Lab 07
Course: Networks System Design
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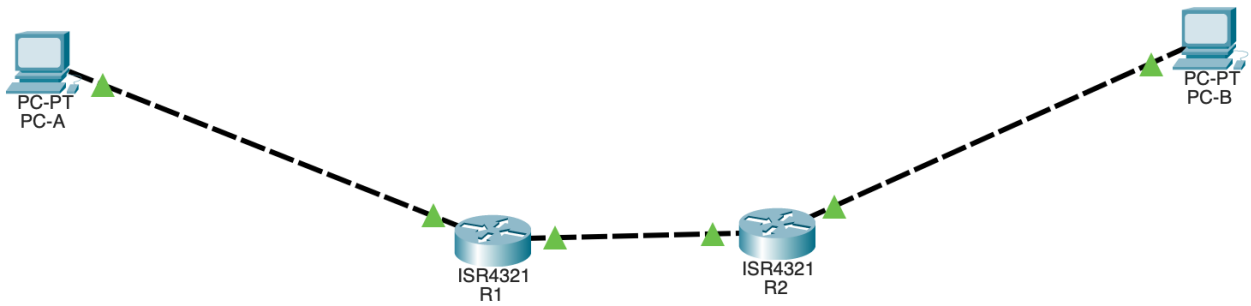
Instructor: Mr. Kuy Movsun
Due Date: Tuesday, 16 December 2025, 12:00 AM

Link to my GitHub: https://github.com/Do-Davin/Network-Lab.git

Part 1: Network Topology Setup

1.1 Devices Required

- Routers: 2× ISR4321/2911 (R1, R2)
- PCs: 2× PCs (PC-A, PC-B)



Cabling

From	To
PC-A NIC	R1 G0/0/0
R1 G0/0/1	R2 G0/0/0
R2 G0/0/1	PC-B NIC

1.2 Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
PC-A	NIC	192.168.1.10	255.255.255.0	192.168.1.1
R1	G0/0/0	192.168.1.1	255.255.255.0	N/A

Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	G0/0/1	10.0.0.1	255.255.255.252	N/A
R2	G0/0/0	10.0.0.2	255.255.255.252	N/A
R2	G0/0/1	192.168.2.1	255.255.255.0	N/A
PC-B	NIC	192.168.2.10	255.255.255.0	192.168.2.1

Router Interface Configuration

```
Router> enable
Router# configure terminal
Router(config)# interface g0/0/0
Router(config-if)# ip address [IP] [MASK]
Router(config-if)# no shutdown
```

Repeat for all interfaces according to the table.

Part 2: Data Plane & Forwarding Tables

2.1 Static Routing

Configure R1:

```
R1(config)# ip route 192.168.2.0 255.255.255.0 10.0.0.2
```

Configure R2:

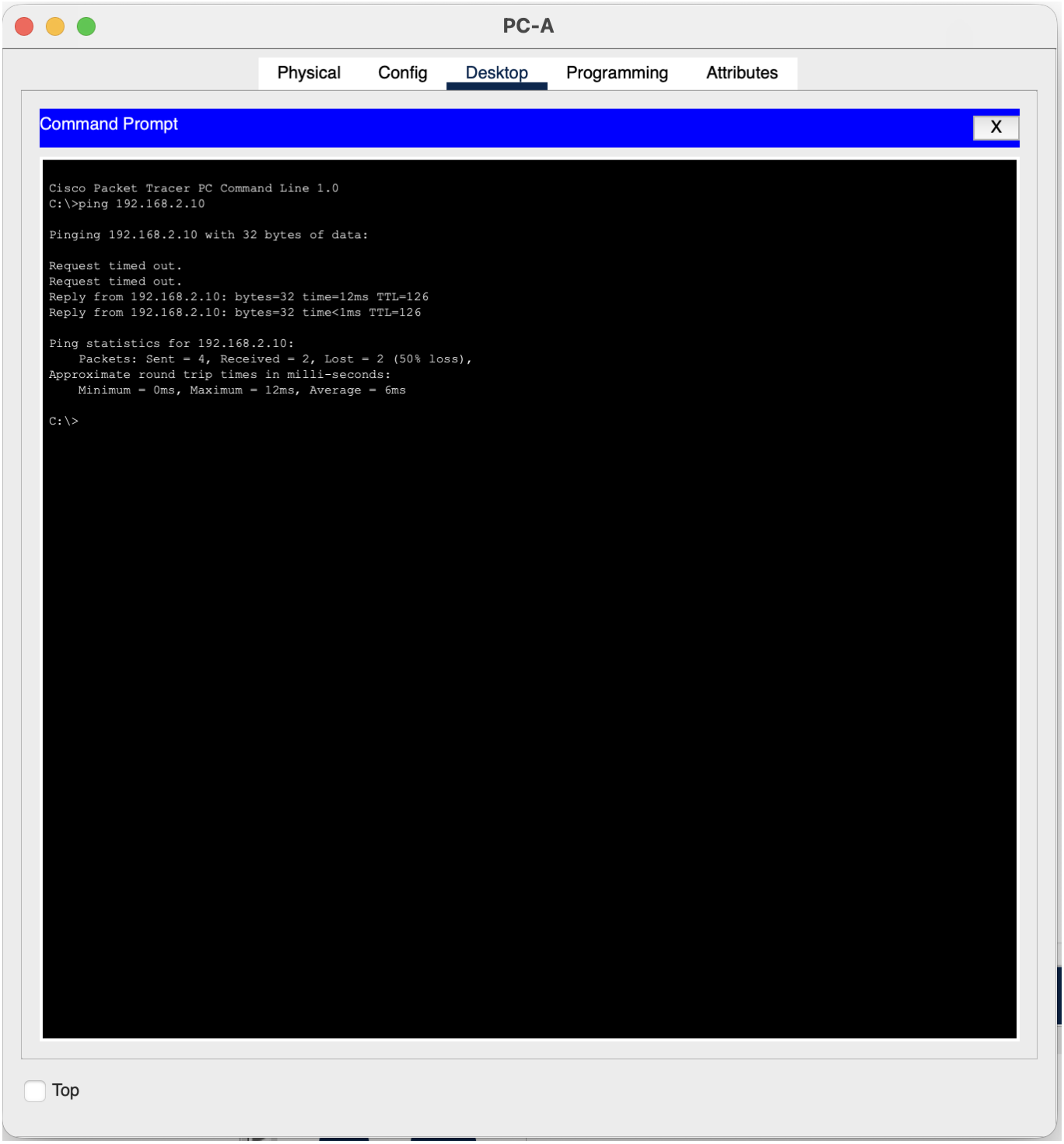
```
R2(config)# ip route 192.168.1.0 255.255.255.0 10.0.0.1
```

