

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.

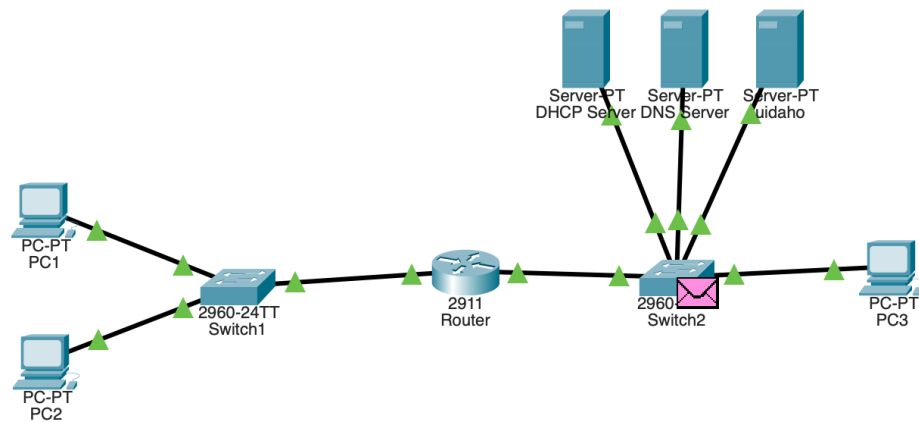
Additionally, this project emphasizes understanding packet flow by inspecting Protocol Data Units (PDUs) for both outbound and inbound traffic. Through analyzing PDUs, we gain insight into how data is encapsulated, transmitted, and processed across the network layers.

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

The screenshot shows a window titled "DHCP Server" with a tabbed interface. The "Desktop" tab is selected, showing the "IP Configuration" section. This section has a blue header bar with a close button (X). Below the header, there are three main configuration areas: IP Configuration, IPv6 Configuration, and 802.1X. The IP Configuration area has radio buttons for "DHCP" (unselected) and "Static" (selected). It includes text fields for IPv4 Address (192.168.2.2), Subnet Mask (255.255.255.0), Default Gateway (192.168.2.1), and DNS Server (192.168.2.3). The IPv6 Configuration area has radio buttons for "Automatic" (unselected) and "Static" (selected). It includes text fields for IPv6 Address (empty), Link Local Address (FE80::260:47FF:FEE4:AA2C), Default Gateway (empty), and DNS Server (empty). The 802.1X section has a checkbox for "Use 802.1X Security" (unchecked), a dropdown menu for "Authentication" (MD5), and text fields for "Username" and "Password". At the bottom left, there is a "Top" button.

DHCP Server

Physical Config Services **Desktop** Programming Attributes

IP Configuration X

IP Configuration

☐ DHCP ☒ Static

IPv4 Address 192.168.2.2

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::260:47FF:FEE4:AA2C

Default Gateway

DNS Server

802.1X

☐ Use 802.1X Security

Authentication MD5

Username

Password

☐ Top

3.2 DHCP Server Address Pools Configuration

SERVICES

- HTTP
- DHCP**
- DHCPv6
- TFTP
- DNS
- SYSLOG
- AAA
- NTP
- EMAIL
- FTP
- IoT
- VM Management
- Radius EAP

DHCP

Interface: FastEthernet0 Service: ☒ On ☐ Off

Pool Name: serverPool

Default Gateway: 192.168.1.1

DNS Server: 192.168.2.3

Start IP Address : 192 168 1 2

Subnet Mask: 255 255 255 0

Maximum Number of Users : 60

TFTP Server: 0.0.0.0

WLC Address: 0.0.0.0

Pool Name	Default Gateway	DNS Server	Start IP Address	Subnet Mask	Max User	TFTP Server	WLC Address
serverPool2	192.168.2.1	192.168.2.3	192.168.2.2	255.255.255.0	60	0.0.0.0	0.0.0.0
serverPool	192.168.1.1	192.168.2.3	192.168.1.2	255.255.255.0	60	0.0.0.0	0.0.0.0

☐ Top

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

DNS Server

PhysicalConfigServicesDesktopProgrammingAttributes

IP Configuration

X

IP Configuration

☐ DHCP

☒ Static

IPv4 Address

192.168.2.3

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::203:E4FF:FE84:8219

Default Gateway

DNS Server

802.1X

☐ Use 802.1X Security

Authentication

MD5

Username

Password

☐ Top

4.2 DNS Services Configuration

DNS Server

PhysicalConfig**Services**DesktopProgrammingAttributes

SERVICES

HTTP

DHCP

DHCPv6

TFTP

DNS

SYSLOG

AAA

NTP

EMAIL

FTP

IoT

VM Management

Radius EAP

DNS

DNS Service

☒ On

☐ Off

Resource Records

NameType

A Record

Address

Add

Save

Remove

No.	Name	Type	Detail
0	uidaho	A Record	192.168.2.4

DNS Cache

☐ Top

5 Web Server Setup

5.1 uidaho IP Address Configuration

The screenshot shows a web browser window titled "uidaho" with a navigation bar containing tabs: Physical, Config, Services, Desktop (selected), Programming, and Attributes. Below the navigation bar is a blue header for "IP Configuration" with a close button (X). The main content area is divided into three sections: IP Configuration, IPv6 Configuration, and 802.1X.

IP Configuration

☐ DHCP ☒ Static

IPv4 Address: 192.168.2.4

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::2D0:FFFF:FED8:D80C

Default Gateway:

DNS Server:

802.1X

☐ Use 802.1X Security

Authentication: MD5

Username:

Password:

☐ Top

6 PCs IP Addresses Configurations

Done by the DHCP protocol (post DHCP configuration).

6.1 PC1

The screenshot shows the 'PC1' configuration window with the 'Desktop' tab selected. The 'IP Configuration' section is active, showing the 'FastEthernet0' interface. The 'DHCP' option is selected for IP Configuration, and the 'Static' option is selected for IPv6 Configuration. The IPv4 Address is 192.168.1.2, Subnet Mask is 255.255.255.0, Default Gateway is 192.168.1.1, and DNS Server is 192.168.2.3. The IPv6 Address is empty, Link Local Address is FE80::290:CFF:FE0E:848A, Default Gateway is empty, and DNS Server is empty. The 802.1X section shows 'Use 802.1X Security' is unchecked, Authentication is MD5, Username is empty, and Password is empty. A 'Top' button is at the bottom left.

PC1

Physical Config **Desktop** Programming Attributes

IP Configuration [X]

Interface: FastEthernet0 [v]

IP Configuration

☒ DHCP ☐ Static

IPv4 Address: 192.168.1.2

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::290:CFF:FE0E:848A

Default Gateway:

DNS Server:

802.1X

☐ Use 802.1X Security

Authentication: MD5 [v]

Username:

Password:

☐ Top

6.2 PC2

PC2

PhysicalConfigDesktopProgrammingAttributes

IP Configuration

InterfaceFastEthernet0

IP Configuration

☒ DHCP

☐ Static

IPv4 Address192.168.1.3

Subnet Mask255.255.255.0

Default Gateway192.168.1.1

DNS Server192.168.2.3

IPv6 Configuration

☐ Automatic

☒ Static

IPv6 Address /

Link Local AddressFE80::2D0:BAFF:FE26:1D69

Default Gateway

DNS Server

802.1X

☐ Use 802.1X Security

AuthenticationMD5

Username

Password

☐ Top

6.3 PC3

The screenshot shows a configuration window for a device named PC3. The window has a title bar with standard macOS window controls (red, yellow, green buttons) and a tabbed interface with tabs for Physical, Config, Desktop (selected), Programming, and Attributes. A blue header bar at the top of the main content area is labeled 'IP Configuration' with a close button (X) on the right. Below this header, there is a dropdown menu for 'Interface' currently set to 'FastEthernet0'. The main configuration area is divided into three sections: IP Configuration, IPv6 Configuration, and 802.1X. In the IP Configuration section, the 'DHCP' radio button is selected, and fields for IPv4 Address (192.168.2.5), Subnet Mask (255.255.255.0), Default Gateway (192.168.2.1), and DNS Server (192.168.2.3) are visible. In the IPv6 Configuration section, the 'Static' radio button is selected, and fields for IPv6 Address (empty), Link Local Address (FE80::2E0:F9FF:FED9:AE80), Default Gateway (empty), and DNS Server (empty) are visible. In the 802.1X section, the 'Use 802.1X Security' checkbox is unchecked, and fields for Authentication (MD5), Username (empty), and Password (empty) are visible. At the bottom left of the window, there is a 'Top' button with a small square icon next to it.

