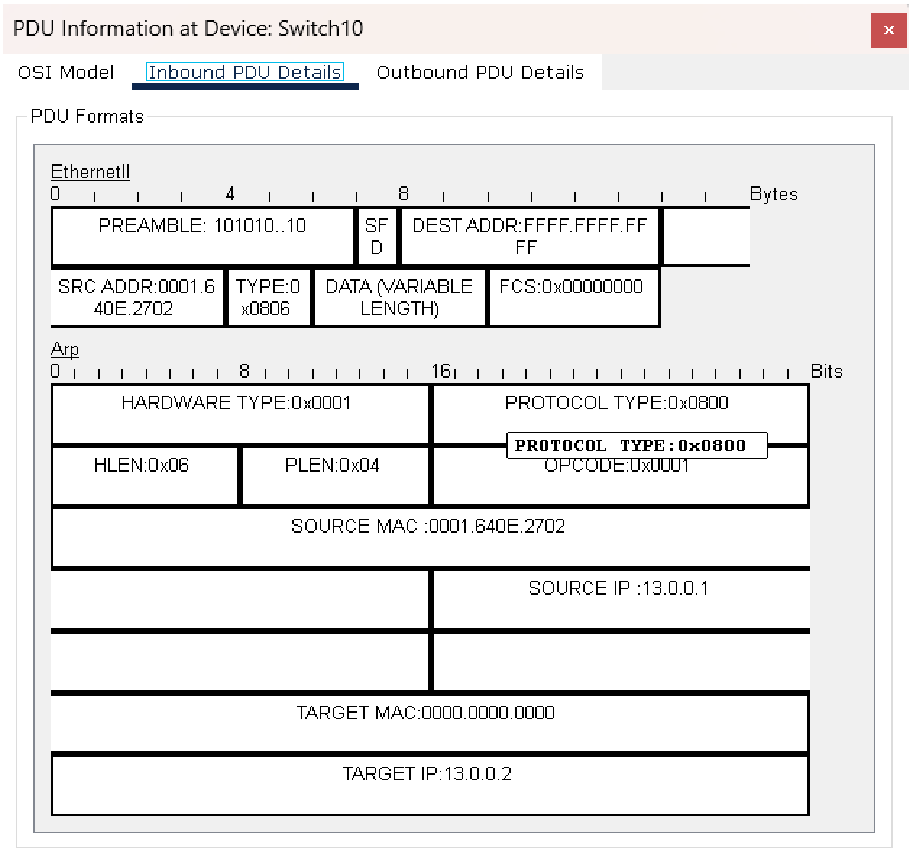


Fig:3.1.9

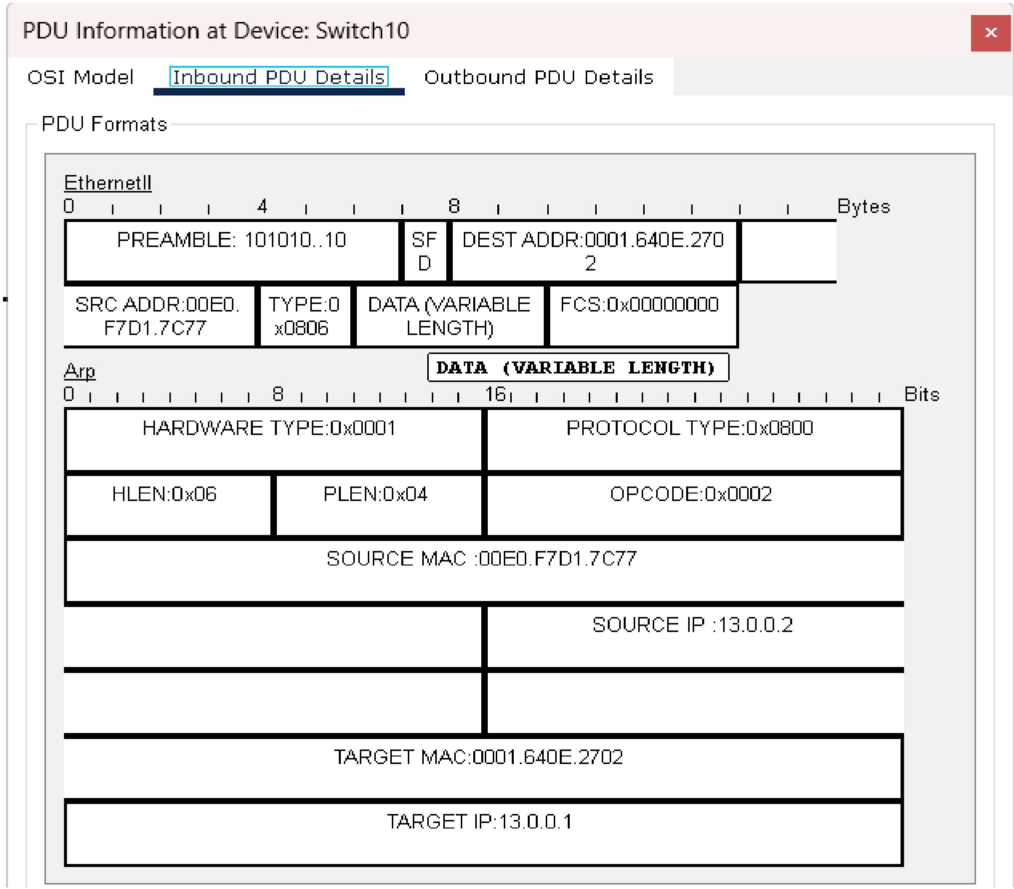


Fig: 3.1.10

- This is the response from the destination host and it is sending the mac address of it to that router and noe the communication can happen without any interruptions.
- In the **Fig: 3.1.11 and 3.1.12** we can see the ICMP request and the ICMP response packet details and that is how the successfu communication can happen.
- And this RIP makes this flow better and it will automatically updates that routing table.
- The maximum hop count is 15
- It can be used for small networks where we have less than 15 hops we can go for this RIP else we can go for other routing protocols like OSPF.