2.2 Connectivity Test

From PC-A

```
PC> ping 192.168.2.10
```

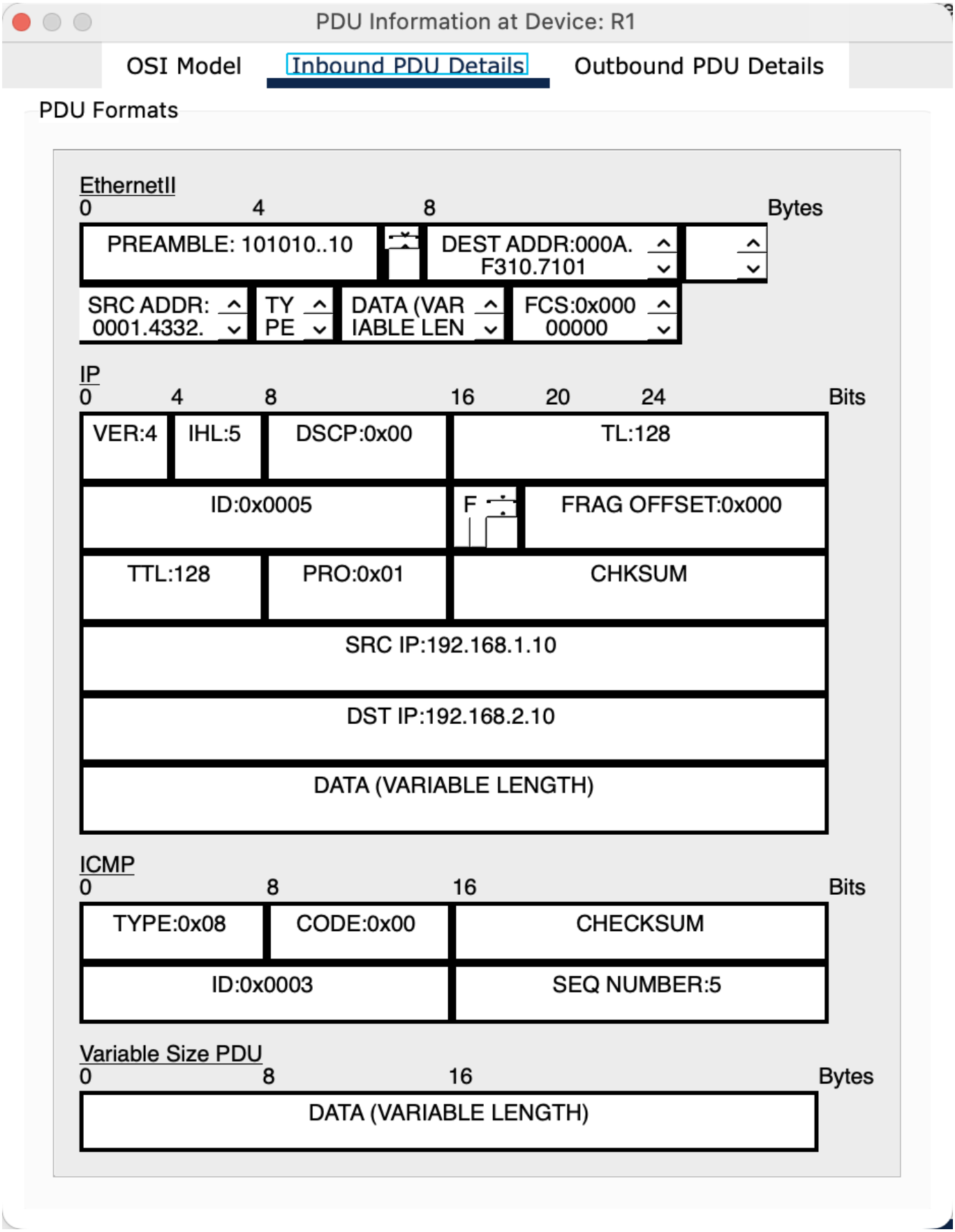
A few initial failures are normal due to ARP.