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:AE80

Default Gateway:

DNS Server:

802.1X

☐ Use 802.1X Security

Authentication: MD5

Username:

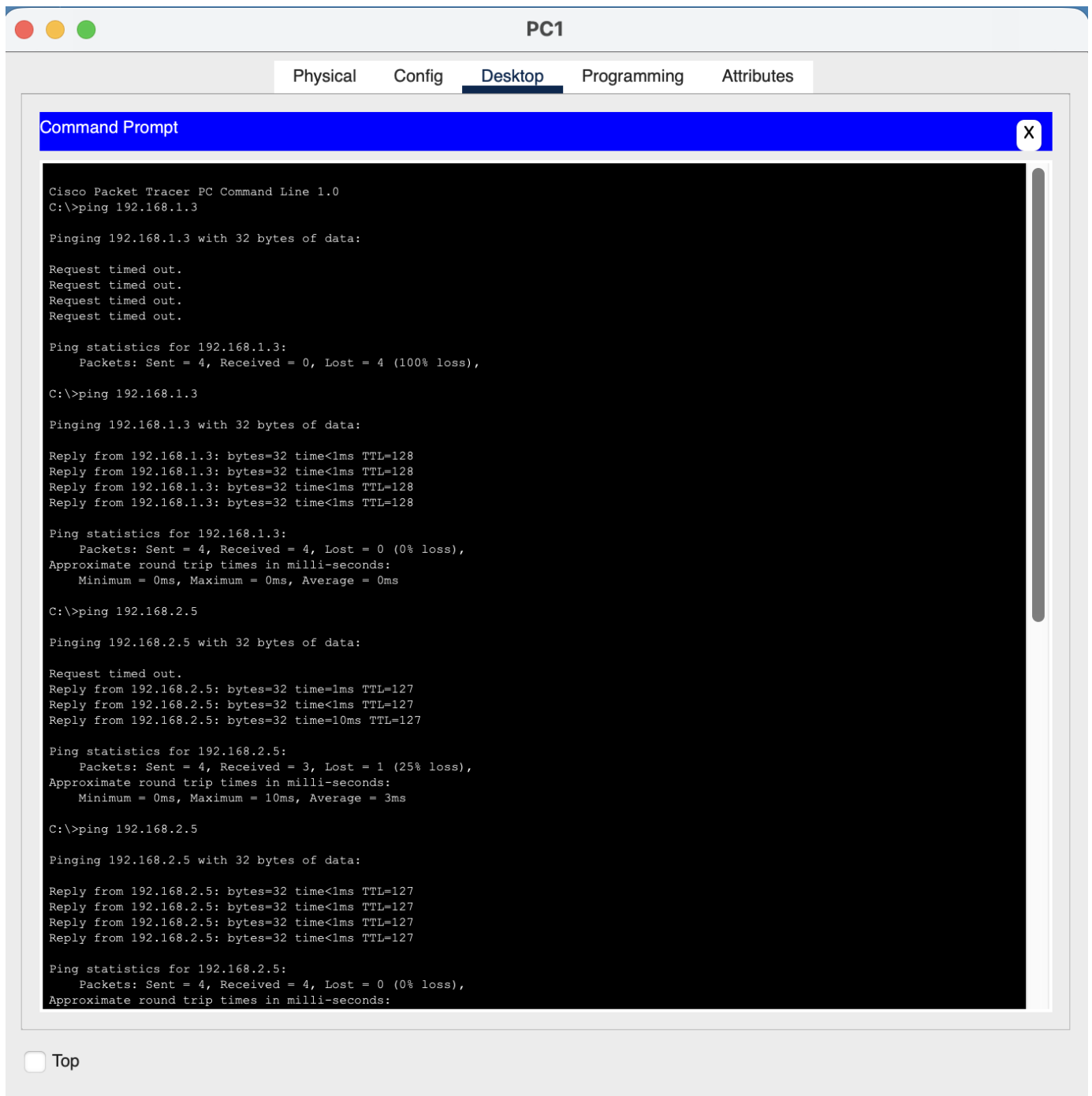
Password:

☐ 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

PhysicalConfigDesktopProgrammingAttributes

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:

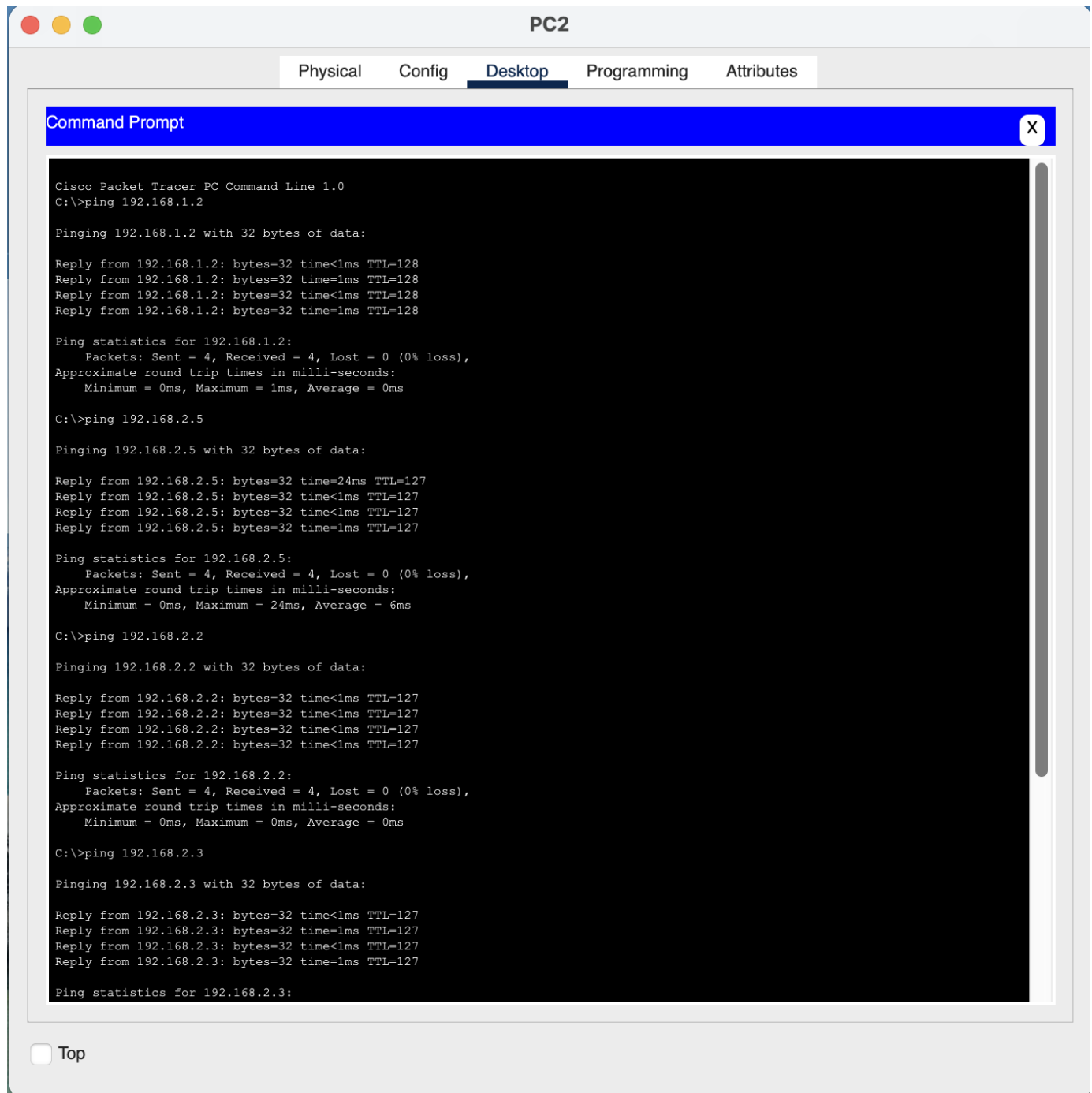
Reply from 192.168.2.4: bytes=32 time<1ms TTL=127
Reply from 192.168.2.4: bytes=32 time<1ms TTL=127
Reply from 192.168.2.4: bytes=32 time<1ms TTL=127
Reply from 192.168.2.4: bytes=32 time<1ms TTL=127

