Network Setup Simulation in Cisco Packet Tracer

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1 Introduction

The purpose of this project is to design and simulate a functional, real-world network environment that incorporates fundamental networking services and demonstrates how they interact within a multi-subnet topology. This project focuses on building a network with two subnets connected through a router, enabling communication between various hosts and services.

The network simulation includes three essential services: a DHCP server responsible for dynamically assigning IP addresses to end devices, a DNS server that resolves domain names to IP addresses, and a web server that provides accessible web content to clients. As part of the exploration, clients in the network are expected to communicate with each other, request domain name resolutions, and access web pages.

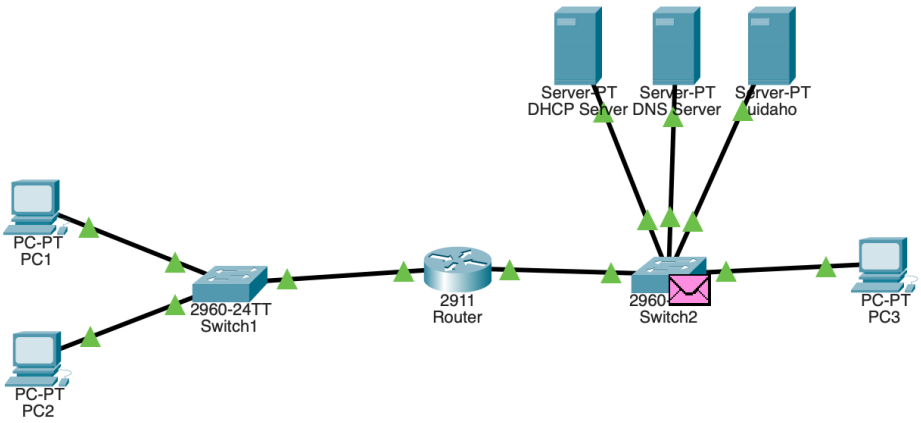
Additionally, this project emphasizes understanding packet flow by inspecting Protocol Data Units (PDUs) for both outbound and inbound traffic. Through analyzing PDUs, we gain insight into how data is encapsulated, transmitted, and processed across the network layers.

2 Network Topology

2.1 Logical Topology

The network is composed of two subnets connected through a central router. The first subnet (192.168.1.0/24) includes a switch and two end-user PCs. The second subnet (192.168.2.0/24) contains a switch, three servers, and one PC. Together, these subnets form a functional topology that supports inter-device communication and service interactions across the router.

2.2 Virtual Setup



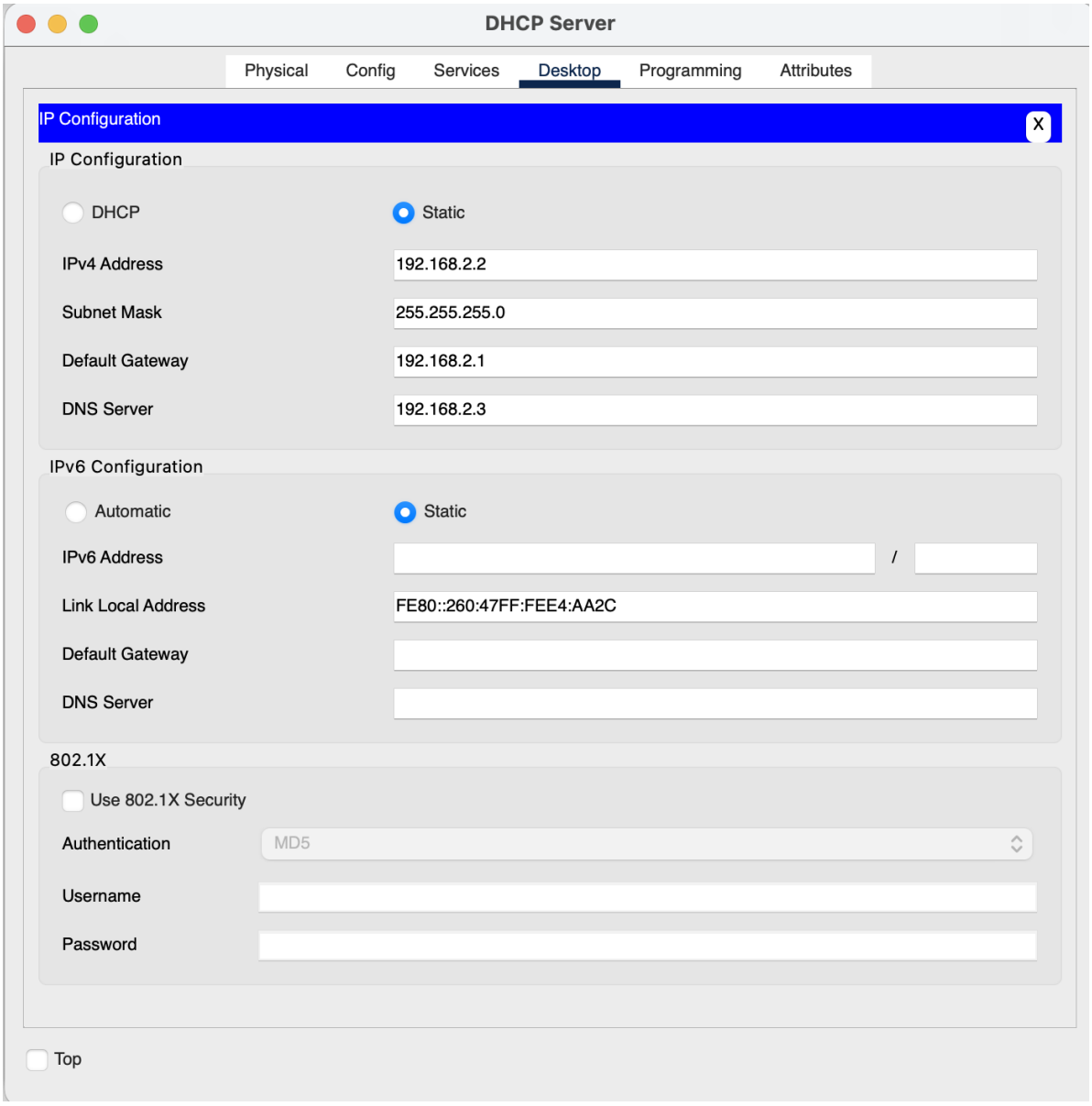
2.3 Servers Configuration

Table 1: Host IP Addressing Overview

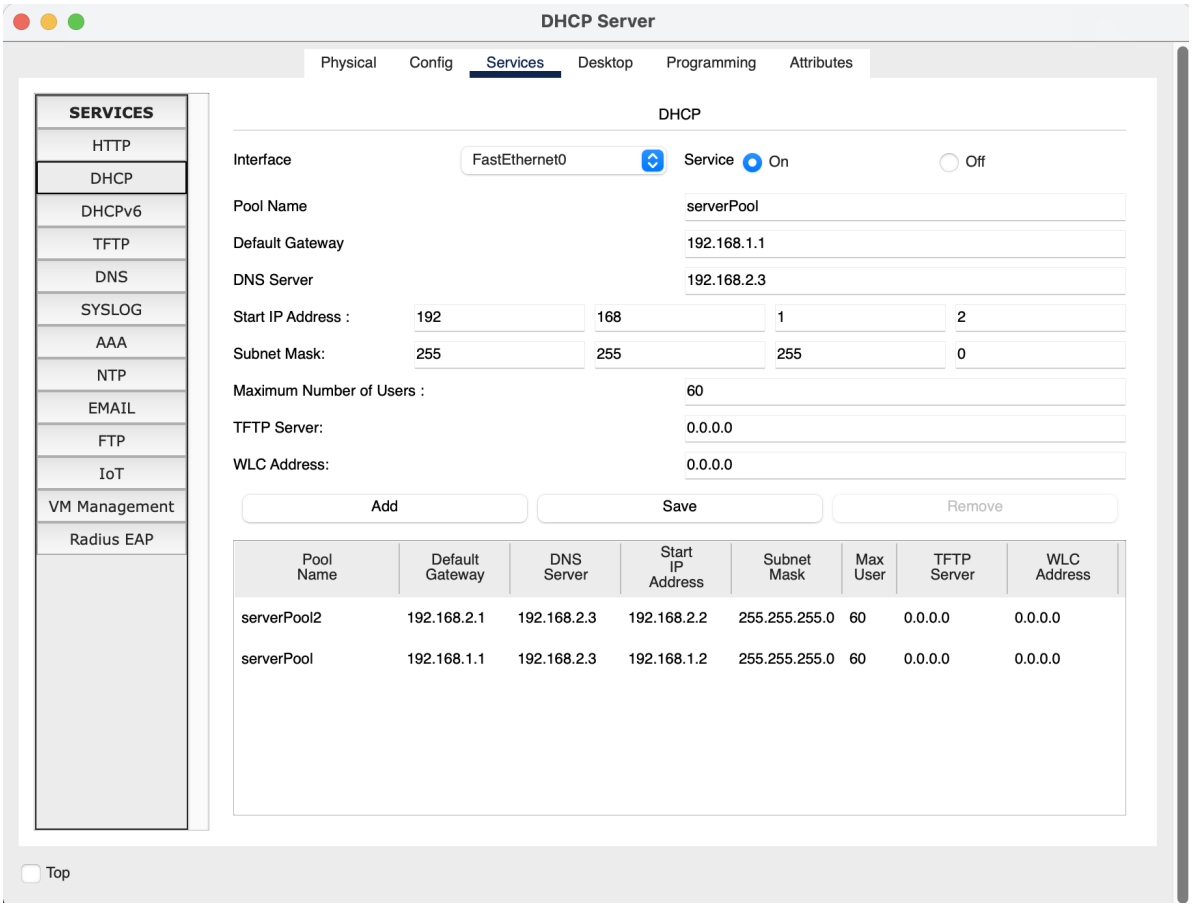
Host	Role	IP Address
DHCP Server	DHCP Address Resolution	192.168.2.2
DNS Server	DNS Queries Resolution	192.168.2.3
uidaho	WebServer	192.168.2.4