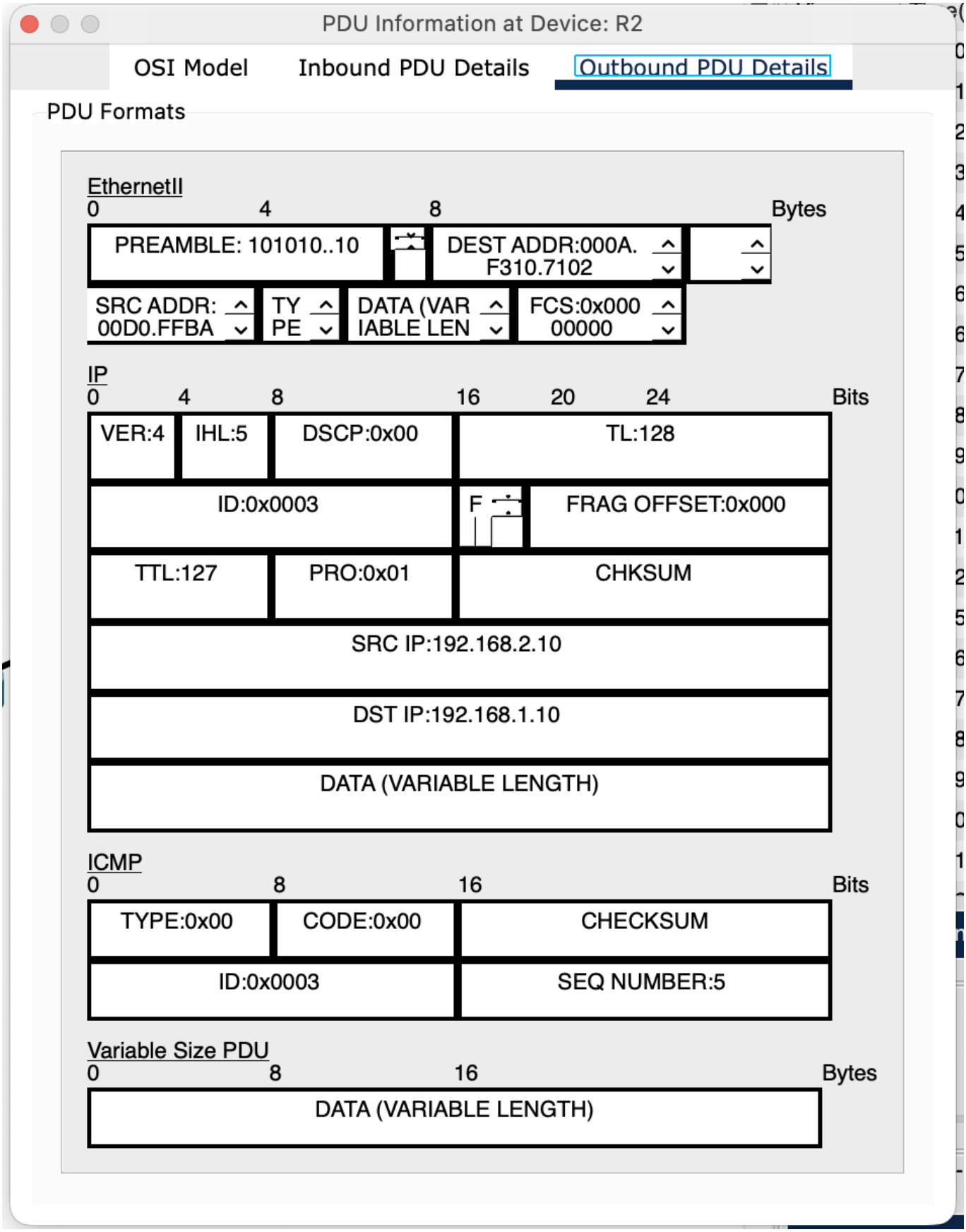


Part 3: Inspecting the IPv4 Header

3.1 Simulation Mode Steps

1. enter Simulation Mode
2. Filter for ICMP and IP
3. Ping PC-B again
4. Click Capture/Forward to move packets hop-by-hop


PDU Information at Device: R1
OSI Model
Inbound PDU Details
Outbound PDU Details
PDU Formats
EthernetII
0
4
8
Bytes
PREAMBLE: 101010..10
DEST ADDR:000A.F310.7101
SRC ADDR:0001.4332.
TY PE
DATA (VARIABLE LEN
FCS:0x00000000
IP
0
4
8
16
20
24
Bits
VER:4
IHL:5
DSCP:0x00
TL:128
ID:0x0005
F
FRAG OFFSET:0x000
TTL:128
PRO:0x01
CHKSUM
SRC IP:192.168.1.10
DST IP:192.168.2.10
DATA (VARIABLE LENGTH)
ICMP
0
8
16
Bits
TYPE:0x08
CODE:0x00
CHECKSUM
ID:0x0003
SEQ NUMBER:5
Variable Size PDU
0
8
16
Bytes
DATA (VARIABLE LENGTH)



3.2 Activity Questions

Activity Question 1

TTL at R1: Usually TTL = 128 or 64 (depends on OS).

TTL at R2: TTL is decremented by 1 (e.g., from 128 -> 127)

Why did it change?

Every router reduces TTL by 1 to prevent packets from looping forever.

Activity Question 2

Protocol value "1" = ICMP (Internet Control Message Protocol).

Why not TCP (6) or UDP (17)?

Because ping uses ICMP, not TCP/UDP.

Activity Question 3

Do source/Destination IP change between R1 -> R2?

No! IP addresses stay the same.

What changes?

The MAC addresses in the Ethernet frame are rewritten at every hop (Layer 2 behavior).

Part 4: IP Fragmentation Experiment

4.1 Lowering the MTU on R1

```
R1(config)# interface g0/0/1
R1(config-if)# ip mtu 500
```

Generating a Fragmented Packet

Use Add Complex PDU -> Click R1:

- Destination IP: 192.168.2.10
- Size: 1000 bytes
- Sequence: 1
- Mode: One Shot

4.3 Observing Fragmentation

Press Capture/Forward once.