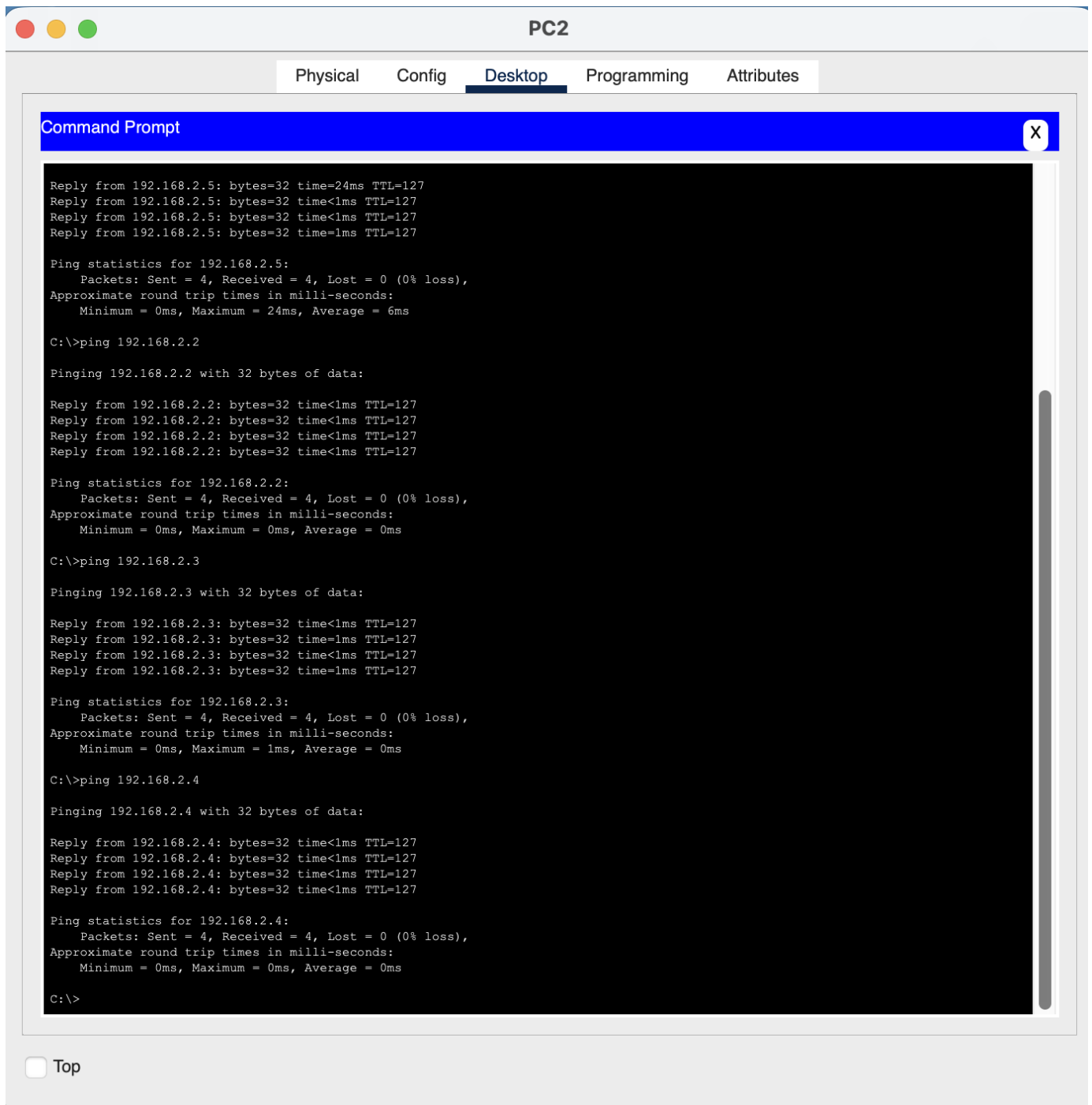
Ping statistics for 192.168.2.4:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