3 DHCP Configuration

3.1 DHCP IP Address Configuration



3.2 DHCP Server Address Pools Configuration

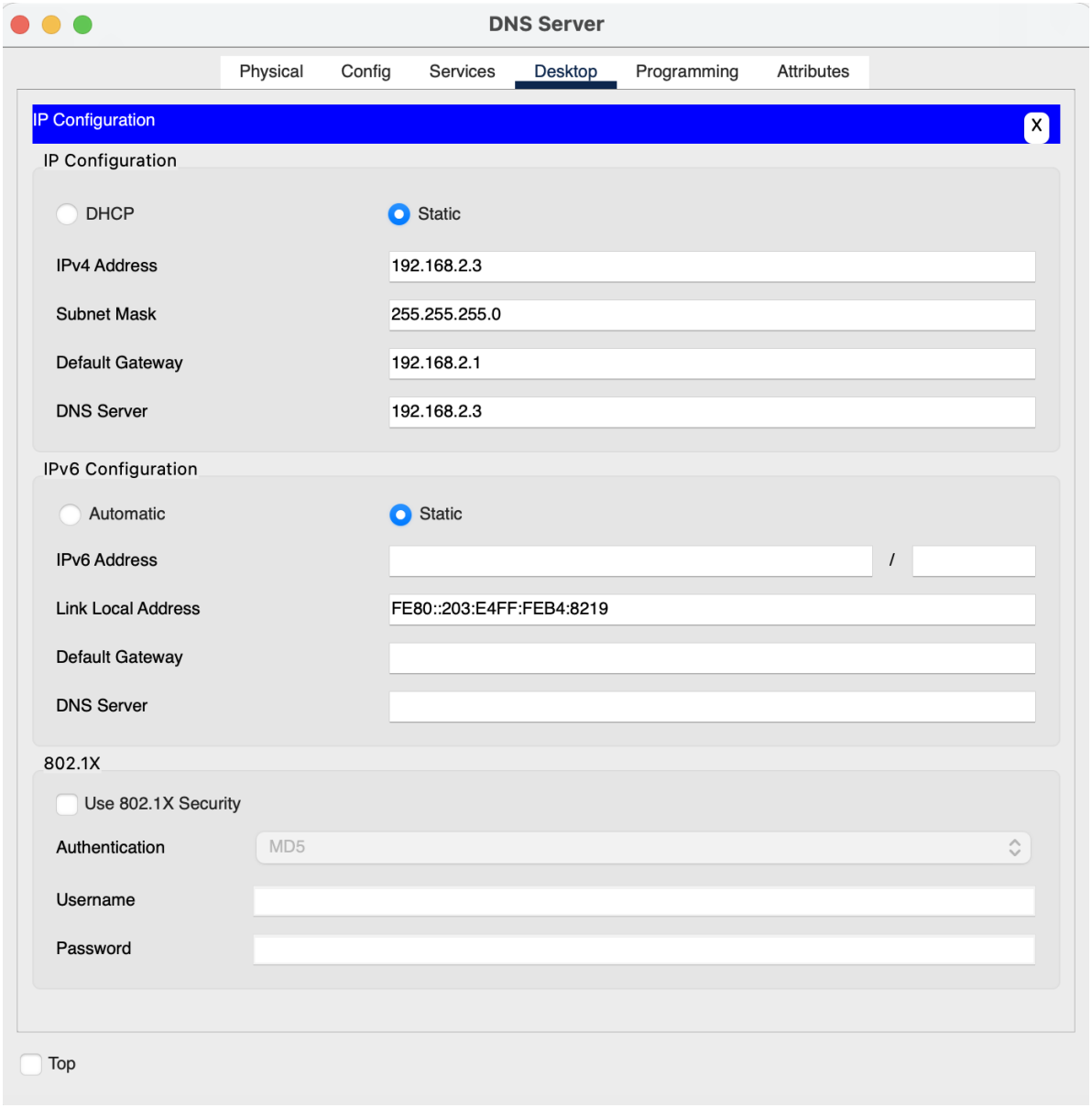


3.3 DHCP Router Configuration

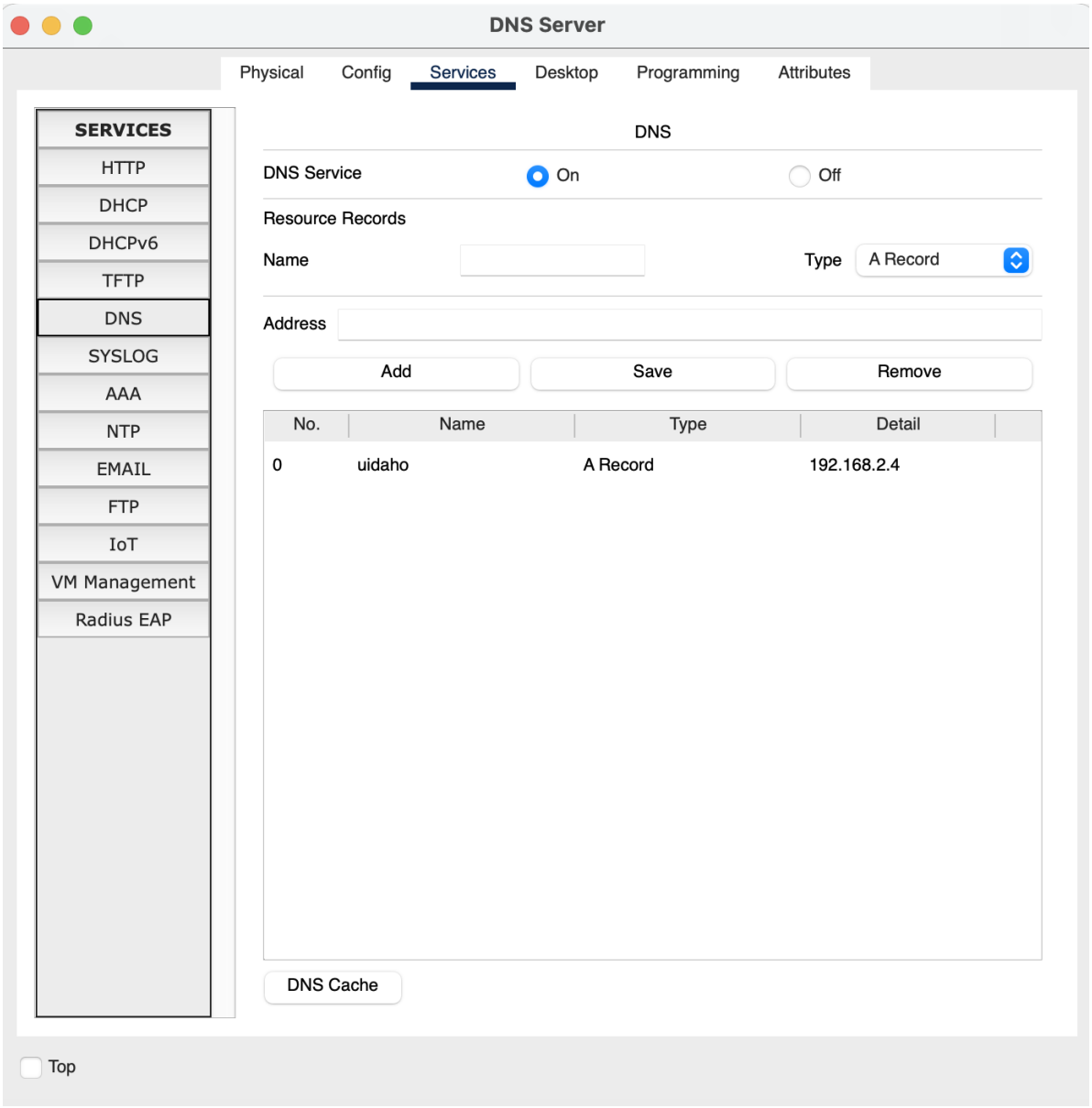
```
Router(config)#ip dhcp excluded-address 192.168.1.1
Router(config)#ip dhcp excluded-address 192.168.2.1
Router(config)#ip dhcp pool 192.168.1.1
Router(dhcp-config)#network 192.168.1.0 255.255.255.0
Router(dhcp-config)#default-router 192.168.1.1
Router(dhcp-config)#dns-server 192.168.2.3
Router(dhcp-config)#exit
Router(config)#ip dhcp pool 192.168.2.1
Router(dhcp-config)#network 192.168.2.0 255.255.255.0
Router(dhcp-config)#default-router 192.168.2.1
Router(dhcp-config)#dns-server 192.168.2.3
Router(dhcp-config)#exit
```

4 DNS Configuration

4.1 DNS IP Address Configuration

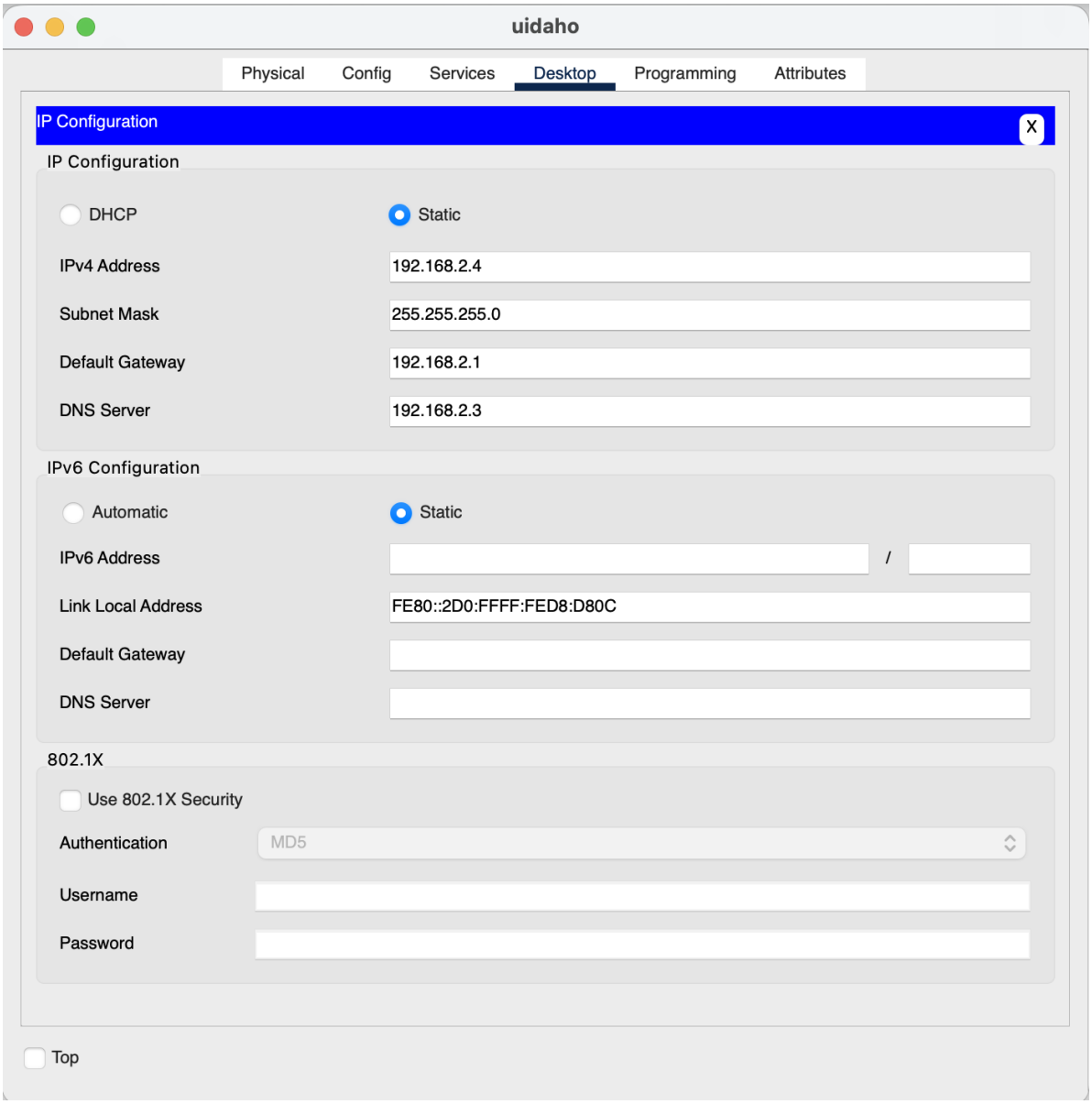


4.2 DNS Services Configuration



5 Web Server Setup

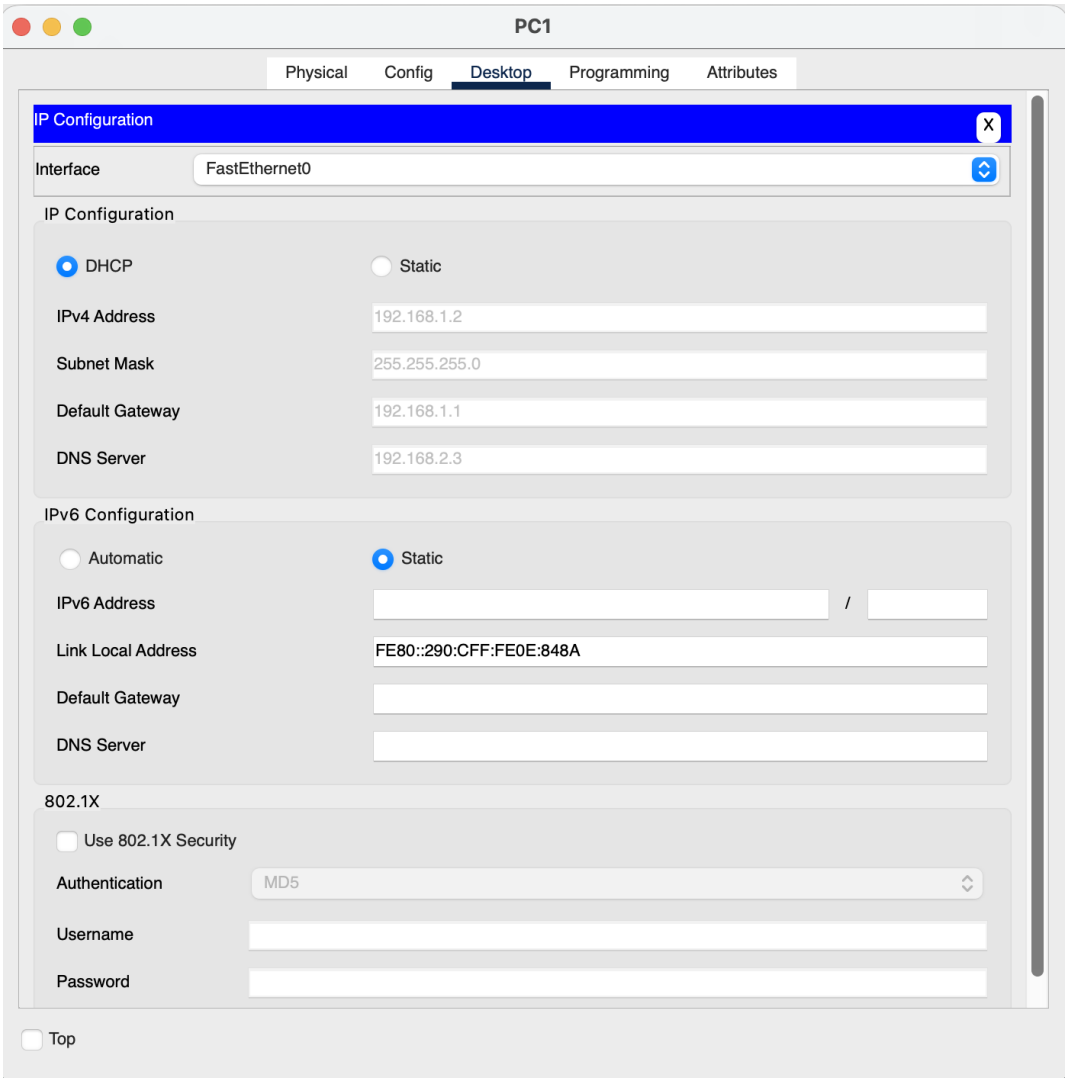
5.1 uidaho IP Address Configuration



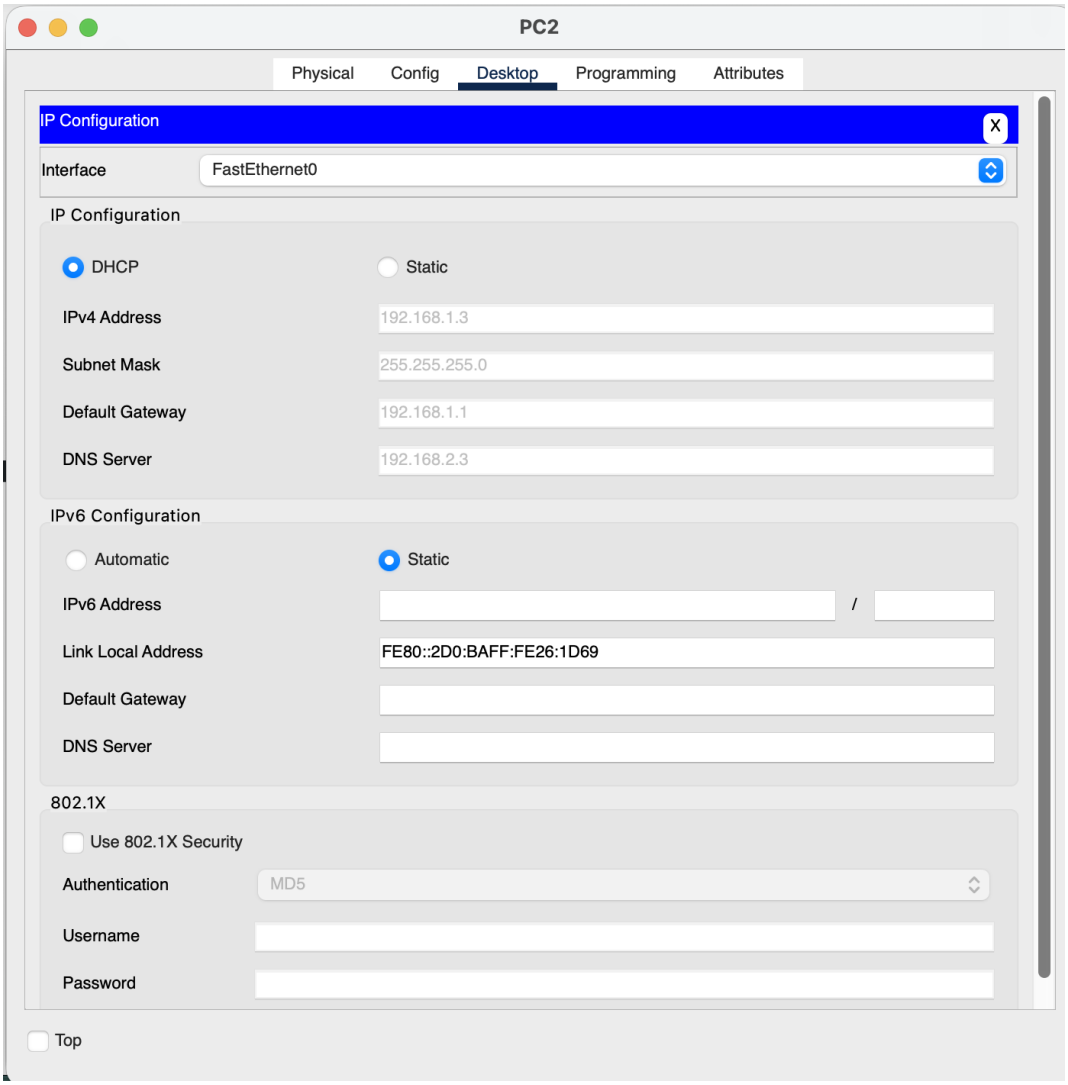
6 PCs IP Addresses Configurations

Done by the DHCP protocol (post DHCP configuration).