Activity Question 4

How many envelopes do you see?

- You should see 2 fragements, because:
  - MTU = 500 bytes
  - Packet = 1000 bytes
  - Router splits it into two ~500-byte fragments.

Fragment 1 Header Observations

- Total Length ≈ 500 bytes
- More Fragments (MF) = 1
- Fragment Offset = 0

This indicates: “This is the first fragment; more are coming.”

Fragment 2 Header Observations

- More Fragments (MF) = 0 (final fragment)
- Fragment Offset > 0 (usually 60, 65, or similar depending on Packet Tracer block size)

Offset > 0 = “This fragment continues the previous one.”

Activity Question 5

Why is reassembly done at the destination (PC-B) instead of at R2?

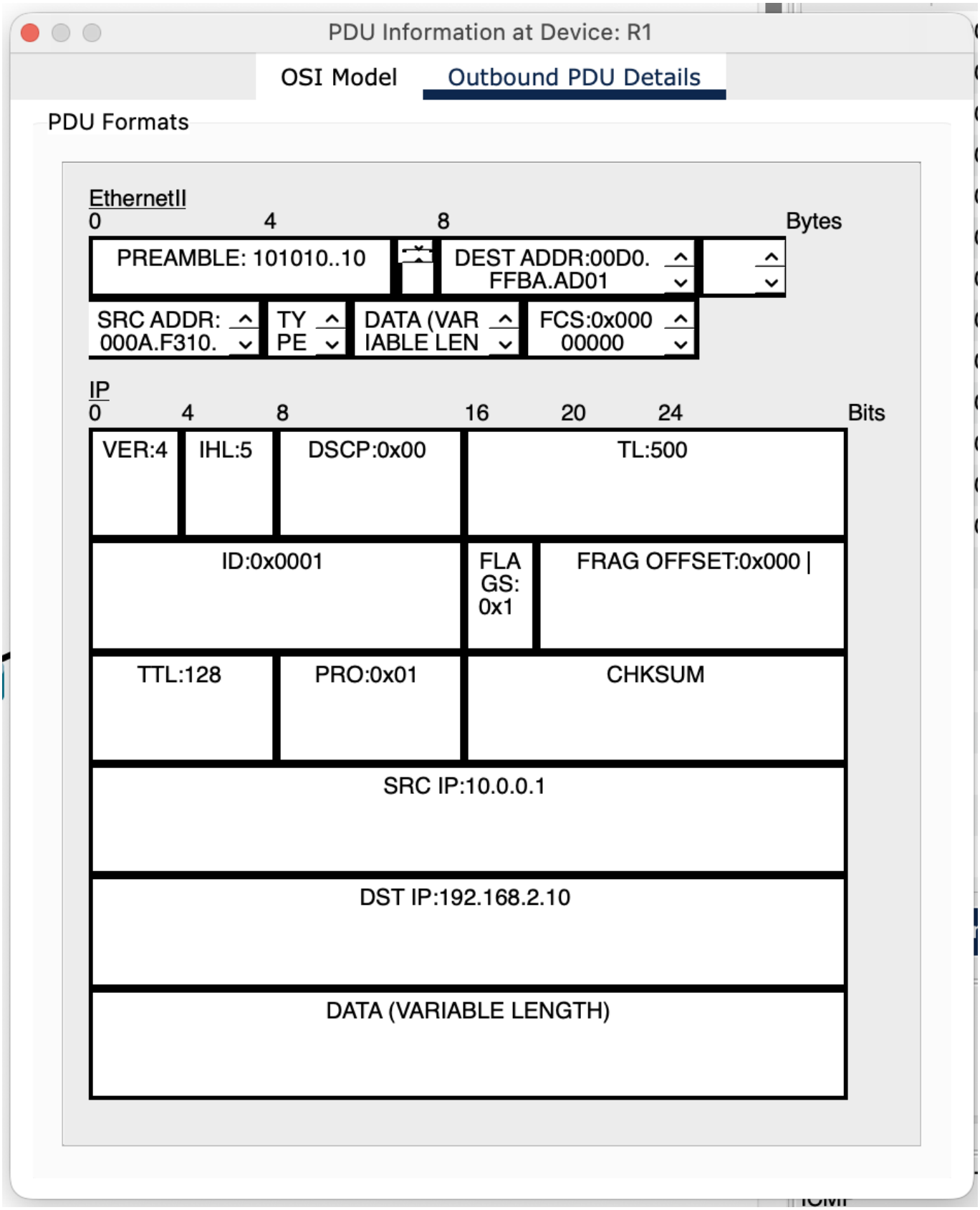
Because routers do NOT reassemble fragments. Reasons:

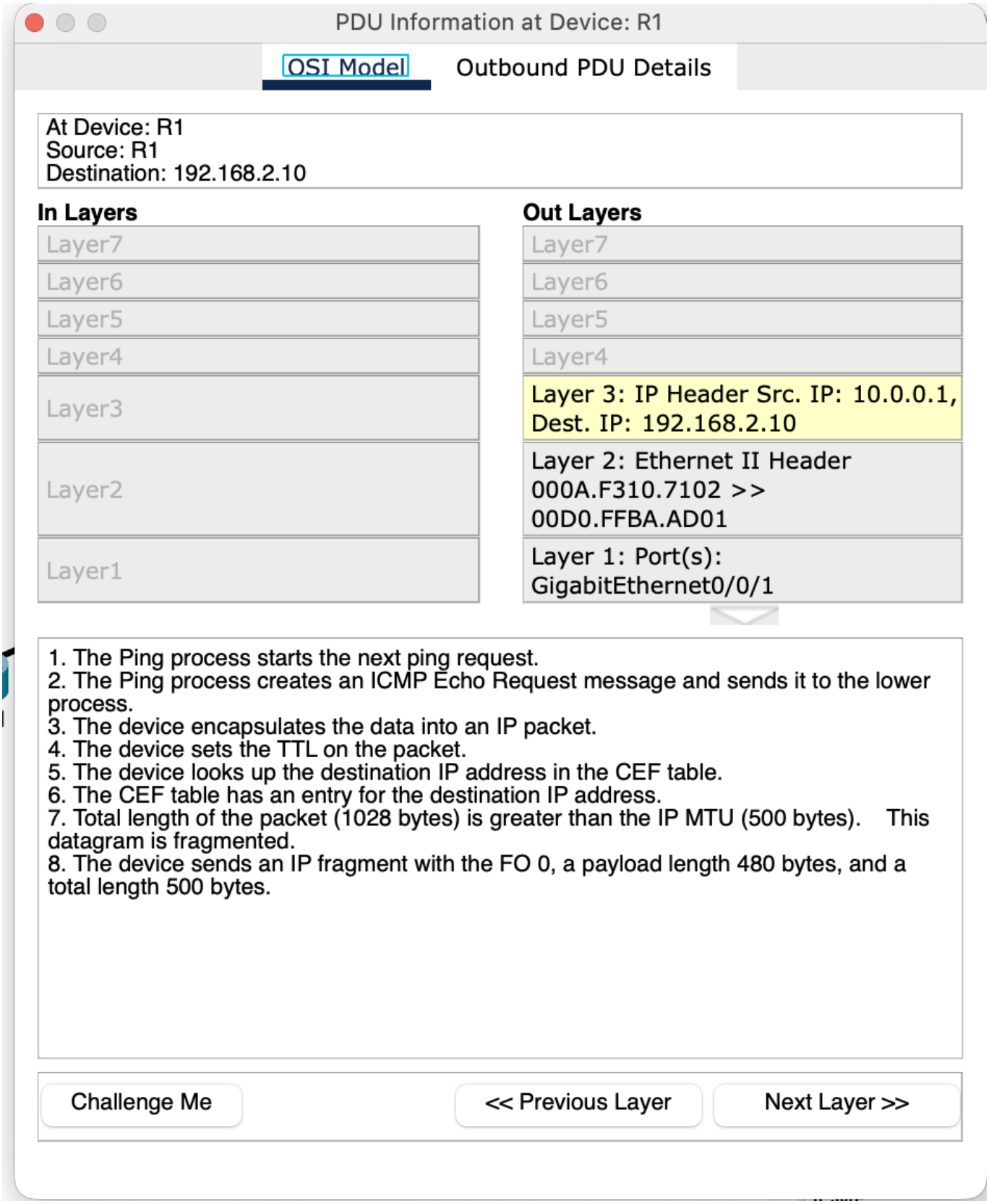
1. Performance – reassembly is CPU-heavy; routers must stay fast.
2. Risk of buffer overflow – fragments may arrive slowly or out of order.
3. Design rule – only the final destination host reassembles fragmented IP packets.

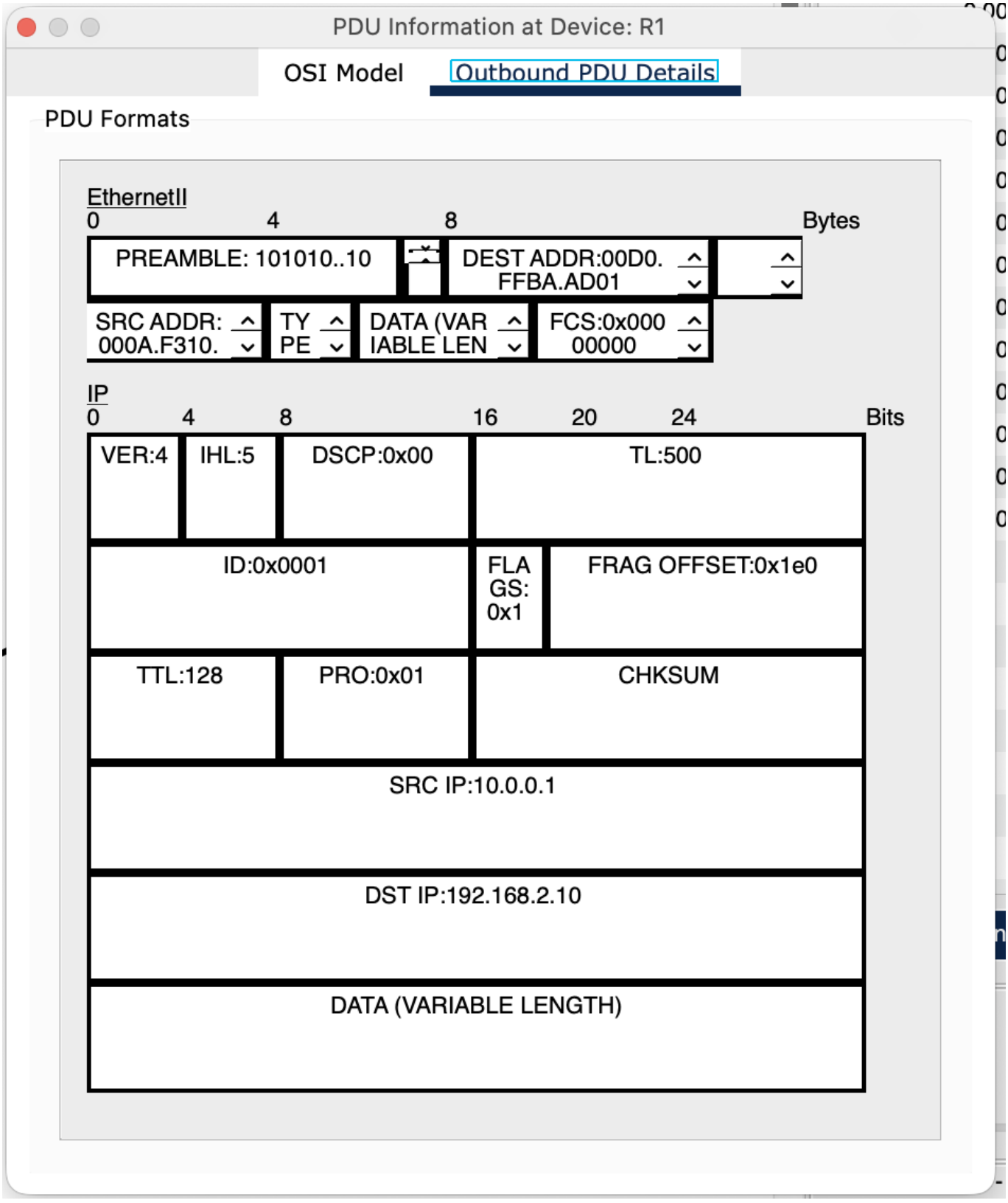
Therefore, only PC-B reassembles the packet into the original 1000-byte datagram.