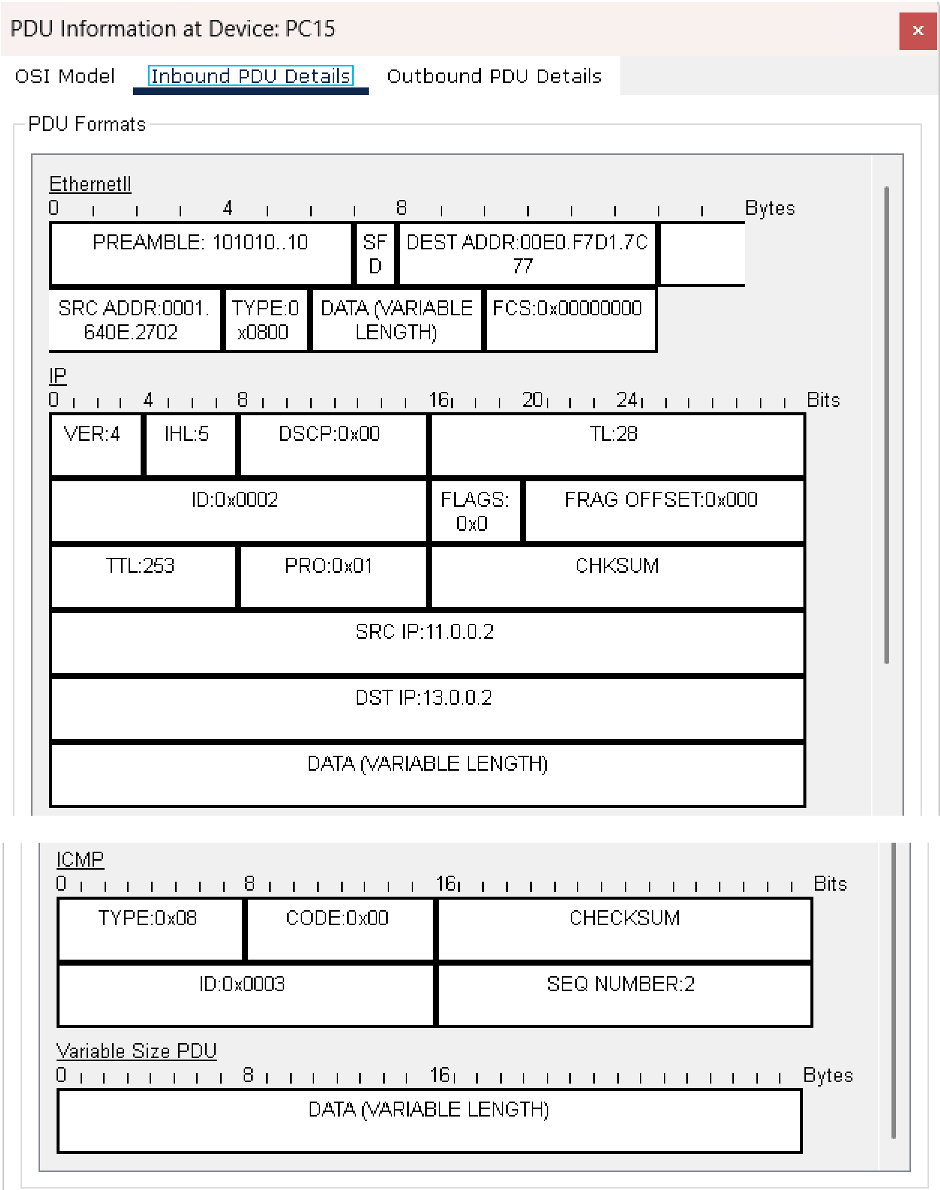

PDU Information at Device: PC15
OSI Model
Inbound PDU Details
Outbound PDU Details
PDU Formats
EthernetII
Bytes
PREAMBLE: 101010..10
SFD
DEST ADDR:00E0.F7D1.7C77
SRC ADDR:0001.640E.2702
TYPE:0x0800
DATA (VARIABLE LENGTH)
FCS:0x00000000
IP
Bits
VER:4
IHL:5
DSCP:0x00
TL:28
ID:0x0002
FLAGS: 0x0
FRAG OFFSET:0x000
TTL:253
PRO:0x01
CHKSUM
SRC IP:11.0.0.2
DST IP:13.0.0.2
DATA (VARIABLE LENGTH)
ICMP
Bits
TYPE:0x08
CODE:0x00
CHECKSUM
ID:0x0003
SEQ NUMBER:2
Variable Size PDU
Bytes
DATA (VARIABLE LENGTH)