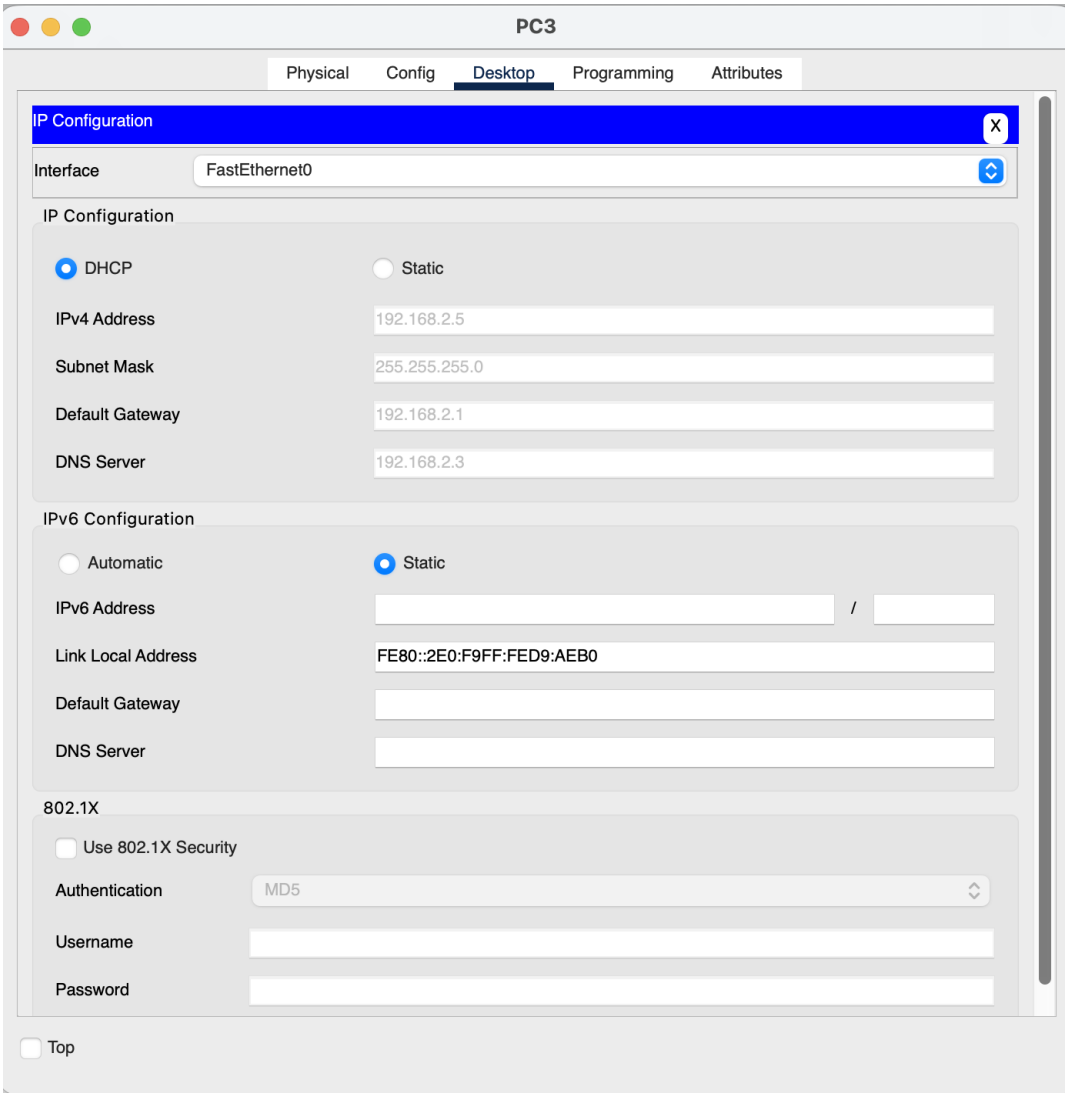
6.1 PC1



6.2 PC2


PC2
Physical
Config
Desktop
Programming
Attributes
IP Configuration
X
Interface
FastEthernet0
IP Configuration
DHCP
Static
IPv4 Address
192.168.1.3
Subnet Mask
255.255.255.0
Default Gateway
192.168.1.1
DNS Server
192.168.2.3
IPv6 Configuration
Automatic
Static
IPv6 Address
/
Link Local Address
FE80::2D0:BAFF:FE26:1D69
Default Gateway
DNS Server
802.1X
Use 802.1X Security
Authentication
MD5
Username
Password
Top

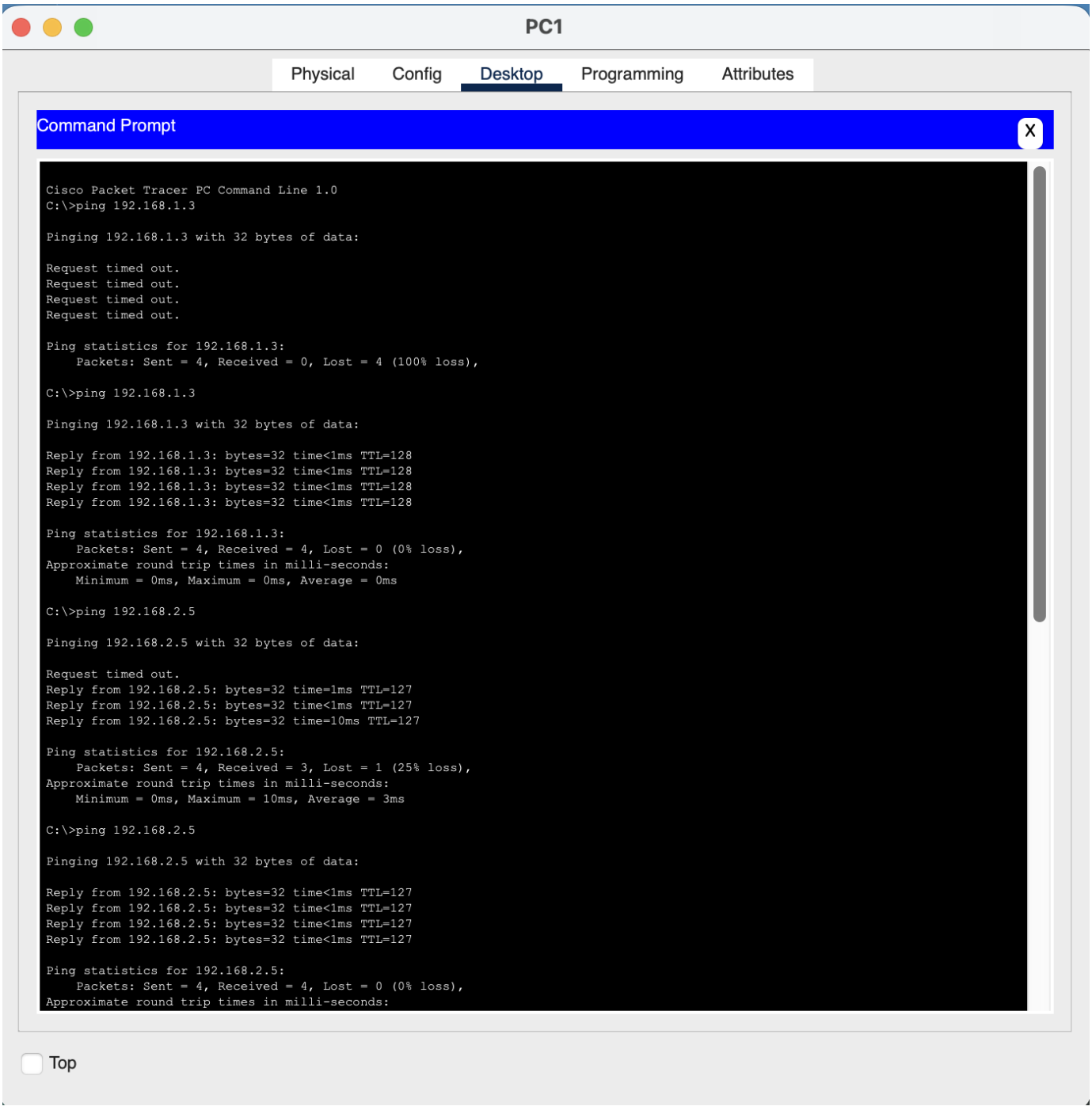
6.3 PC3

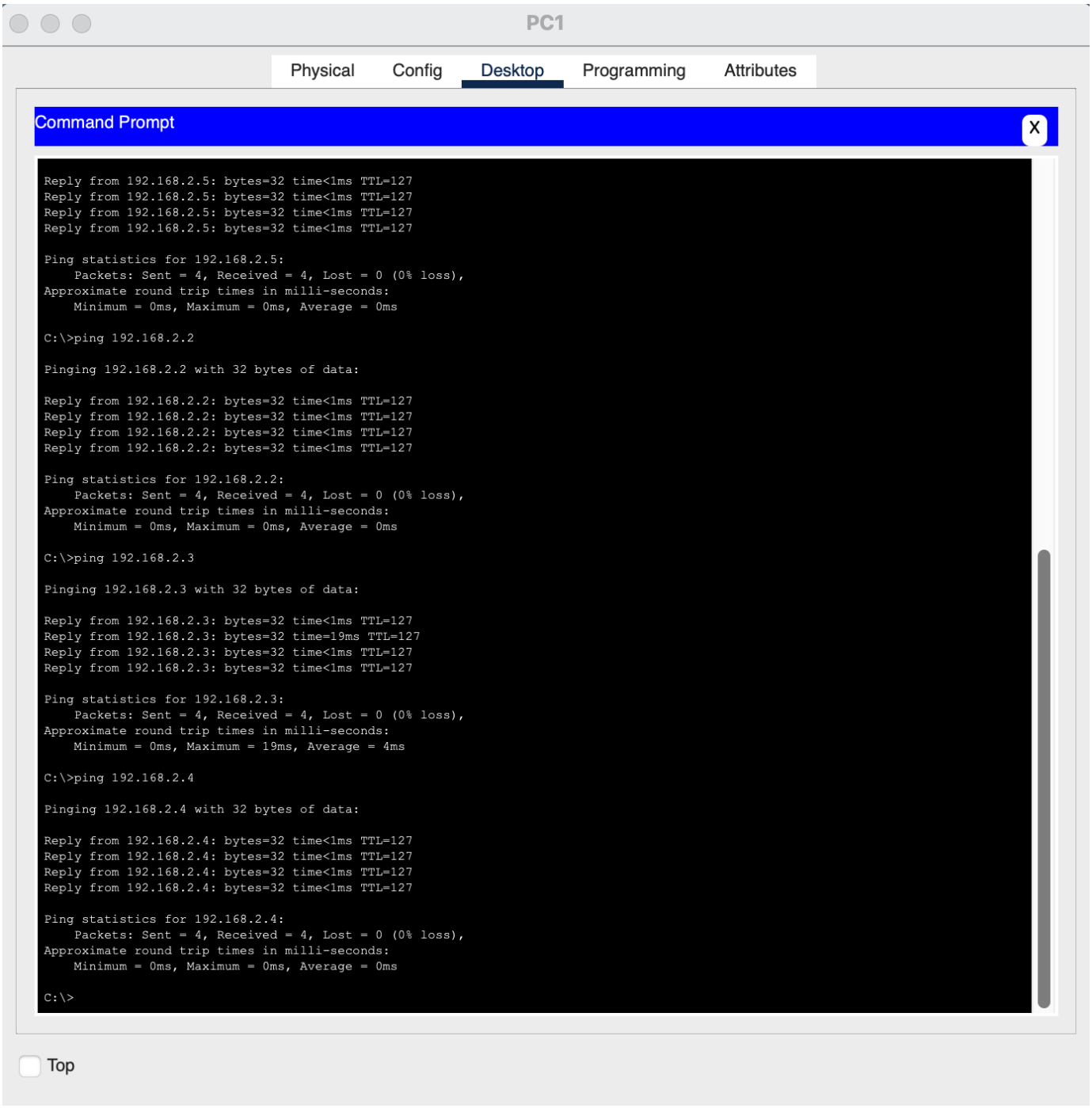

PC3
Physical
Config
Desktop
Programming
Attributes
IP Configuration
X
Interface
FastEthernet0
IP Configuration
DHCP
Static
IPv4 Address
192.168.2.5
Subnet Mask
255.255.255.0
Default Gateway
192.168.2.1
DNS Server
192.168.2.3
IPv6 Configuration
Automatic
Static
IPv6 Address
/
Link Local Address
FE80::2E0:F9FF:FED9:AEB0
Default Gateway
DNS Server
802.1X
Use 802.1X Security
Authentication
MD5
Username
Password
Top

7 PCs Test Pings

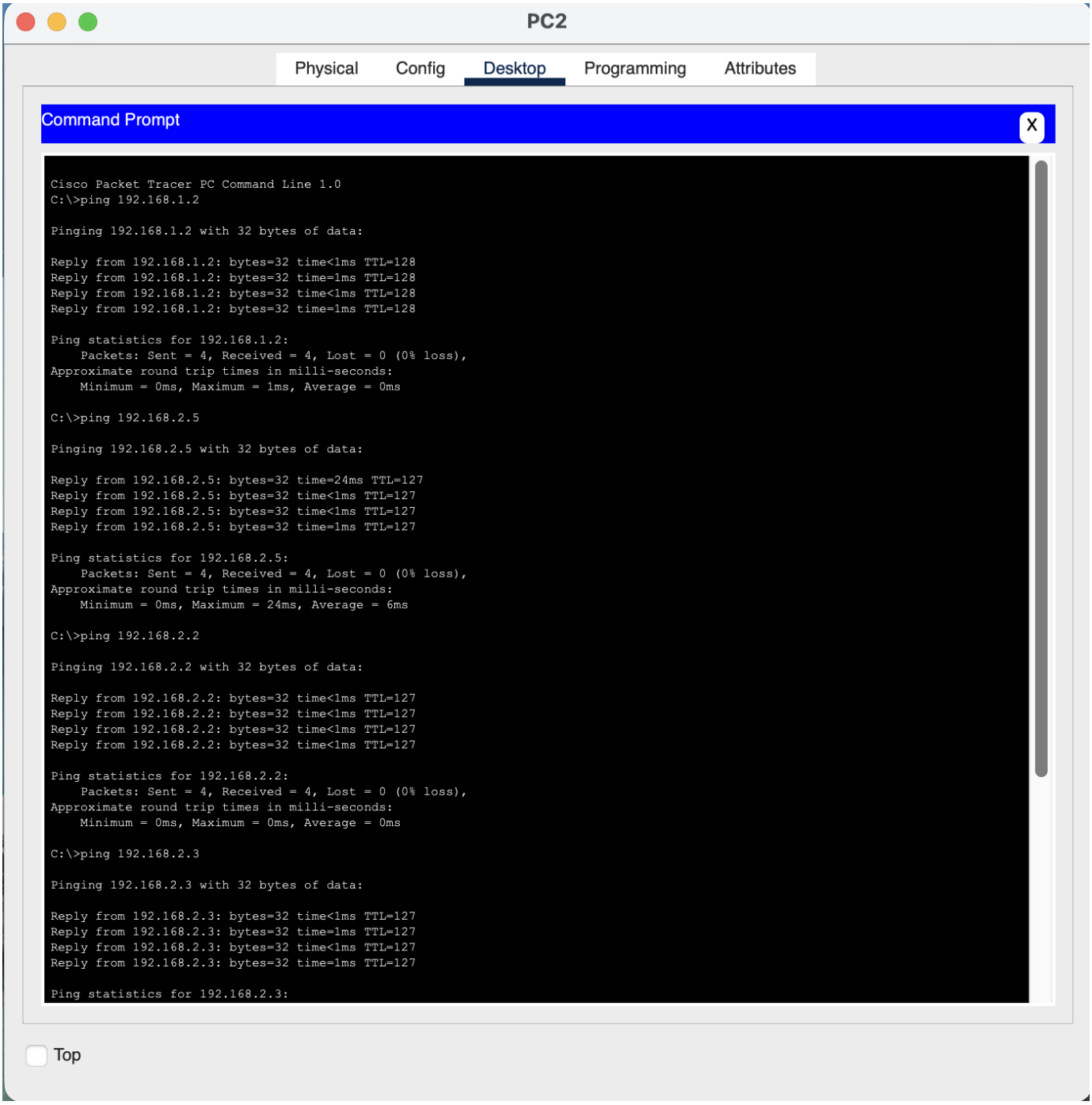
Each PC has pinged the DNS Server, DHCP Server, Web Server, and other PCs on the network.