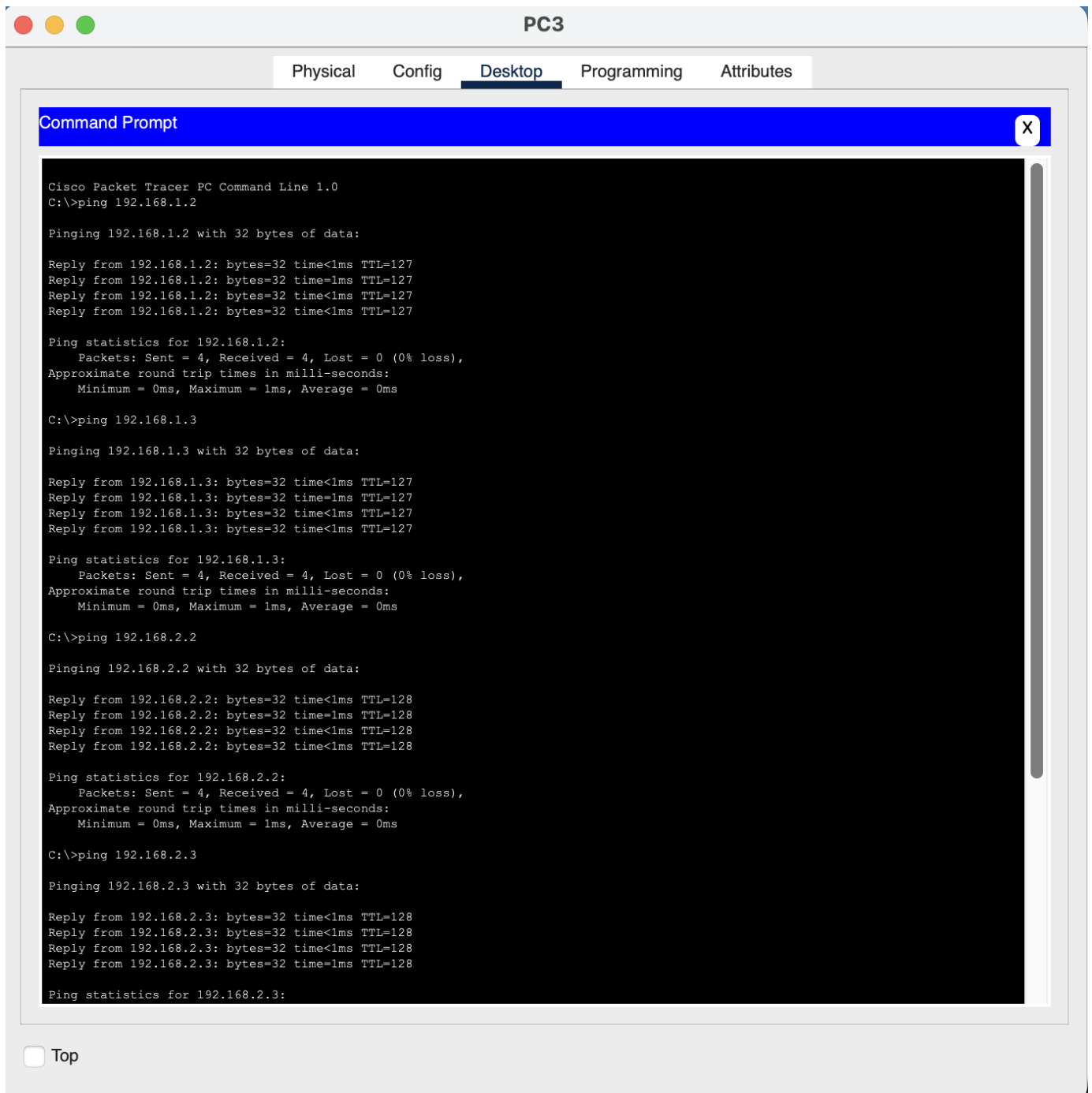
☐ Top

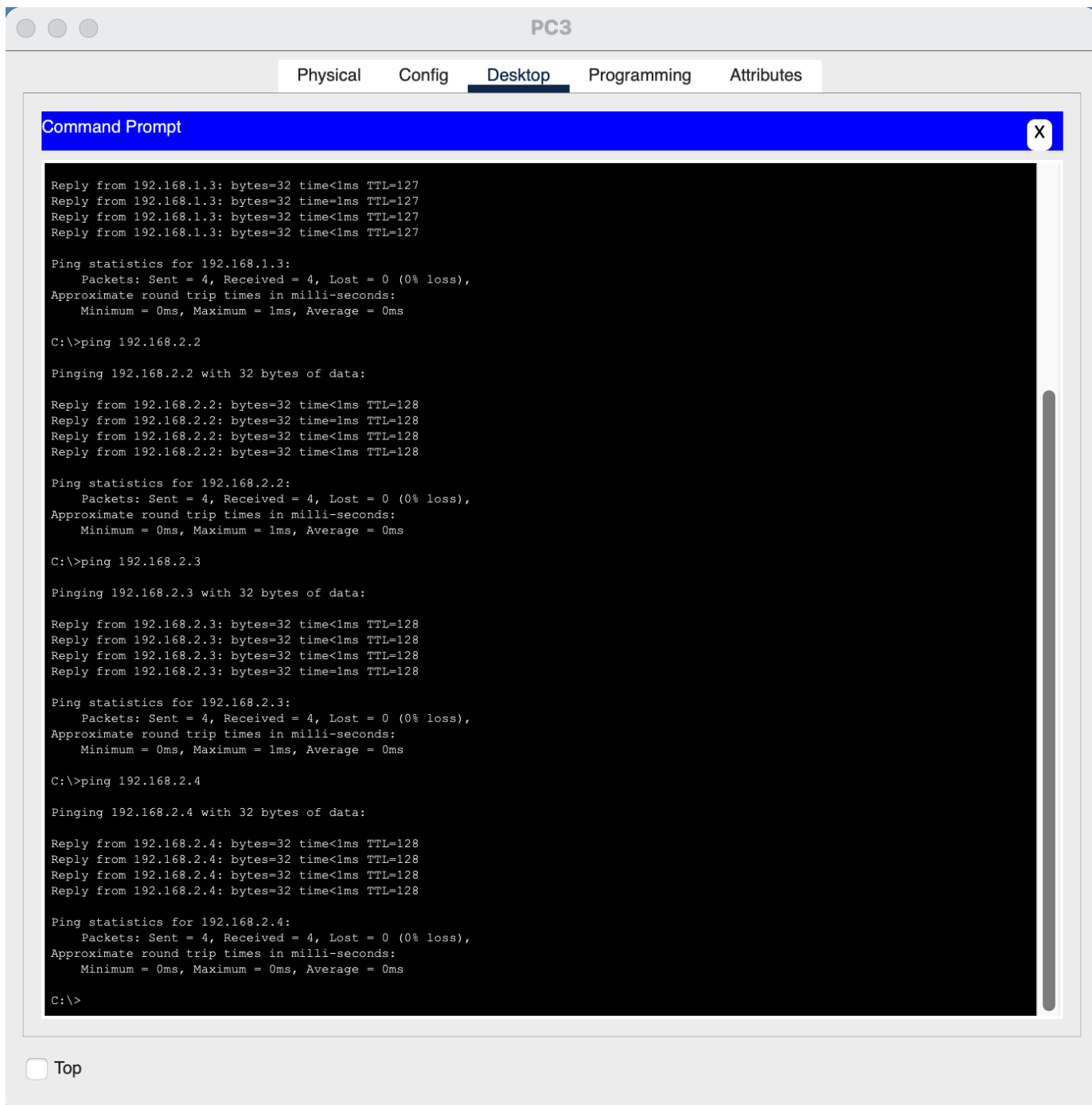
7.2 PC2





7.3 PC3





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

PDU Information at Device: PC2

OSI Model Outbound PDU Details

At Device: PC2
Source: PC2
Destination: 192.168.2.3

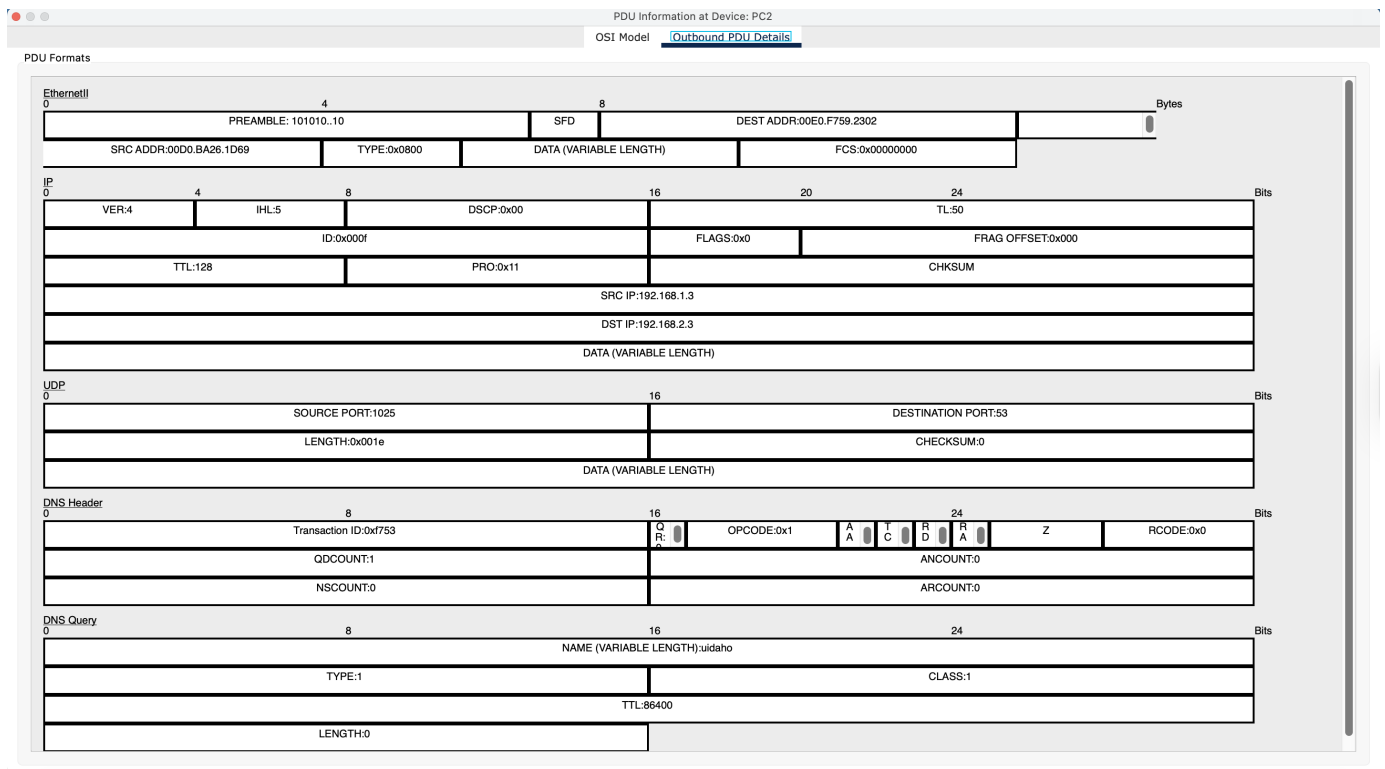
In Layers	Out Layers
Layer7	Layer 7: DNS
Layer6	Layer6
Layer5	Layer5
Layer4	Layer 4: UDP Src Port: 1025, Dst Port: 53
Layer3	Layer 3: IP Header Src. IP: 192.168.1.3, Dest. IP: 192.168.2.3
Layer2	Layer 2: Ethernet II Header 00D0.BA26.1D69 >> 00E0.F759.2302
Layer1	Layer 1: Port(s): FastEthernet0