Event List

Vis.	Time(sec)	Last Device	At Device	Type
	0.000	--	R1	ICMP
	0.000	--	R1	ICMP
	0.000	--	R1	ICMP
	0.001	R1	R2	ICMP
	0.001	--	R1	ICMP
	0.002	R1	R2	ICMP
	0.002	R2	PC-B	ICMP
	0.002	--	R1	ICMP
	0.003	R1	R2	ICMP
	0.003	R2	PC-B	ICMP
	0.004	R2	PC-B	ICMP
	0.005	PC-B	R2	ICMP
Visible	0.006	R2	R1	ICMP


PDU Information at Device: R1
OSI Model
Outbound PDU Details
PDU Formats
EthernetII
0
4
8
Bytes
PREAMBLE: 101010..10
DEST ADDR:00D0.
FFBA.AD01
SRC ADDR:
000A.F310.
TY
PE
DATA (VAR
IABLE LEN
FCS:0x000
00000
IP
0
4
8
16
20
24
Bits
VER:4
IHL:5
DSCP:0x00
TL:500
ID:0x0001
FLA
GS:
0x1
FRAG OFFSET:0x000 |
TTL:128
PRO:0x01
CHKSUM
SRC IP:10.0.0.1
DST IP:192.168.2.10
DATA (VARIABLE LENGTH)