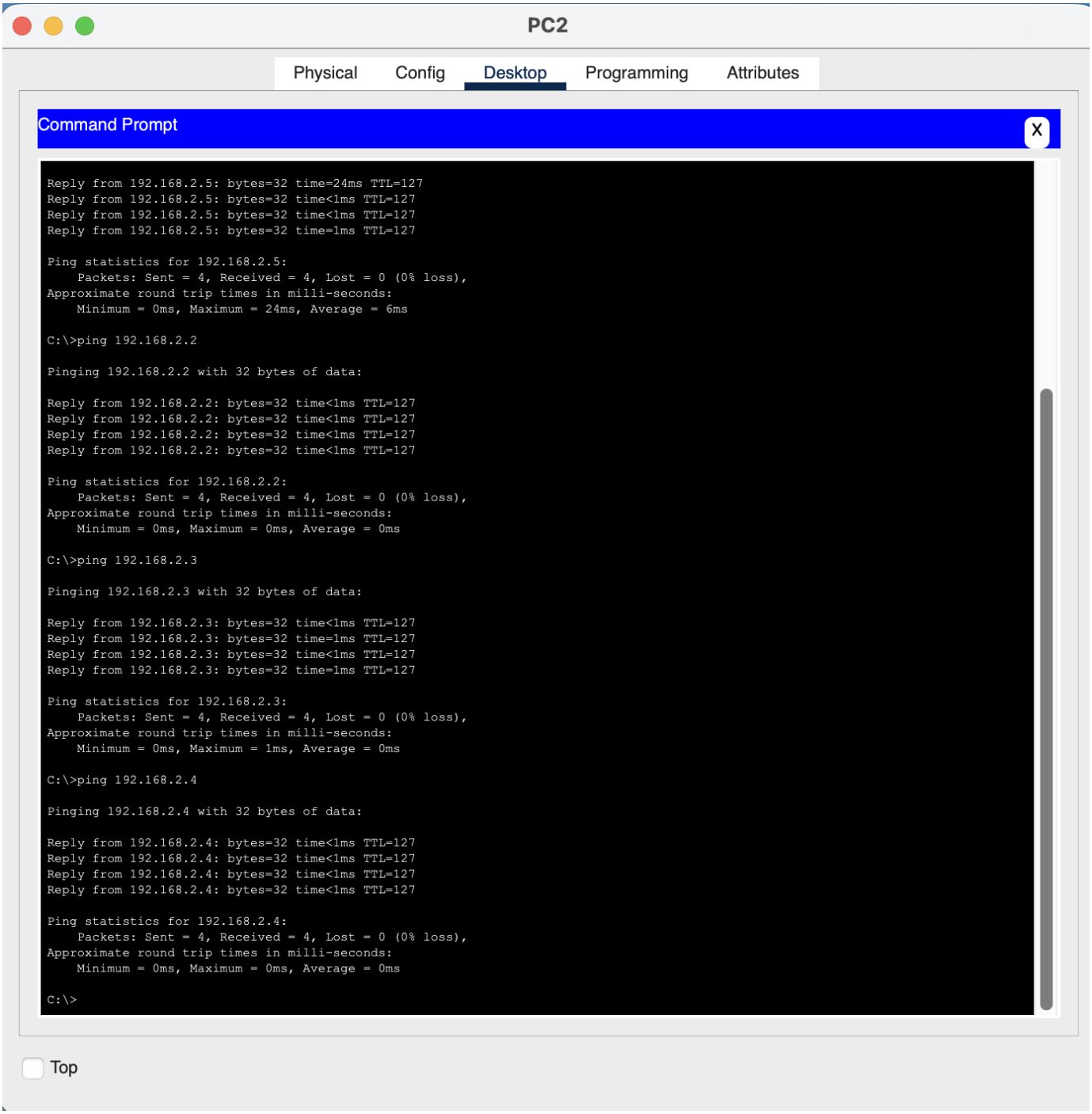
7.1 PC1



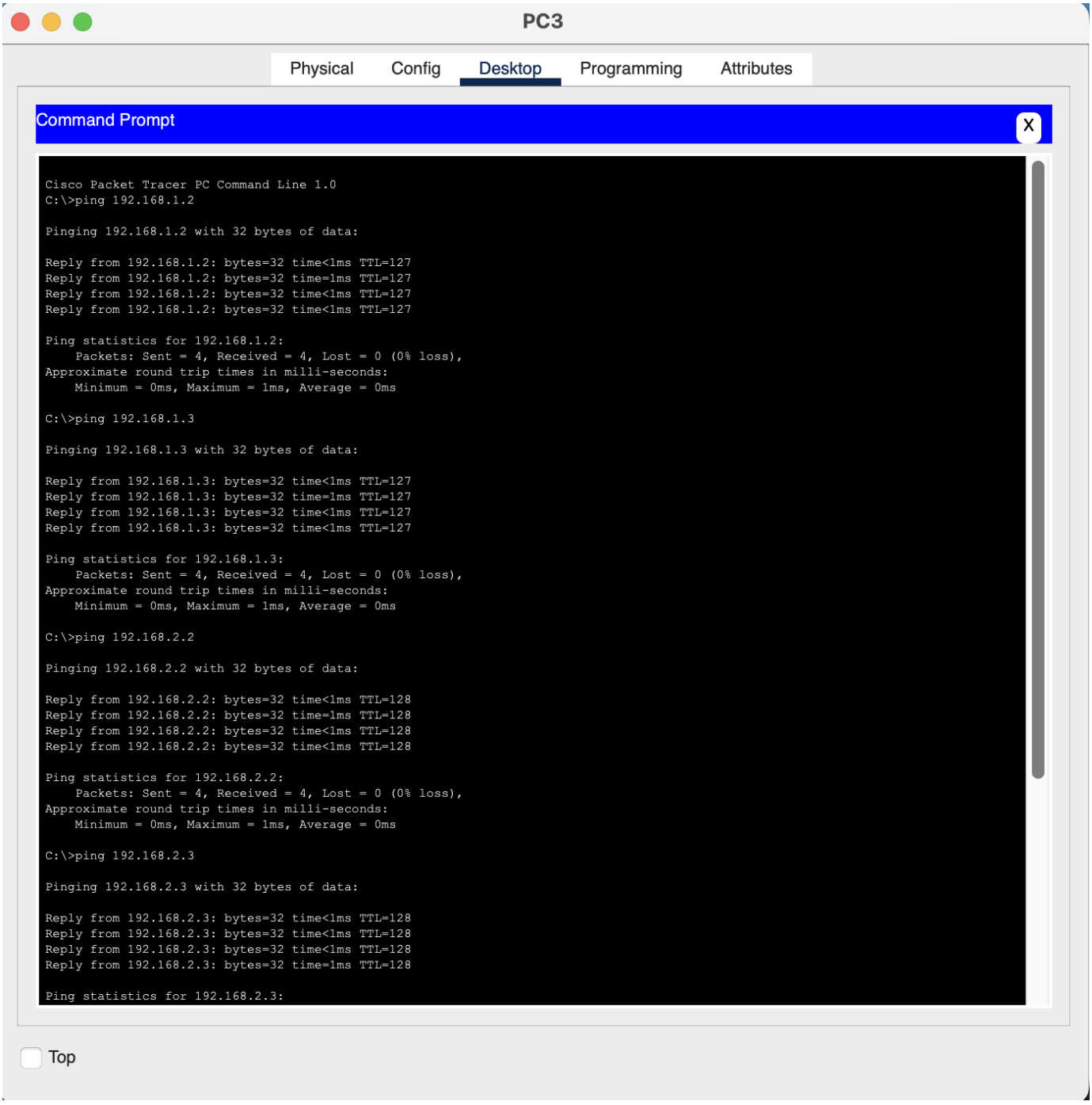

PC1
Physical
Config
Desktop
Programming
Attributes
Command Prompt
X
Reply from 192.168.2.5: bytes=32 time<1ms TTL=127
Reply from 192.168.2.5: bytes=32 time<1ms TTL=127
Reply from 192.168.2.5: bytes=32 time<1ms TTL=127
Reply from 192.168.2.5: bytes=32 time<1ms TTL=127
Ping statistics for 192.168.2.5:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\>ping 192.168.2.2
Pinging 192.168.2.2 with 32 bytes of data:
Reply from 192.168.2.2: bytes=32 time<1ms TTL=127
Reply from 192.168.2.2: bytes=32 time<1ms TTL=127
Reply from 192.168.2.2: bytes=32 time<1ms TTL=127
Reply from 192.168.2.2: bytes=32 time<1ms TTL=127
Ping statistics for 192.168.2.2:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\>ping 192.168.2.3
Pinging 192.168.2.3 with 32 bytes of data:
Reply from 192.168.2.3: bytes=32 time<1ms TTL=127
Reply from 192.168.2.3: bytes=32 time=19ms TTL=127
Reply from 192.168.2.3: bytes=32 time<1ms TTL=127
Reply from 192.168.2.3: bytes=32 time<1ms TTL=127
Ping statistics for 192.168.2.3:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 19ms, Average = 4ms
C:\>ping 192.168.2.4
Pinging 192.168.2.4 with 32 bytes of data:
Reply from 192.168.2.4: bytes=32 time<1ms TTL=127
Reply from 192.168.2.4: bytes=32 time<1ms TTL=127
Reply from 192.168.2.4: bytes=32 time<1ms TTL=127
Reply from 192.168.2.4: bytes=32 time<1ms TTL=127
Ping statistics for 192.168.2.4:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\>
Top

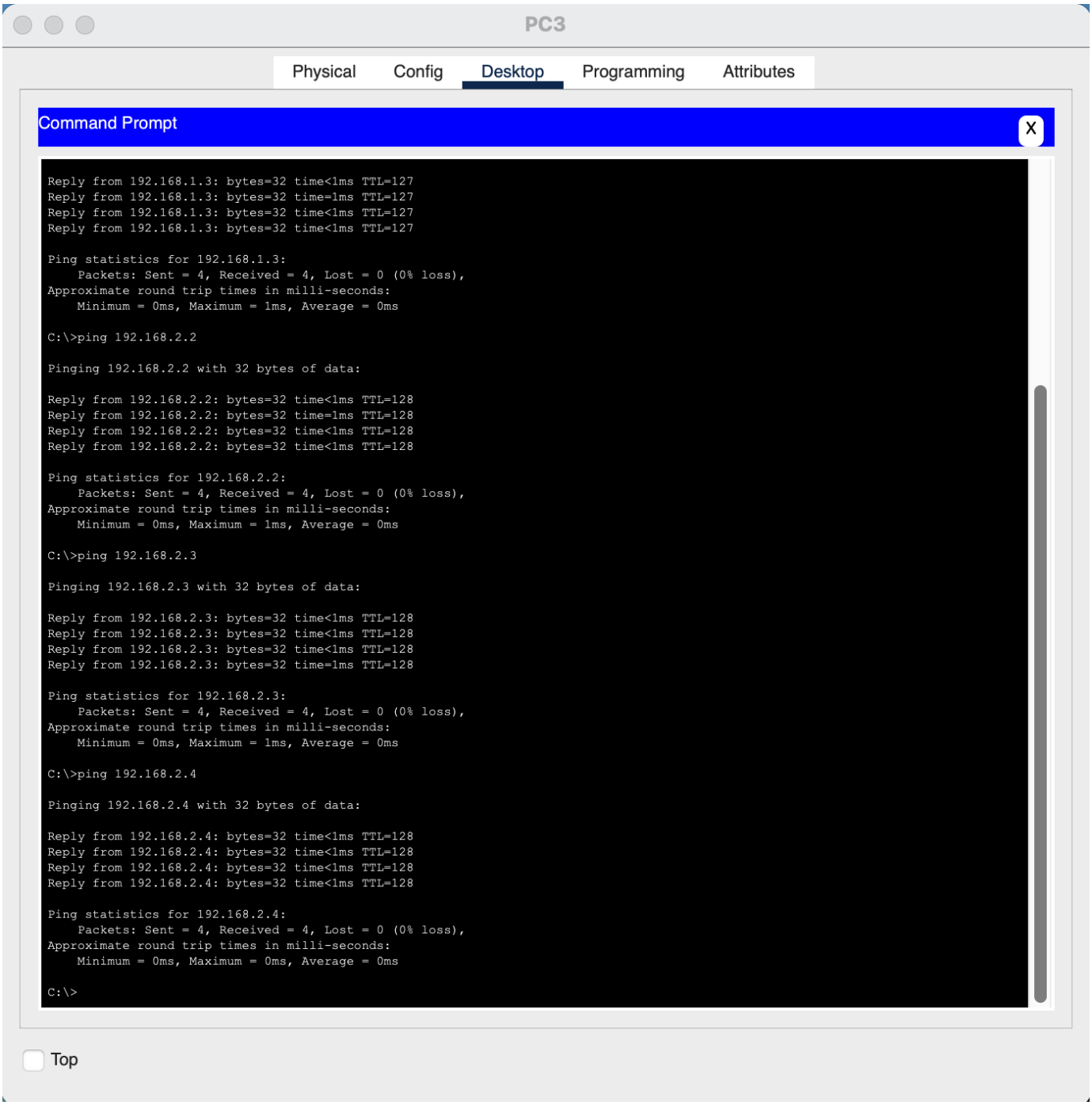
7.2 PC2


PC2
Physical
Config
Desktop
Programming
Attributes
Command Prompt
X
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.1.2
Pinging 192.168.1.2 with 32 bytes of data:
Reply from 192.168.1.2: bytes=32 time<1ms TTL=128
Reply from 192.168.1.2: bytes=32 time=1ms TTL=128
Reply from 192.168.1.2: bytes=32 time<1ms TTL=128
Reply from 192.168.1.2: bytes=32 time=1ms TTL=128
Ping statistics for 192.168.1.2:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 1ms, Average = 0ms
C:\>ping 192.168.2.5
Pinging 192.168.2.5 with 32 bytes of data:
Reply from 192.168.2.5: bytes=32 time=24ms TTL=127
Reply from 192.168.2.5: bytes=32 time<1ms TTL=127
Reply from 192.168.2.5: bytes=32 time<1ms TTL=127
Reply from 192.168.2.5: bytes=32 time=1ms TTL=127
Ping statistics for 192.168.2.5:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 24ms, Average = 6ms
C:\>ping 192.168.2.2
Pinging 192.168.2.2 with 32 bytes of data:
Reply from 192.168.2.2: bytes=32 time<1ms TTL=127
Reply from 192.168.2.2: bytes=32 time<1ms TTL=127
Reply from 192.168.2.2: bytes=32 time<1ms TTL=127
Reply from 192.168.2.2: bytes=32 time<1ms TTL=127
Ping statistics for 192.168.2.2:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\>ping 192.168.2.3
Pinging 192.168.2.3 with 32 bytes of data:
Reply from 192.168.2.3: bytes=32 time<1ms TTL=127
Reply from 192.168.2.3: bytes=32 time=1ms TTL=127
Reply from 192.168.2.3: bytes=32 time<1ms TTL=127
Reply from 192.168.2.3: bytes=32 time=1ms TTL=127
Ping statistics for 192.168.2.3:
Top