1. The DNS client sends an A DNS query to the DNS server.

Challenge Me << Previous Layer Next Layer >>

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

PDU Information at Device: DNS Server

OSI Model

Inbound PDU Details

Outbound PDU Details

At Device: DNS Server
Source: PC2
Destination: 192.168.2.3

In Layers

Layer 7: DNS

Layer6

Layer5

Layer 4: UDP Src Port: 1025, Dst Port: 53

Layer 3: IP Header Src. IP: 192.168.1.3, Dest. IP: 192.168.2.3

Layer 2: Ethernet II Header 00E0.F759.2303 >> 0003.E4B4.8219

Layer 1: Port FastEthernet0

Out Layers

Layer 7: DNS

Layer6

Layer5

Layer 4: UDP Src Port: 53, Dst Port: 1025

Layer 3: IP Header Src. IP: 192.168.2.3, Dest. IP: 192.168.1.3

Layer 2: Ethernet II Header 0003.E4B4.8219 >> 00E0.F759.2303

Layer 1: Port(s): FastEthernet0

1. FastEthernet0 receives the frame.

Challenge Me

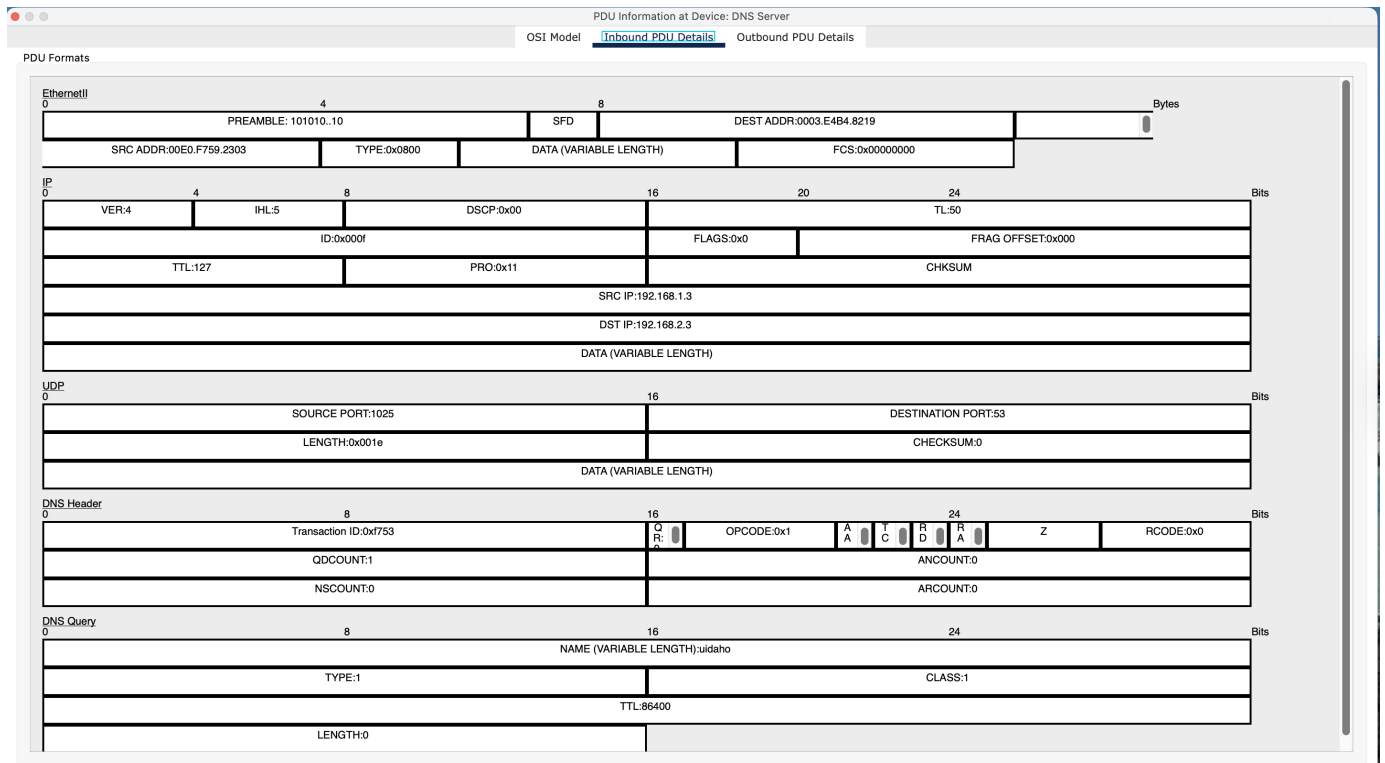
<< Previous Layer

Next Layer >>

22

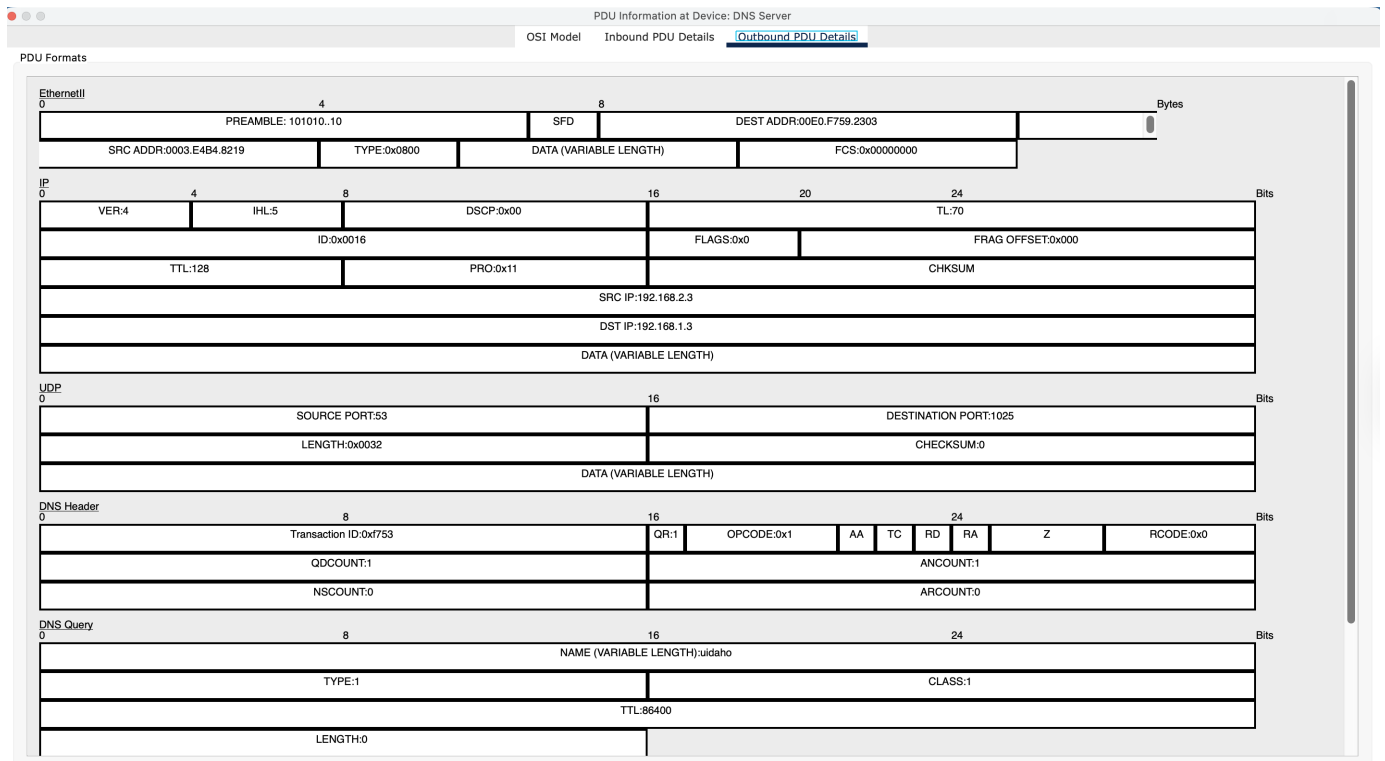
8.1.4 DNS Server DNS Request - Inbound

- 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

PDU Information at Device: PC2

OSI Model

Inbound PDU Details

At Device: PC2
Source: PC2
Destination: 192.168.2.3

In Layers

Layer 7: DNS

Layer6