Fig:3.1.11

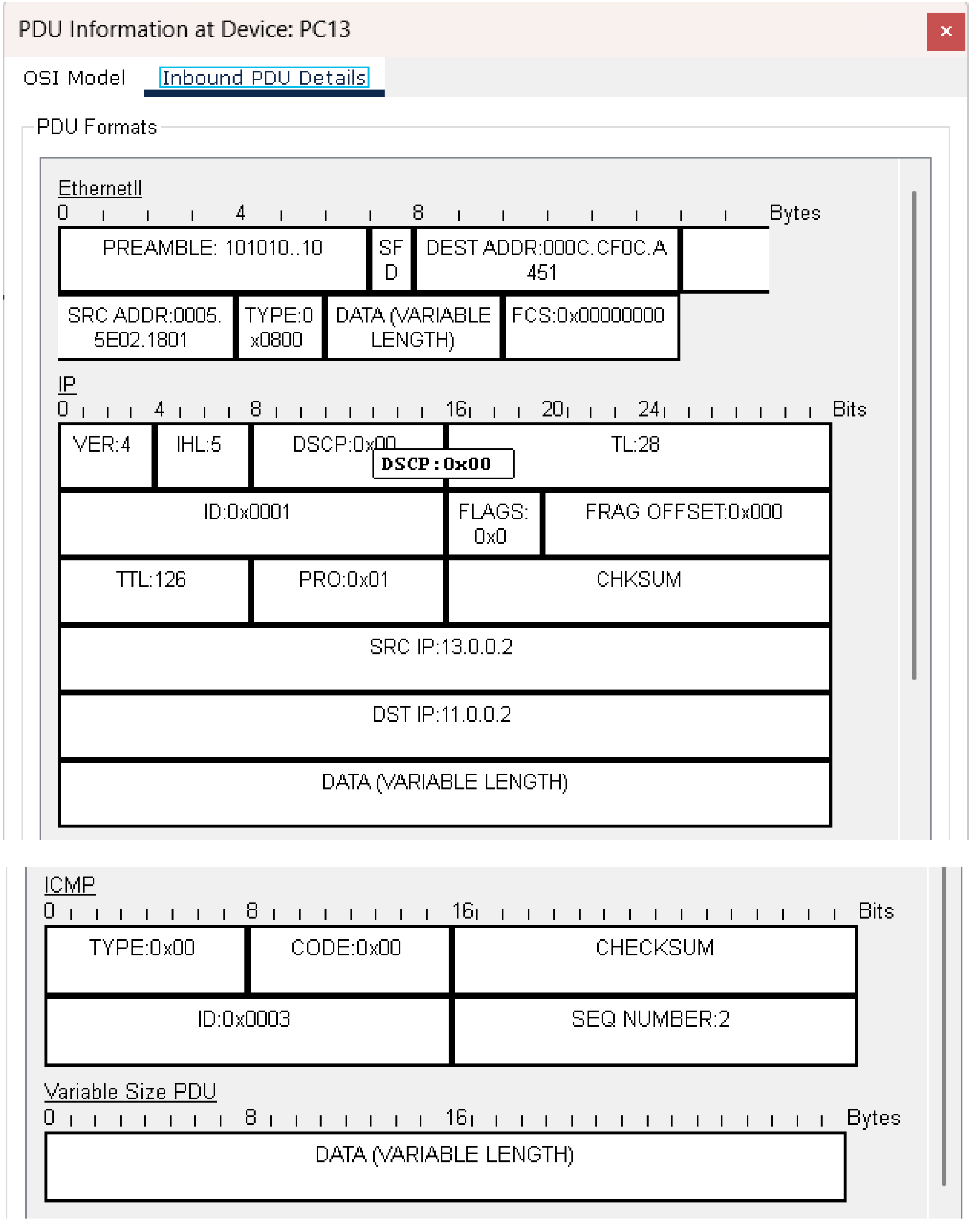


Fig:3.1.12

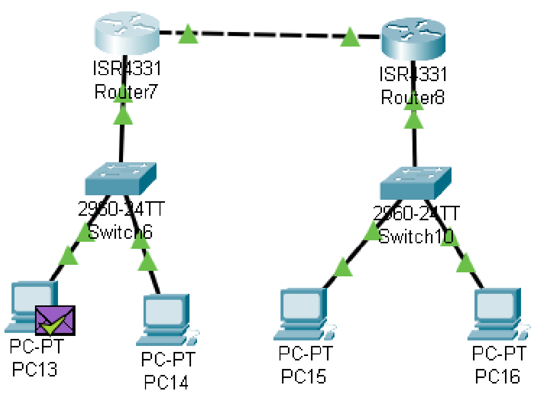


Fig:3.1.13

- Important commands to keep in mind to configure the RIP

en
conf t
router rip
version 2
network 12.0.0.0
network 13.0.0.0

  - This is my second router configuration just we need to enter the networks it know and the first commands are common
  - And we need to do It for all the routers present in that network.
  - We have 2 different versions and we need to use the same for all the routers.