PC2
Physical
Config
Desktop
Programming
Attributes
Command Prompt
X
Reply from 192.168.2.5: bytes=32 time=24ms TTL=127
Reply from 192.168.2.5: bytes=32 time<1ms TTL=127
Reply from 192.168.2.5: bytes=32 time<1ms TTL=127
Reply from 192.168.2.5: bytes=32 time=1ms TTL=127
Ping statistics for 192.168.2.5:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 24ms, Average = 6ms
C:\>ping 192.168.2.2
Pinging 192.168.2.2 with 32 bytes of data:
Reply from 192.168.2.2: bytes=32 time<1ms TTL=127
Reply from 192.168.2.2: bytes=32 time<1ms TTL=127
Reply from 192.168.2.2: bytes=32 time<1ms TTL=127
Reply from 192.168.2.2: bytes=32 time<1ms TTL=127
Ping statistics for 192.168.2.2:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\>ping 192.168.2.3
Pinging 192.168.2.3 with 32 bytes of data:
Reply from 192.168.2.3: bytes=32 time<1ms TTL=127
Reply from 192.168.2.3: bytes=32 time=1ms TTL=127
Reply from 192.168.2.3: bytes=32 time<1ms TTL=127
Reply from 192.168.2.3: bytes=32 time=1ms TTL=127
Ping statistics for 192.168.2.3:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 1ms, Average = 0ms
C:\>ping 192.168.2.4
Pinging 192.168.2.4 with 32 bytes of data:
Reply from 192.168.2.4: bytes=32 time<1ms TTL=127
Reply from 192.168.2.4: bytes=32 time<1ms TTL=127
Reply from 192.168.2.4: bytes=32 time<1ms TTL=127
Reply from 192.168.2.4: bytes=32 time<1ms TTL=127
Ping statistics for 192.168.2.4:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\>
Top

7.3 PC3


PC3
Physical
Config
Desktop
Programming
Attributes
Command Prompt
X
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.1.2
Pinging 192.168.1.2 with 32 bytes of data:
Reply from 192.168.1.2: bytes=32 time<1ms TTL=127
Reply from 192.168.1.2: bytes=32 time=1ms TTL=127
Reply from 192.168.1.2: bytes=32 time<1ms TTL=127
Reply from 192.168.1.2: bytes=32 time<1ms TTL=127
Ping statistics for 192.168.1.2:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 1ms, Average = 0ms
C:\>ping 192.168.1.3
Pinging 192.168.1.3 with 32 bytes of data:
Reply from 192.168.1.3: bytes=32 time<1ms TTL=127
Reply from 192.168.1.3: bytes=32 time=1ms TTL=127
Reply from 192.168.1.3: bytes=32 time<1ms TTL=127
Reply from 192.168.1.3: bytes=32 time<1ms TTL=127
Ping statistics for 192.168.1.3:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 1ms, Average = 0ms
C:\>ping 192.168.2.2
Pinging 192.168.2.2 with 32 bytes of data:
Reply from 192.168.2.2: bytes=32 time<1ms TTL=128
Reply from 192.168.2.2: bytes=32 time=1ms TTL=128
Reply from 192.168.2.2: bytes=32 time<1ms TTL=128
Reply from 192.168.2.2: bytes=32 time<1ms TTL=128
Ping statistics for 192.168.2.2:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 1ms, Average = 0ms
C:\>ping 192.168.2.3
Pinging 192.168.2.3 with 32 bytes of data:
Reply from 192.168.2.3: bytes=32 time<1ms TTL=128
Reply from 192.168.2.3: bytes=32 time<1ms TTL=128
Reply from 192.168.2.3: bytes=32 time<1ms TTL=128
Reply from 192.168.2.3: bytes=32 time=1ms TTL=128
Ping statistics for 192.168.2.3:
Top

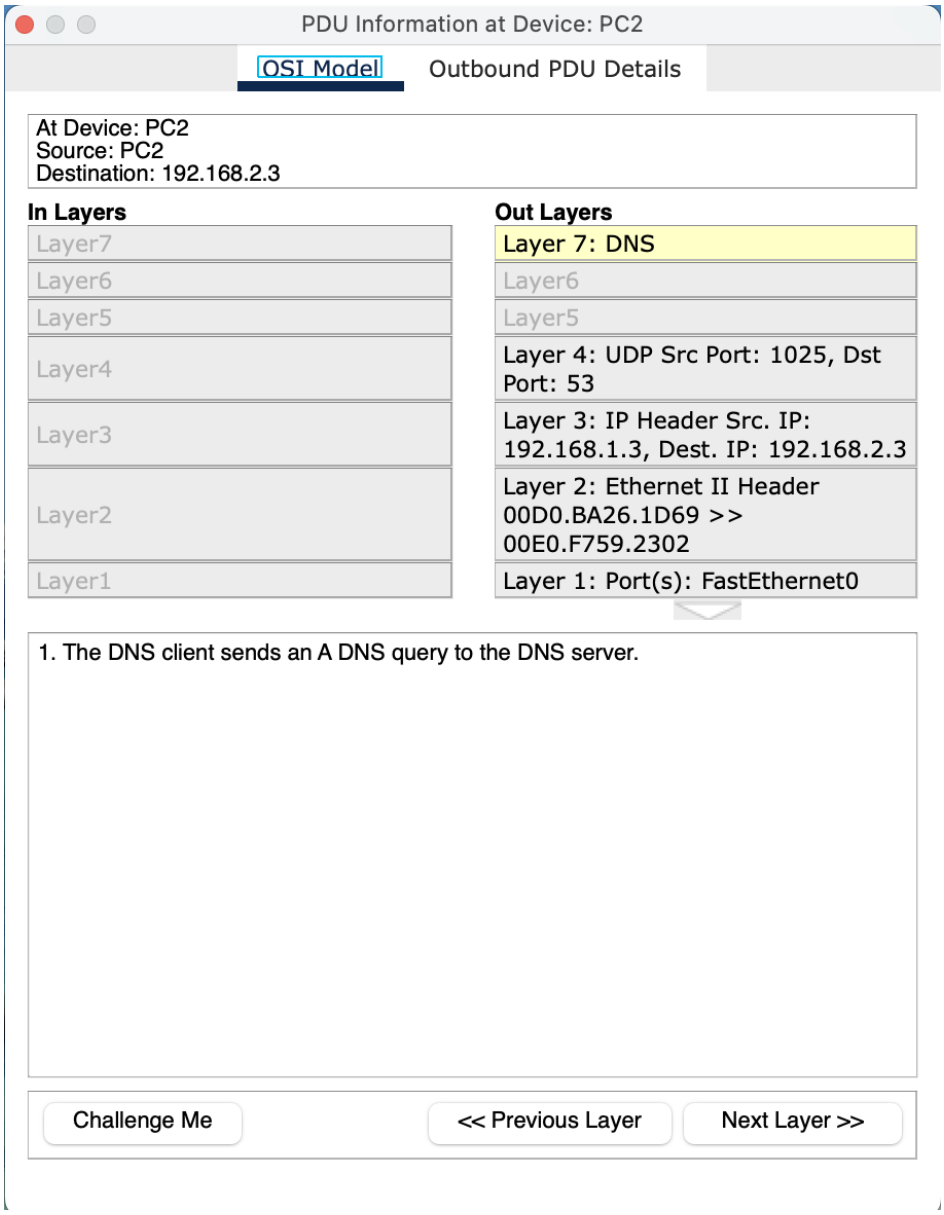

PC3
Physical
Config
Desktop
Programming
Attributes
Command Prompt
X
Reply from 192.168.1.3: bytes=32 time<1ms TTL=127
Reply from 192.168.1.3: bytes=32 time=1ms TTL=127
Reply from 192.168.1.3: bytes=32 time<1ms TTL=127
Reply from 192.168.1.3: bytes=32 time<1ms TTL=127
Ping statistics for 192.168.1.3:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 1ms, Average = 0ms
C:\>ping 192.168.2.2
Pinging 192.168.2.2 with 32 bytes of data:
Reply from 192.168.2.2: bytes=32 time<1ms TTL=128
Reply from 192.168.2.2: bytes=32 time=1ms TTL=128
Reply from 192.168.2.2: bytes=32 time<1ms TTL=128
Reply from 192.168.2.2: bytes=32 time<1ms TTL=128
Ping statistics for 192.168.2.2:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 1ms, Average = 0ms
C:\>ping 192.168.2.3
Pinging 192.168.2.3 with 32 bytes of data:
Reply from 192.168.2.3: bytes=32 time<1ms TTL=128
Reply from 192.168.2.3: bytes=32 time<1ms TTL=128
Reply from 192.168.2.3: bytes=32 time<1ms TTL=128
Reply from 192.168.2.3: bytes=32 time=1ms TTL=128
Ping statistics for 192.168.2.3:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 1ms, Average = 0ms
C:\>ping 192.168.2.4
Pinging 192.168.2.4 with 32 bytes of data:
Reply from 192.168.2.4: bytes=32 time<1ms TTL=128
Reply from 192.168.2.4: bytes=32 time<1ms TTL=128
Reply from 192.168.2.4: bytes=32 time<1ms TTL=128
Reply from 192.168.2.4: bytes=32 time<1ms TTL=128
Ping statistics for 192.168.2.4:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\>
Top