Layer5

Layer 4: UDP Src Port: 53, Dst Port: 1025

Layer 3: IP Header Src. IP: 192.168.2.3, Dest. IP: 192.168.1.3

Layer 2: Ethernet II Header 00E0.F759.2302 >> 00D0.BA26.1D69

Layer 1: Port FastEthernet0

Out Layers

Layer7

Layer6

Layer5

Layer4

Layer3

Layer2

Layer1

1. FastEthernet0 receives the frame.

Challenge Me

<< Previous Layer

Next Layer >>

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

PDU Information at Device: PC2

OSI Model

[Inbound PDU Details](#)

PDU Formats

ID:0x000106		FLAGS:0x0	FRAG OFFSET:0x000	
TTL:127	PRO:0x11	CHKSUM		
SRC IP:192.168.2.3				
DST IP:192.168.1.3				
DATA (VARIABLE LENGTH)				

UDP		16	Bits
SOURCE PORT:53		DESTINATION PORT:1025	
LENGTH:0x0032		CHECKSUM:0	
DATA (VARIABLE LENGTH)			

DNS Header		8	16	24	Bits									
Transaction ID:0x753		Q	R	OPCODE:0x1	A	A	T	C	R	D	R	A	Z	RCODE:0x0
QDCOUNT:1		ANCOUNT:1												
NSCOUNT:0		ARCOUNT:0												

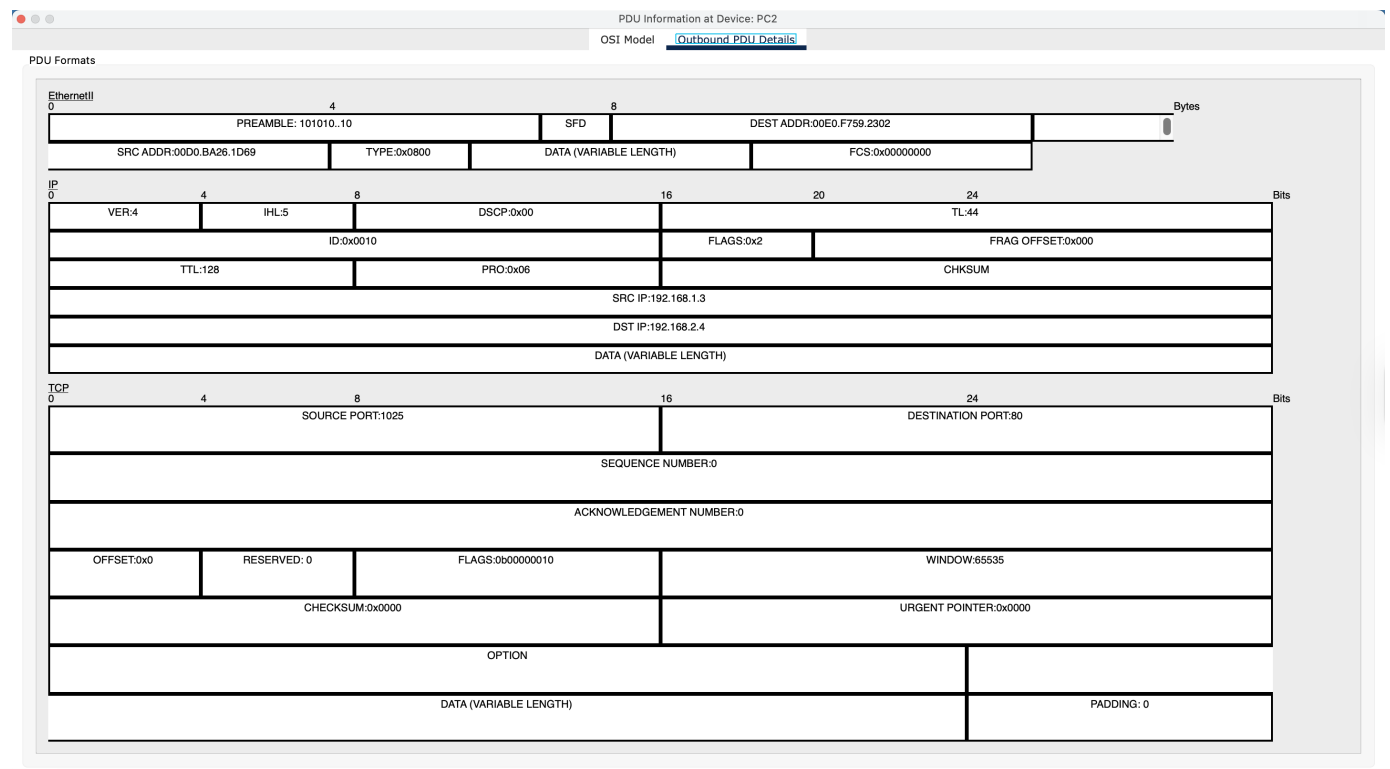
DNS Query		8	16	24	Bits
NAME (VARIABLE LENGTH):uidaho					
TYPE:1			CLASS:1		
TTL:86400					
LENGTH:0					

DNS Answer		8	16	24	Bits
NAME (VARIABLE LENGTH):uidaho					
TYPE:1			CLASS:1		
TTL:86400					
LENGTH:4			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