8 PC to uidaho Web Server Connection Packets

8.1 DNS Address Resolution Request

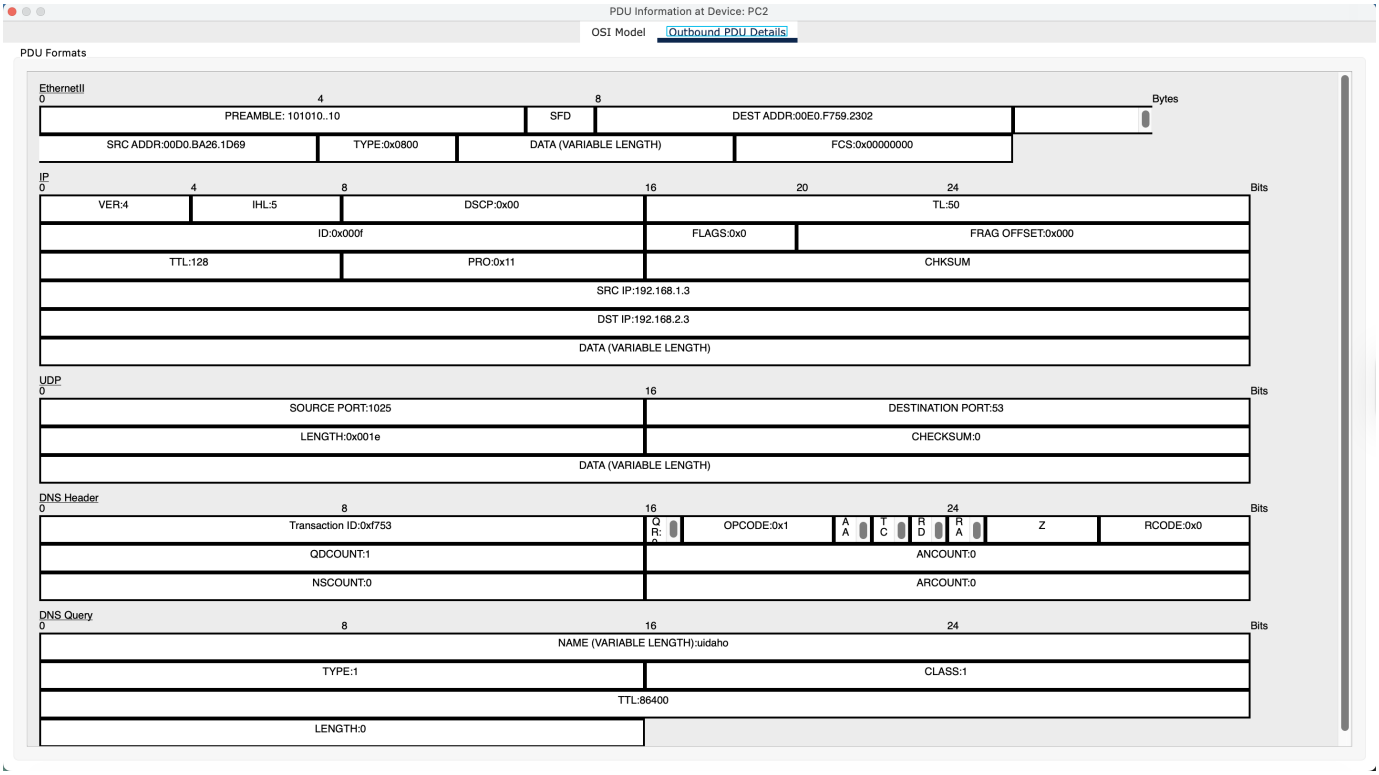
8.1.1 PC DNS Request - OSI

- Layer: 7
- Protocol: DNS,UDP
- Device: PC2



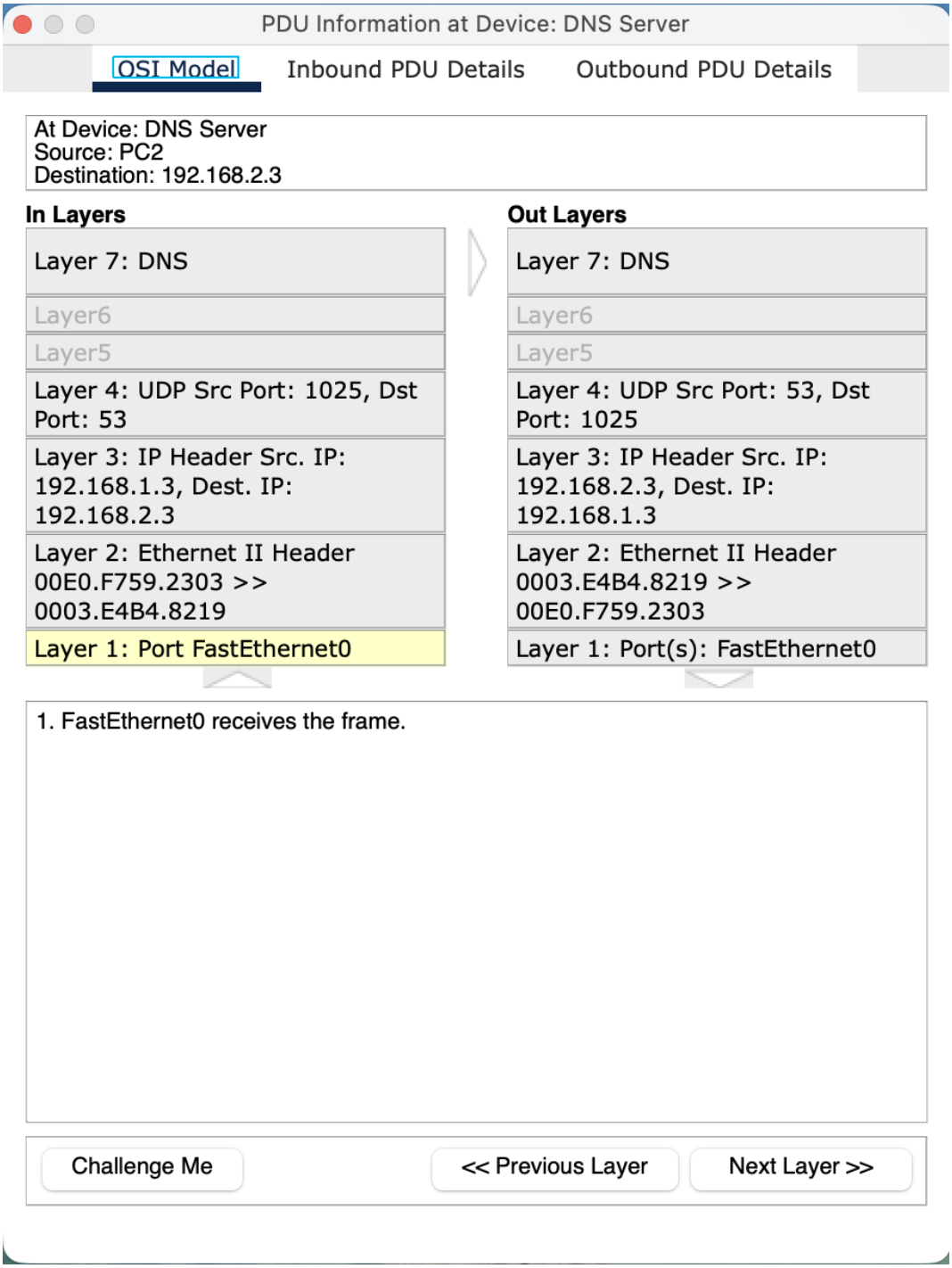
8.1.2 PC DNS Request - Outbound

- Layer: 7
- Protocol: DNS, UDP
- Device: PC2
- Source: 192.168.1.3
- Destination: 192.168.2.3
- Destination Port: 53
- Query; Name: uidaho



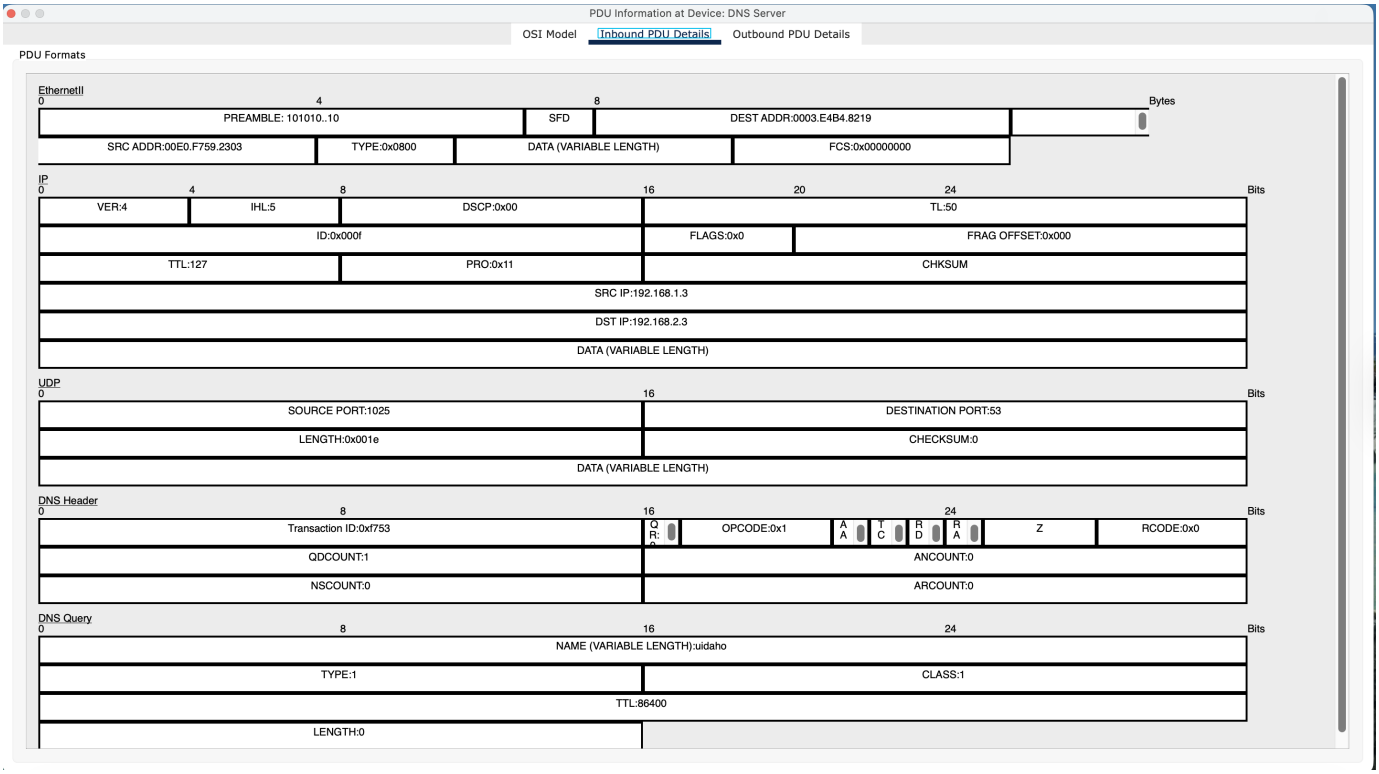
8.1.3 DNS Server DNS Request - OSI

- Layer: 1
- Protocol: DNS, UDP
- Device: DNS Server



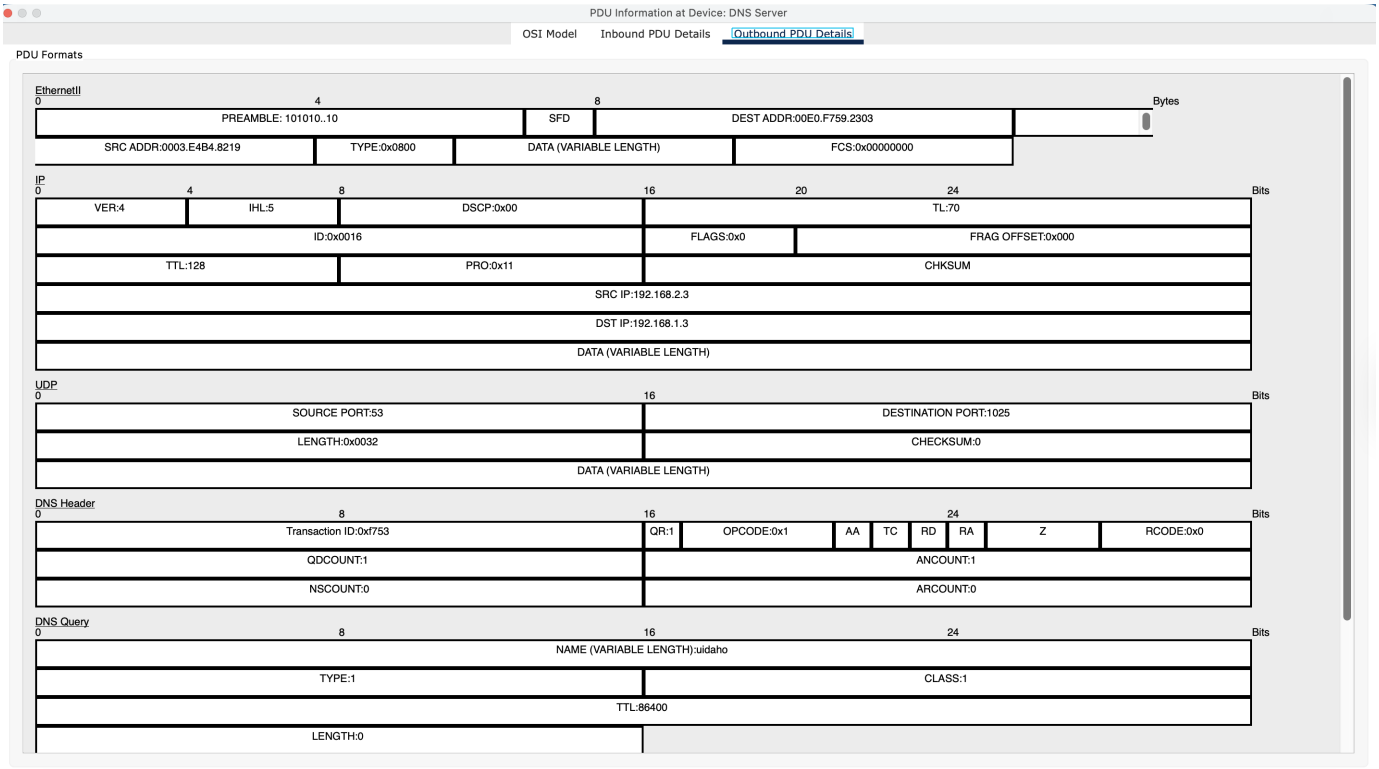
8.1.4 DNS Server DNS Request - Inbound

- Layer: 1
- Protocol: DNS, UDP
- Device: DNS Server
- Source: 192.168.1.3
- Destination: 192.168.2.3
- Destination Port: 53
- Query; Name: uidaho



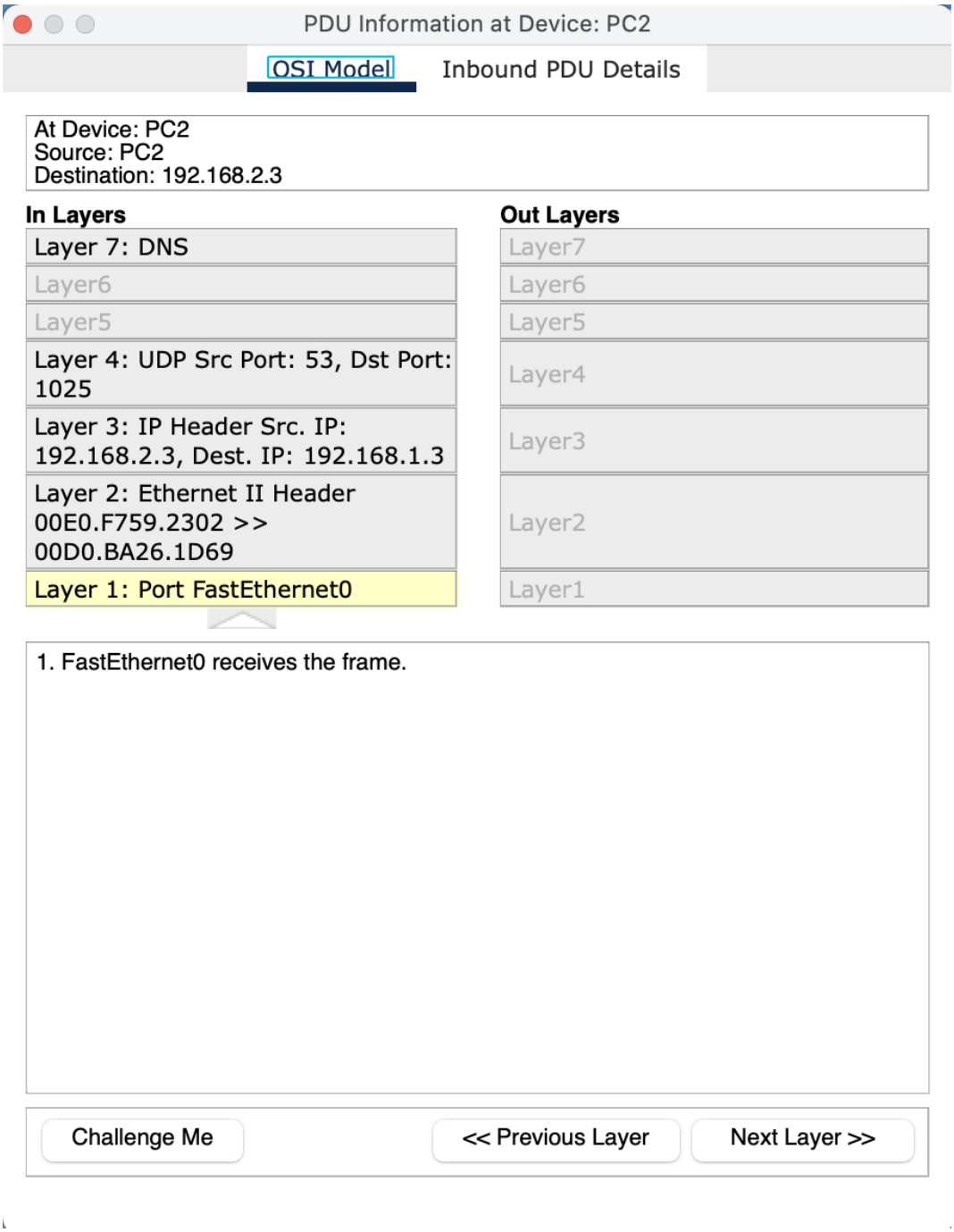
8.1.5 DNS Server DNS Request - Outbound

- Layer: 1
- Protocol: DNS, UDP
- Device: DNS Server
- Source: 192.168.2.3
- Destination: 192.168.1.3
- Destination Port: 1025
- Query; Name: uidaho