PDU Information at Device: uidaho

OSI Model

Inbound PDU Details

Outbound PDU Details

At Device: uidaho
Source: PC2
Destination: 192.168.2.4

Layer7

Layer6

Layer5

Layer 4: TCP Src Port: 1025, Dst Port: 80

Layer 3: IP Header Src. IP: 192.168.1.3, Dest. IP: 192.168.2.4

Layer 2: Ethernet II Header 00E0.F759.2303 >> 00D0.FFD8.D80C

Layer 1: Port FastEthernet0

Layer7

Layer6

Layer5

Layer 4: TCP Src Port: 80, Dst Port: 1025

Layer 3: IP Header Src. IP: 192.168.2.4, Dest. IP: 192.168.1.3

Layer 2: Ethernet II Header 00D0.FFD8.D80C >> 00E0.F759.2303

Layer 1: Port(s): FastEthernet0

1. FastEthernet0 receives the frame.

Challenge Me

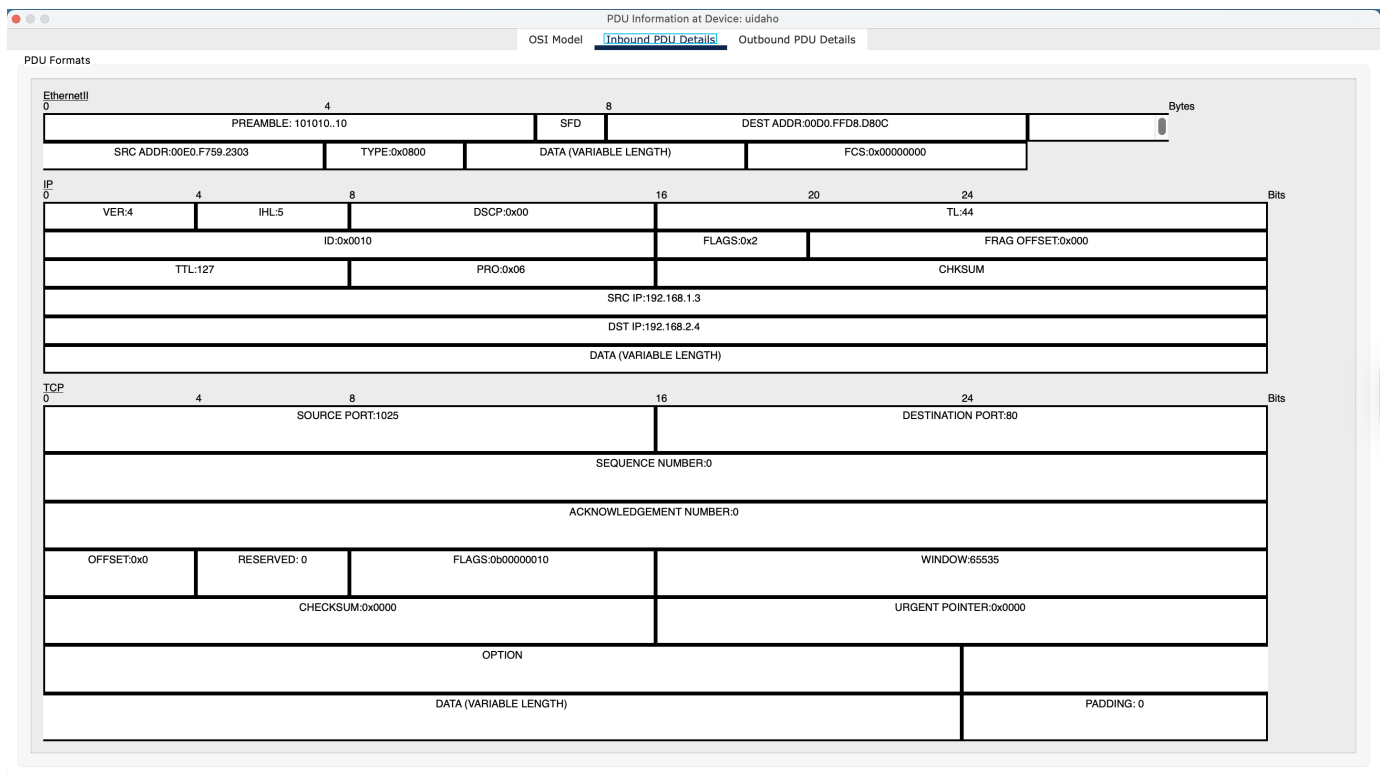
<< Previous Layer

Next Layer >>

28

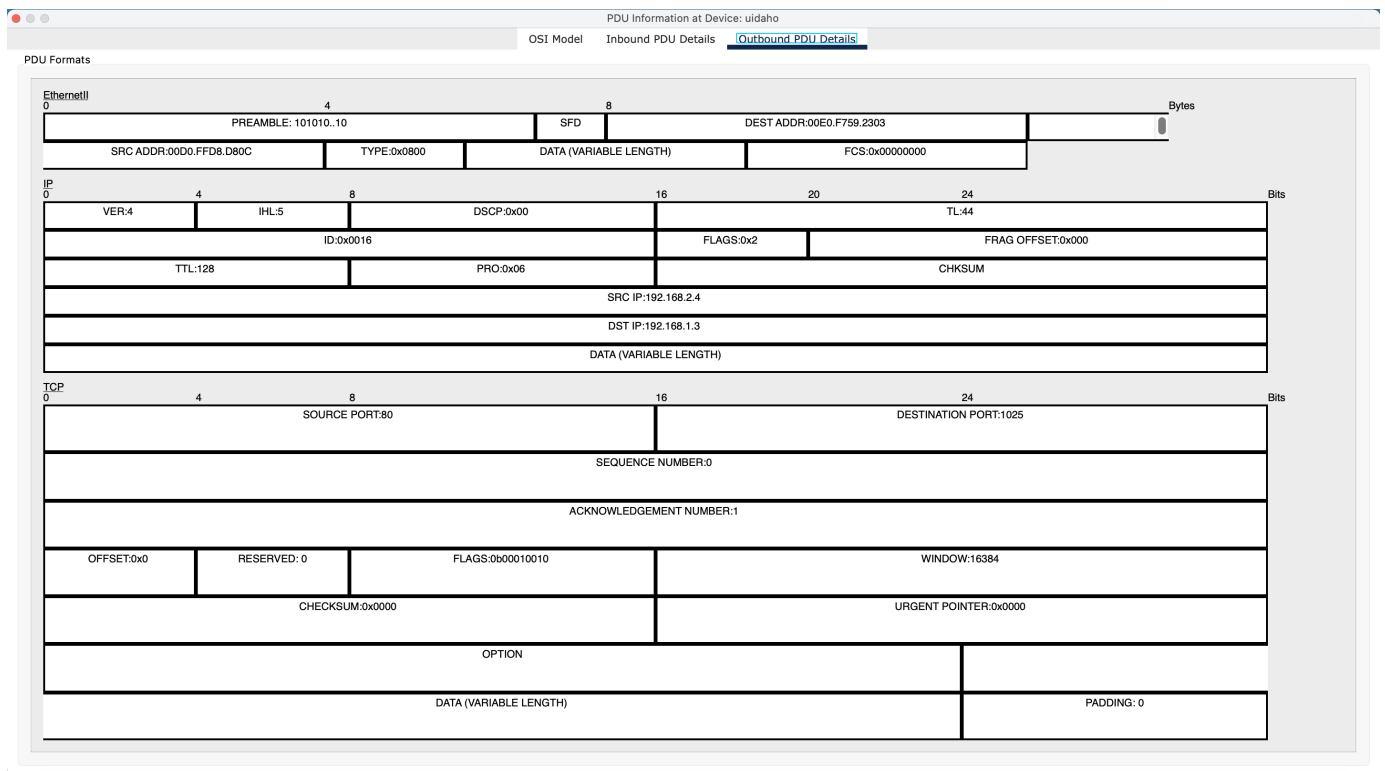
8.2.3 uidaho TCP Connection with the PC - Inbound