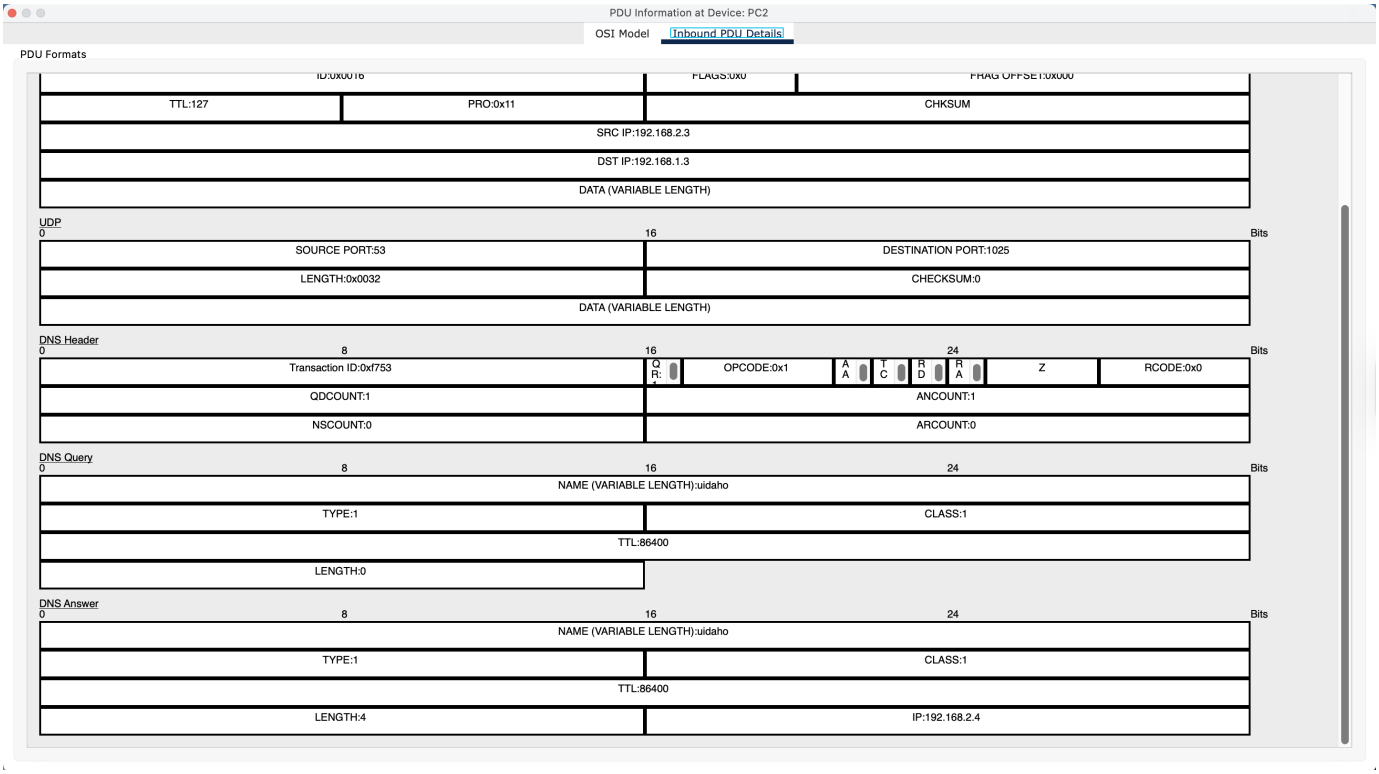
8.1.6 PC DNS Response - OSI

- Layer: 1
- Protocol: DNS, UDP
- Device: PC2



8.1.7 PC DNS Response - Inbound

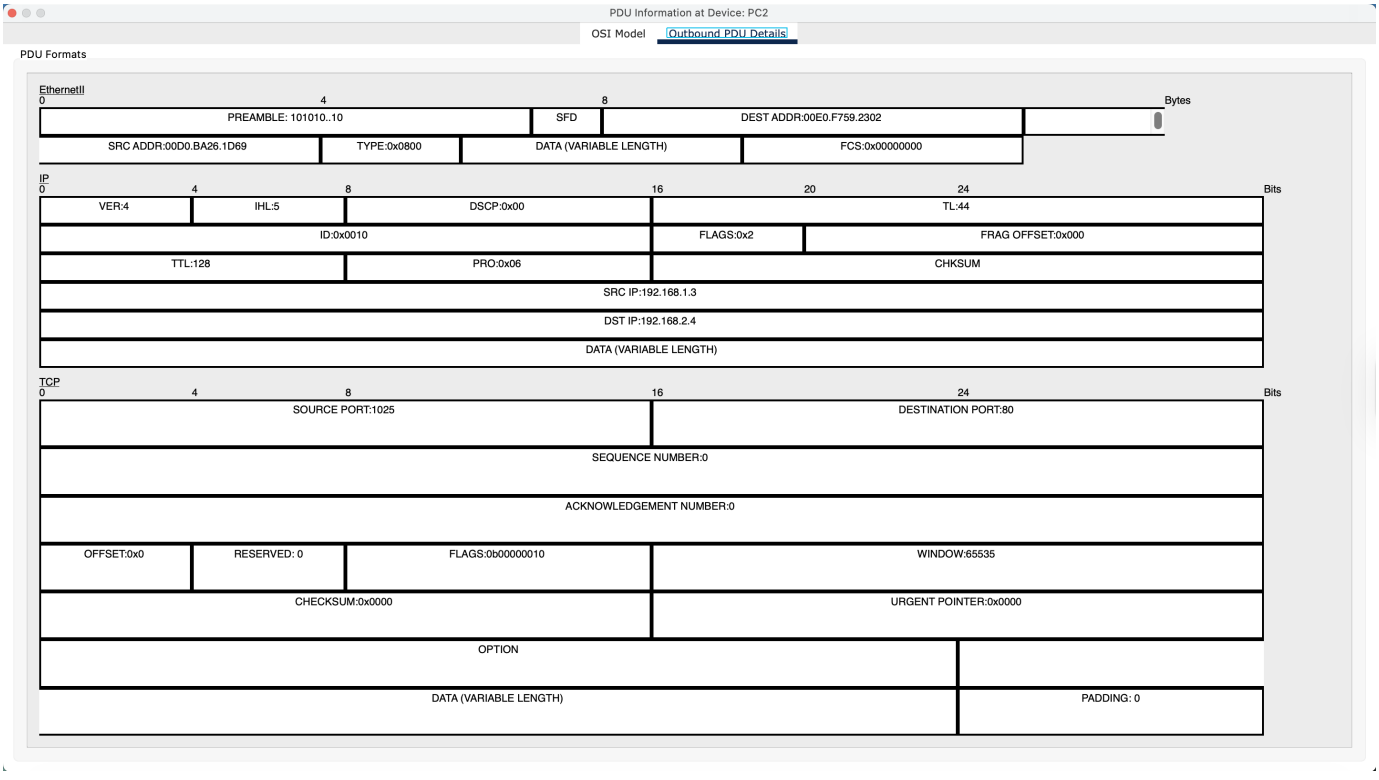
- Layer: 1
- Protocol: DNS, UDP
- Device: PC2
- Source: 192.168.2.3
- Destination: 192.168.1.3
- Destination Port: 1025
- Query; Name: uidaho
- DNS Answer; IP: 192.168.2.4



8.2 TCP Connection to the uidaho Web Server

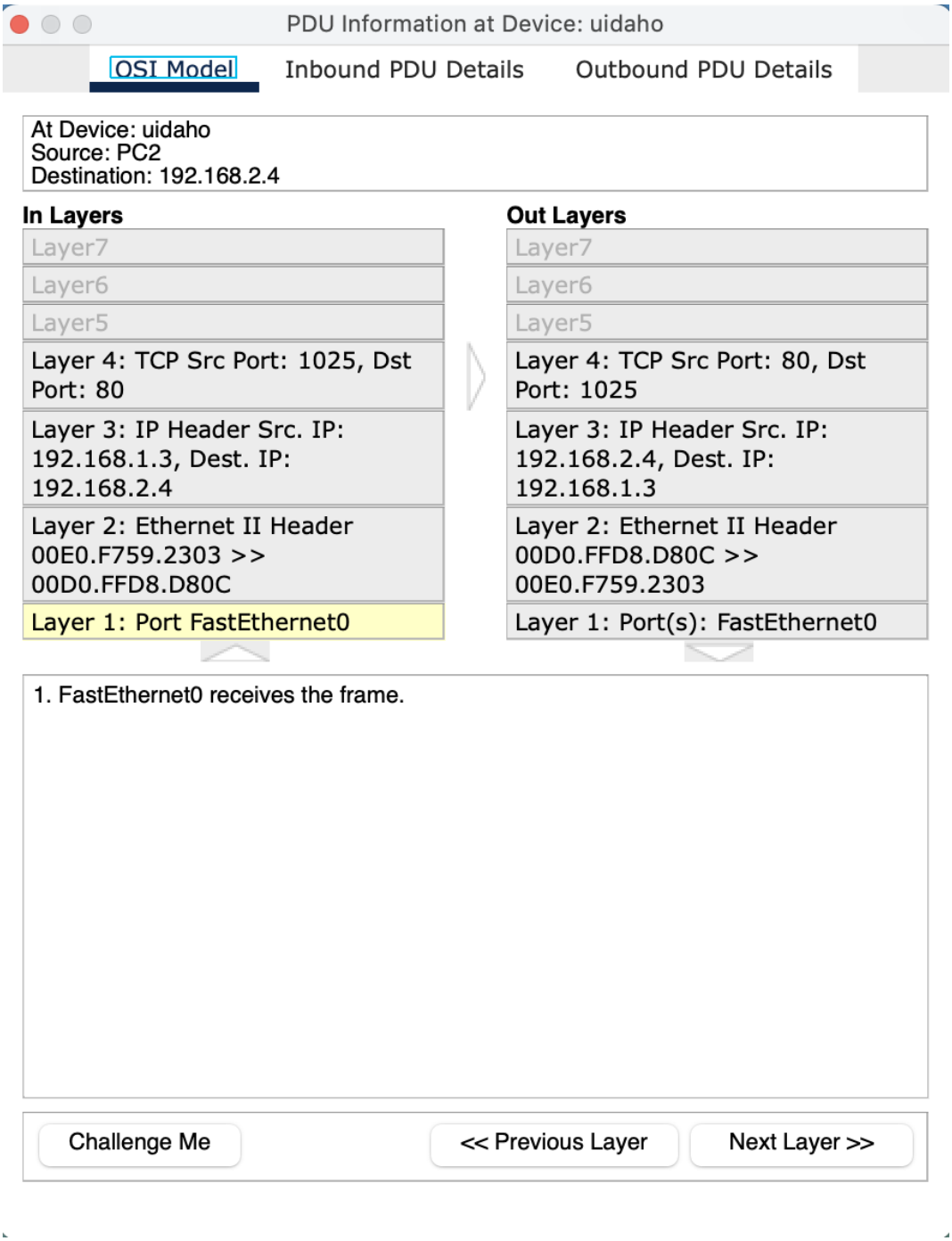
8.2.1 PC TCP Request to the uidaho Server - Outbound

- Layer: 1
- Protocol: TCP
- Device: PC2
- Source: 192.168.1.3
- Destination: 192.168.2.4
- Destination Port: 80
- Sequence Number: 0
- Acknowledgment Number: 0



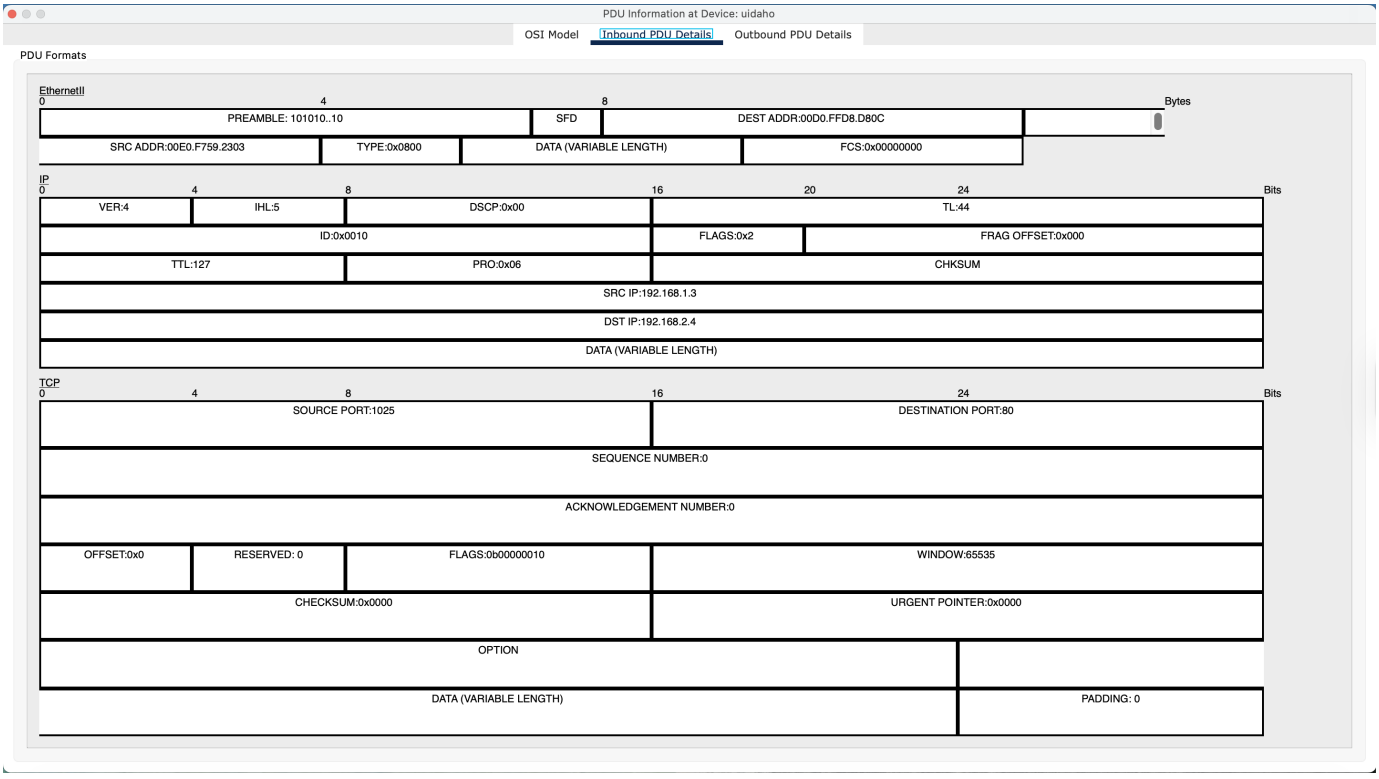
8.2.2 uidaho TCP Connection with the PC - OSI

- Layer: 1
- Protocol: TCP
- Device: uidaho



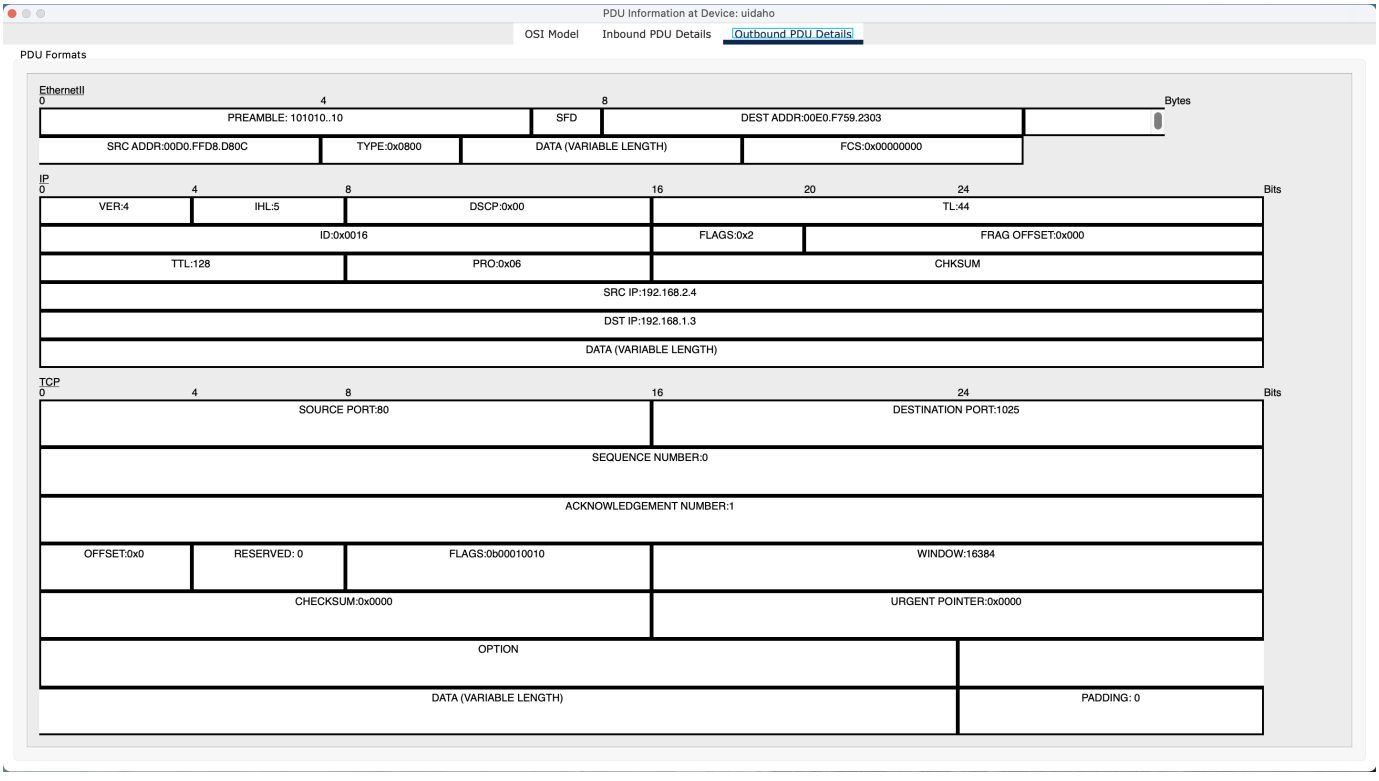
8.2.3 uidaho TCP Connection with the PC - Inbound

- Layer: 1
- Protocol: TCP
- Device: uidaho
- Source: 192.168.1.3
- Destination: 192.168.2.4
- Destination Port: 80
- Sequence Number: 0
- Acknowledgment Number: 0



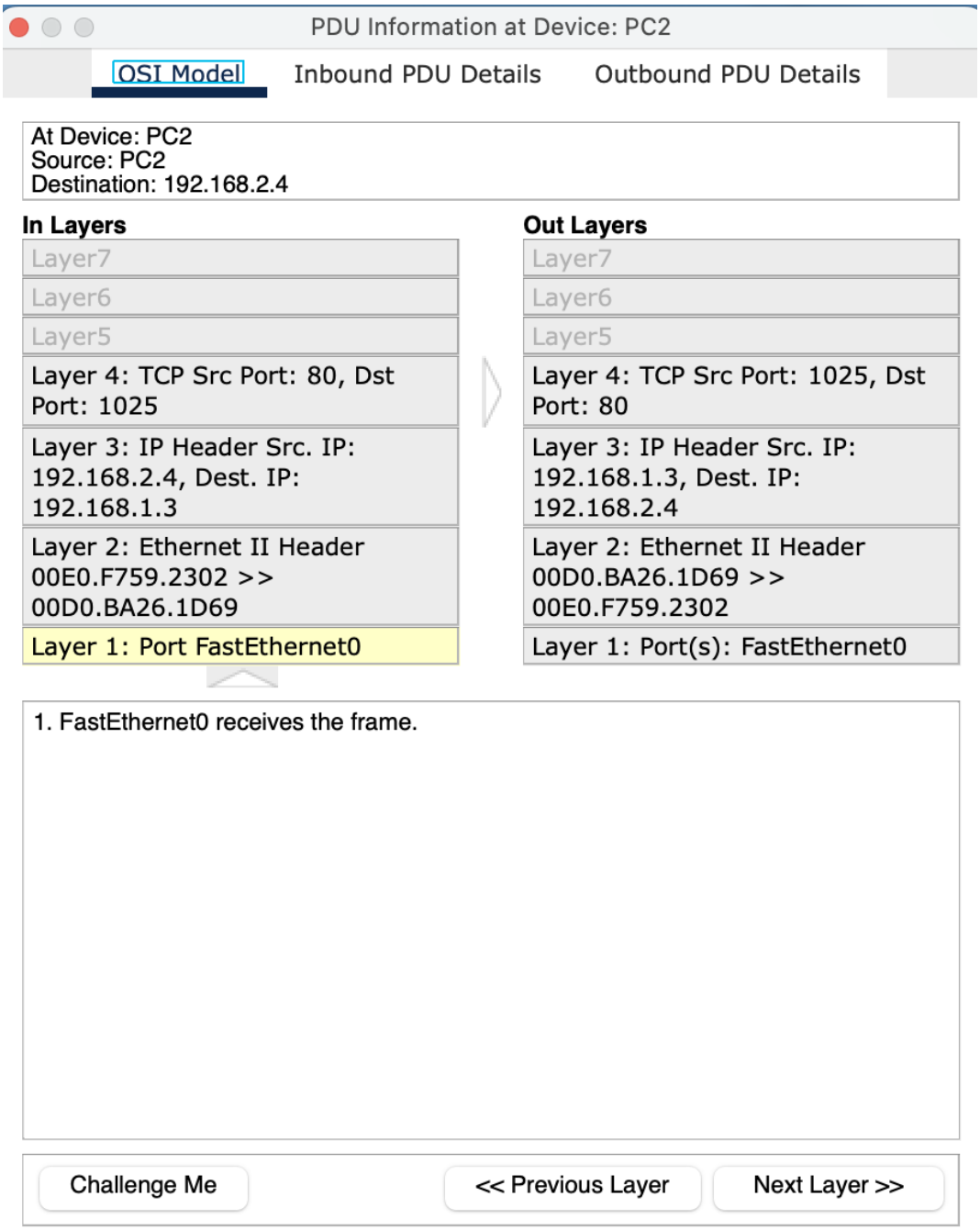
8.2.4 uidaho TCP Connection with the PC - Outbound

- Layer: 1
- Protocol: TCP
- Device: uidaho
- Source: 192.168.2.4
- Destination: 192.168.1.3
- Destination Port: 1025
- Sequence Number: 0
- Acknowledgment Number: 1



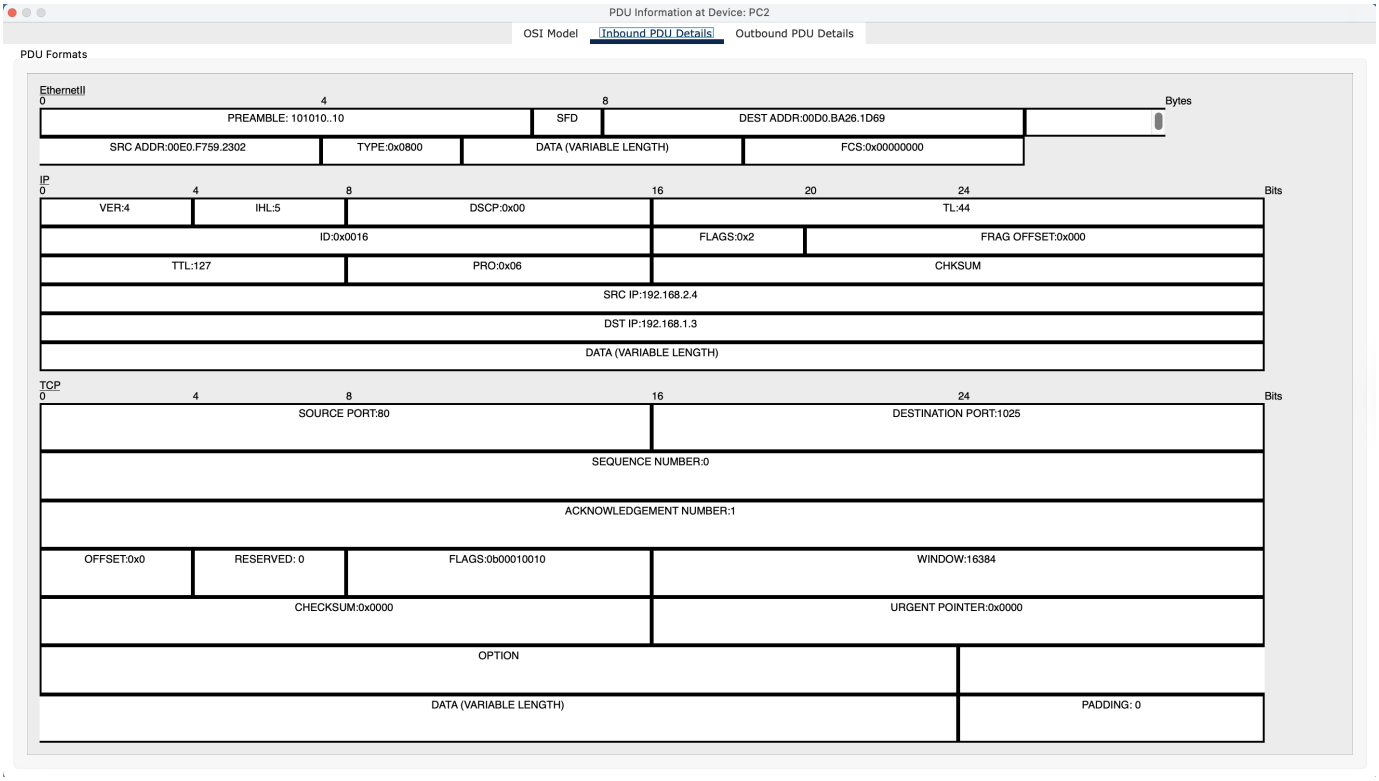
8.2.5 PC TCP Response from the uidaho Server - OSI

- Layer: 1
- Protocol: TCP
- Device: PC2



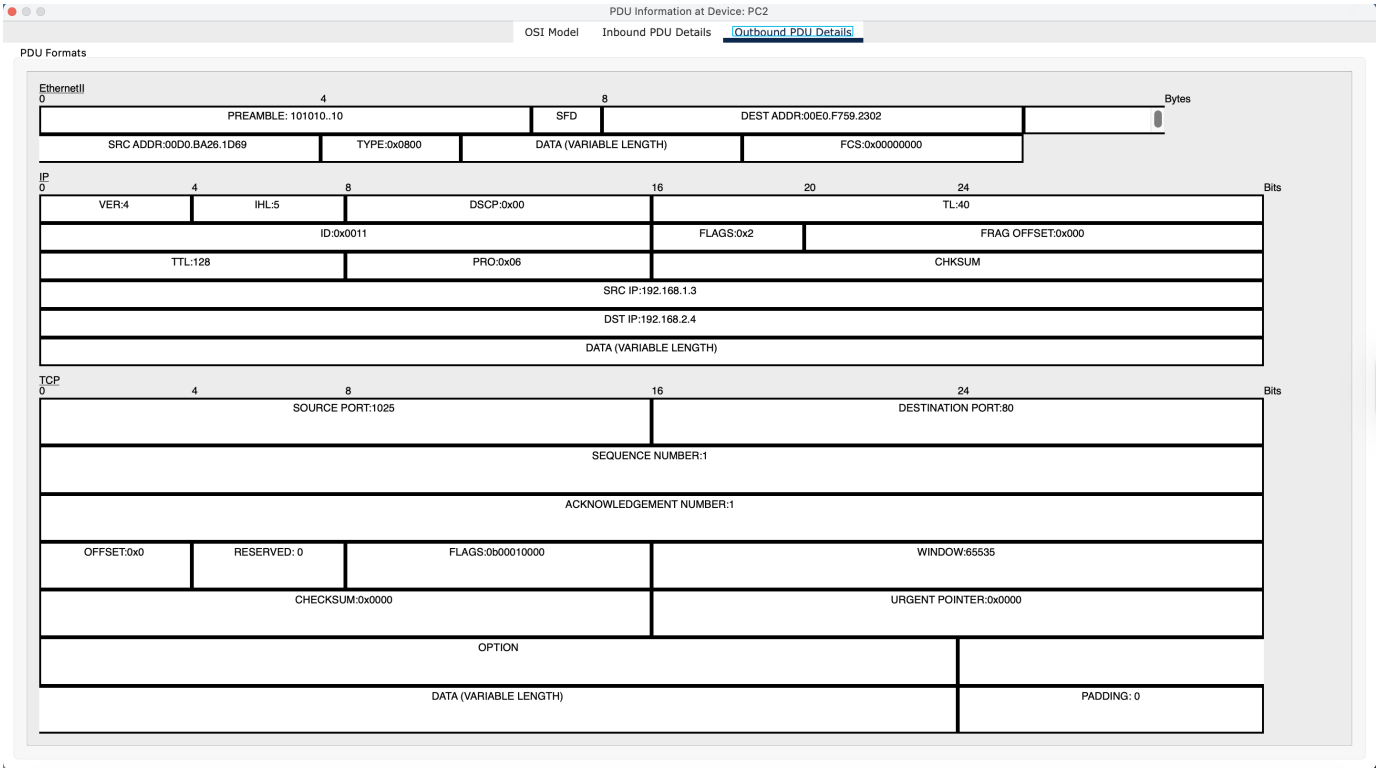
8.2.6 PC TCP Response from the uidaho Server - Inbound

- Layer: 1
- Protocol: TCP
- Device: PC2
- Source: 192.168.2.4
- Destination: 192.168.1.3
- Destination Port: 1025
- Sequence Number: 0
- Acknowledgment Number: 1



8.2.7 PC TCP Response from the uidaho Server - Outbound

- Layer: 1
- Protocol: TCP
- Device: PC2
- Source: 192.168.1.3
- Destination: 192.168.2.4
- Destination Port: 80
- Sequence Number: 1
- Acknowledgment Number: 1



9 Conclusion

This project successfully demonstrated the design and simulation of a functional multi-subnet network incorporating DHCP, DNS, and web services. Through configuring the router, servers, and end devices, the network was able to dynamically assign IP addresses, resolve domain names, and establish client access to the web server. Comprehensive testing—such as inter-PC pings, DNS resolution, and the full TCP handshake—confirmed that communication between devices and services functioned as intended. Inspecting outbound and inbound PDUs further reinforced an understanding of how packets traverse the network stack and how each OSI layer contributes to reliable data delivery. Overall, the project strengthened practical networking skills and provided insight into how foundational network services interact within a real-world topology.