- 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

PDU Information at Device: PC2

OSI Model

Inbound PDU Details

Outbound PDU Details

At Device: PC2
Source: PC2
Destination: 192.168.2.4

In Layers

Layer7

Layer6

Layer5

Layer 4: TCP Src Port: 80, Dst Port: 1025

Layer 3: IP Header Src. IP: 192.168.2.4, Dest. IP: 192.168.1.3

Layer 2: Ethernet II Header 00E0.F759.2302 >> 00D0.BA26.1D69

Layer 1: Port FastEthernet0

Out Layers

Layer7

Layer6

Layer5

Layer 4: TCP Src Port: 1025, Dst Port: 80

Layer 3: IP Header Src. IP: 192.168.1.3, Dest. IP: 192.168.2.4

Layer 2: Ethernet II Header 00D0.BA26.1D69 >> 00E0.F759.2302

Layer 1: Port(s): FastEthernet0

1. FastEthernet0 receives the frame.

Challenge Me

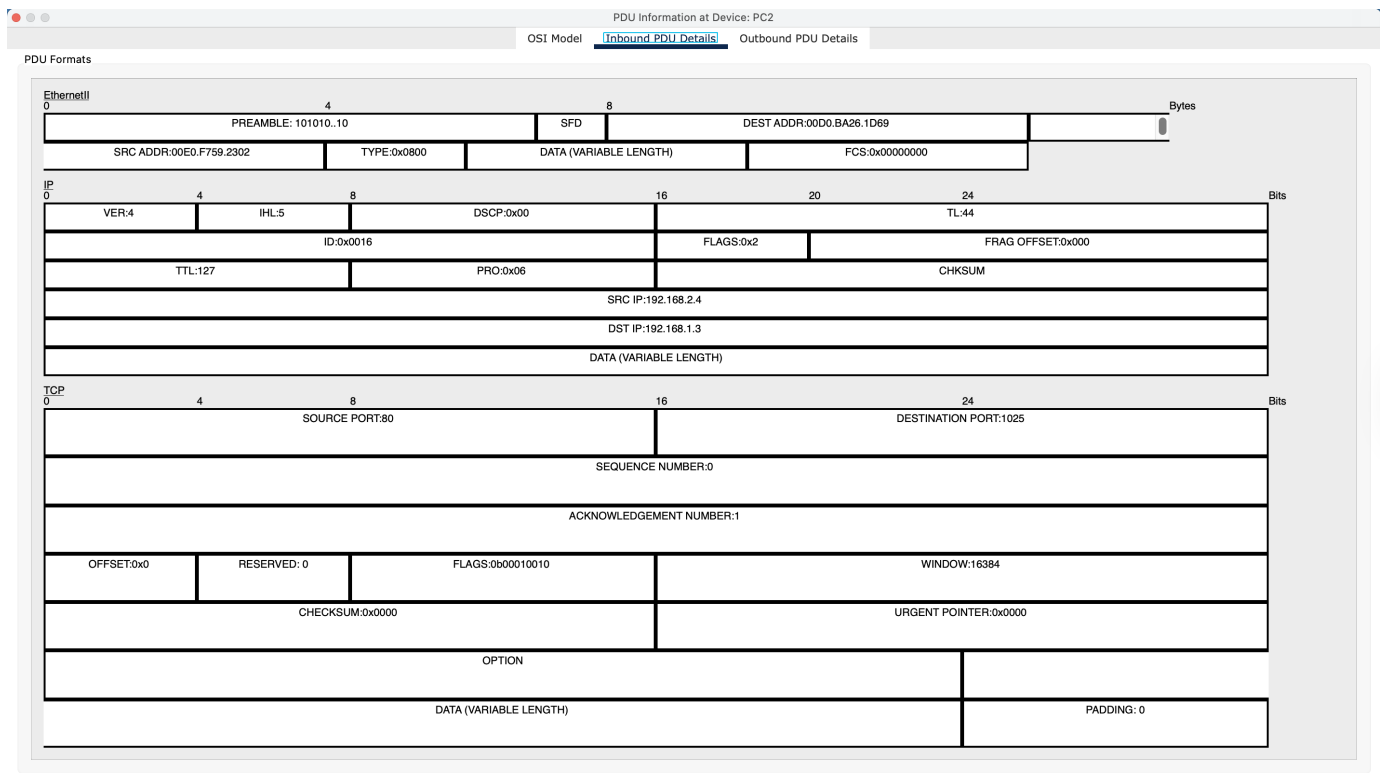
<< Previous Layer

Next Layer >>

31

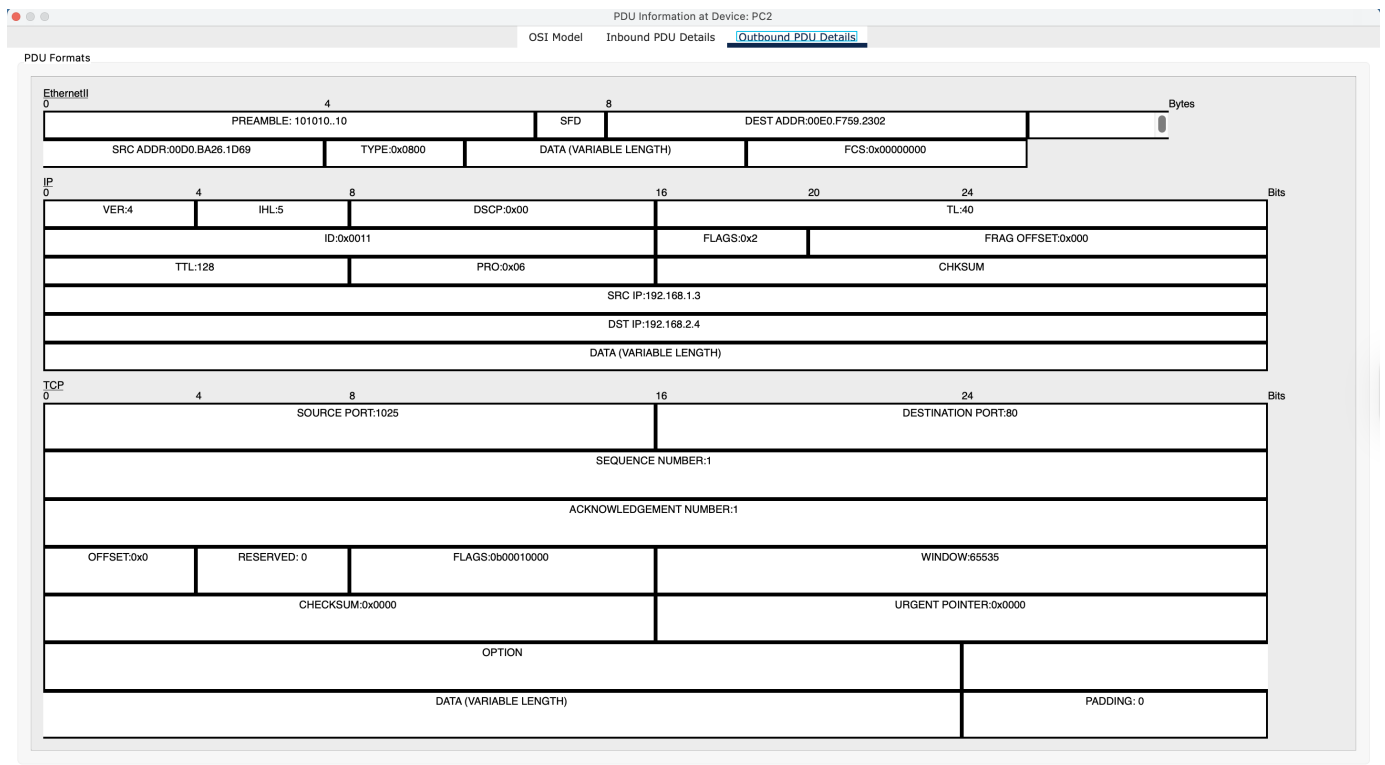
8.2.6 PC TCP Response from the uidaho Server - Inbound

- 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.