PDU Information at Device: R1
OSI Model
Outbound PDU Details
At Device: R1
Source: R1
Destination: 192.168.2.10
In Layers
Out Layers
Layer7
Layer6
Layer5
Layer4
Layer3
Layer2
Layer1
Layer7
Layer6
Layer5
Layer4
Layer 3: IP Header Src. IP: 10.0.0.1, Dest. IP: 192.168.2.10
Layer 2: Ethernet II Header 000A.F310.7102 >> 00D0.FFBA.AD01
Layer 1: Port(s): GigabitEthernet0/0/1
1. The Ping process starts the next ping request.
2. The Ping process creates an ICMP Echo Request message and sends it to the lower process.
3. The device encapsulates the data into an IP packet.
4. The device sets the TTL on the packet.
5. The device looks up the destination IP address in the CEF table.
6. The CEF table has an entry for the destination IP address.
7. Total length of the packet (1028 bytes) is greater than the IP MTU (500 bytes). This datagram is fragmented.
8. The device sends an IP fragment with the FO 0, a payload length 480 bytes, and a total length 500 bytes.
Challenge Me
<< Previous Layer
Next Layer >>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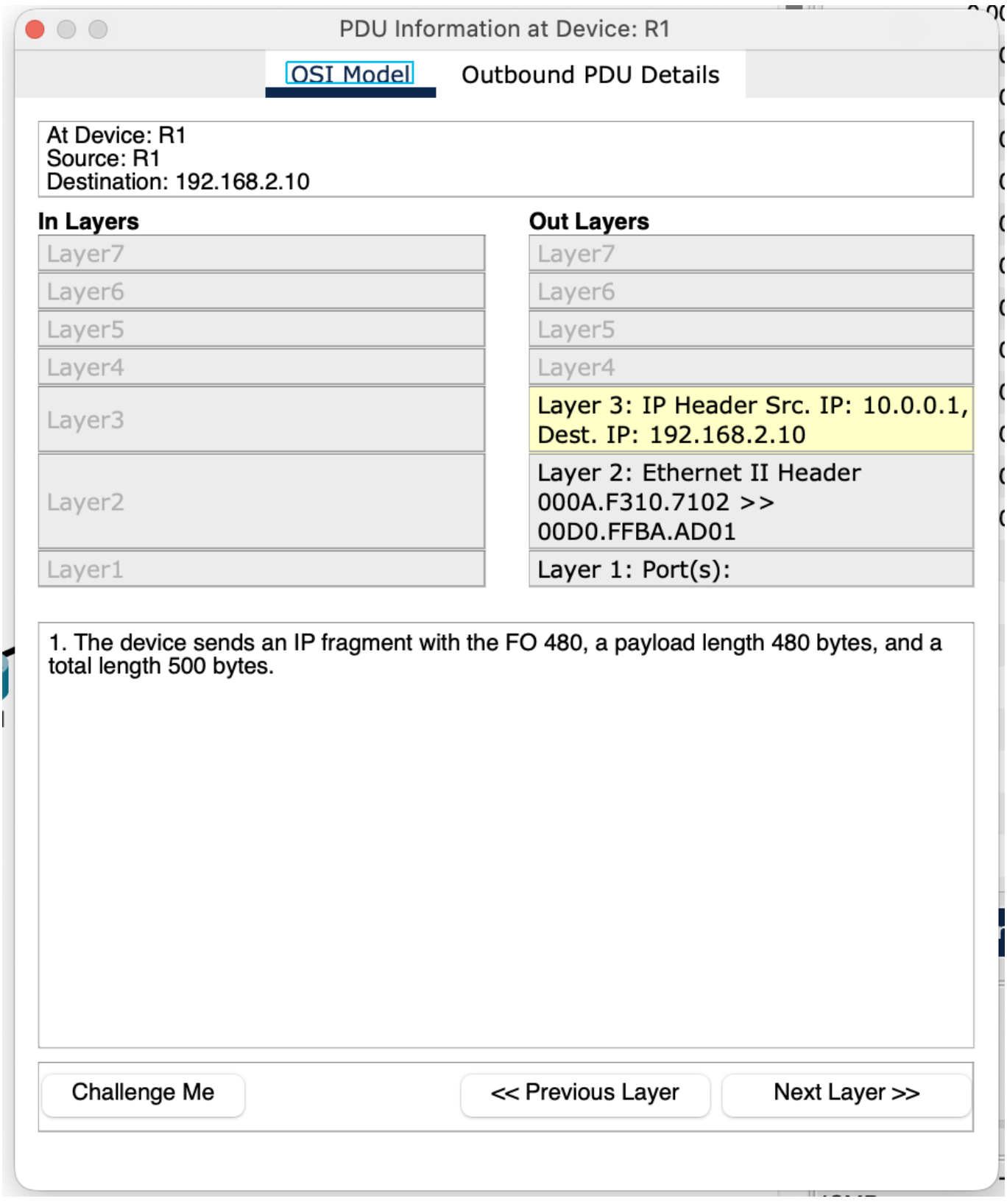
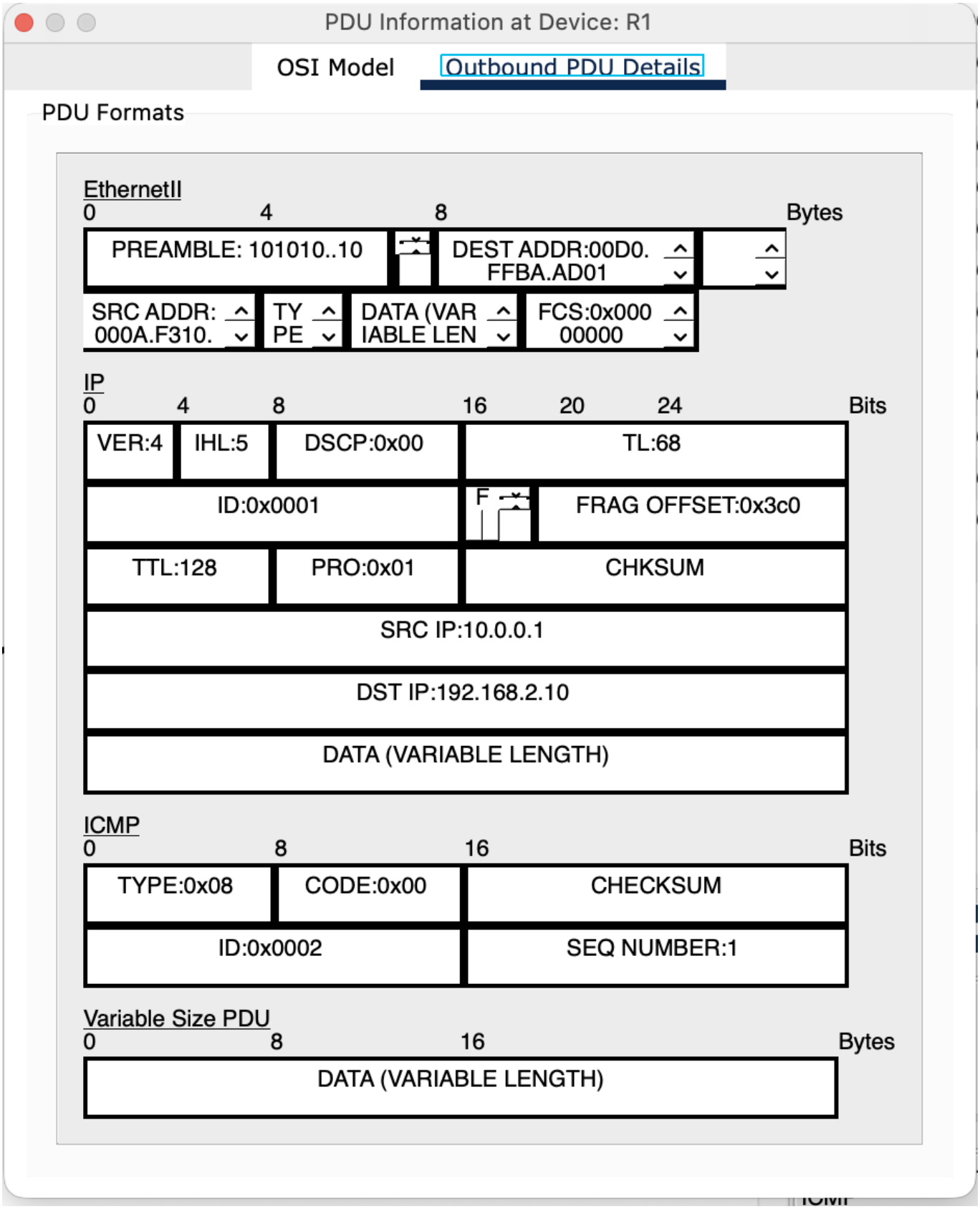
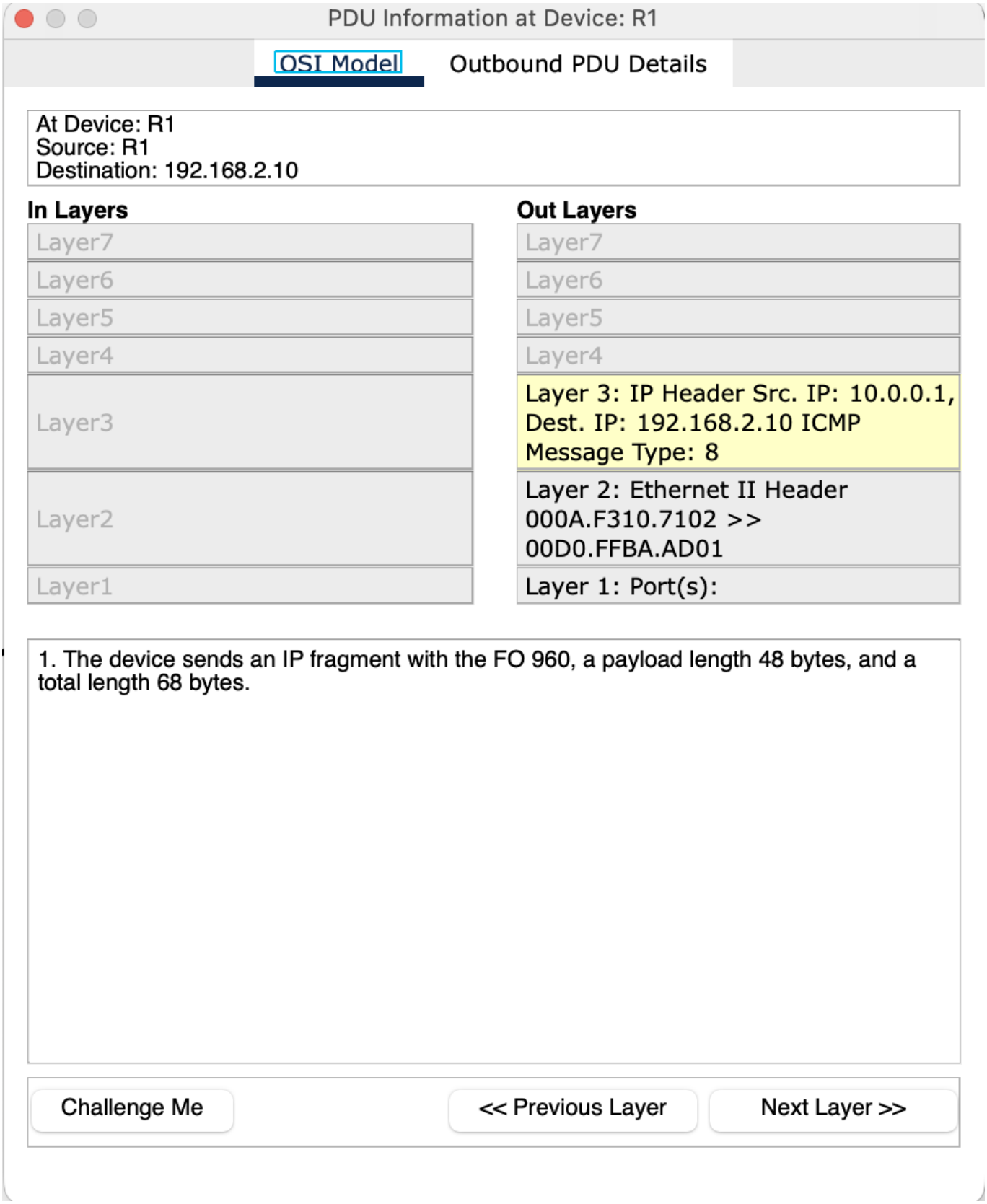
OSI Model
Outbound PDU Details
PDU Formats
EthernetII
0
4
8
Bytes
PREAMBLE: 101010..10
DEST ADDR:00D0.
FFBA.AD01
SRC ADDR:
000A.F310.
TY
PE
DATA (VAR
IABLE LEN
FCS:0x000
00000
IP
0
4
8
16
20
24
Bits
VER:4
IHL:5
DSCP:0x00
TL:500
ID:0x0001
FLA
GS:
0x1
FRAG OFFSET:0x1e0
TTL:128
PRO:0x01
CHKSUM
SRC IP:10.0.0.1
DST IP:192.168.2.10
DATA (VARIABLE LENGTH)


PDU Information at Device: R1
OSI Model
Outbound PDU Details
At Device: R1
Source: R1
Destination: 192.168.2.10
In Layers
Out Layers
Layer7
Layer6
Layer5
Layer4
Layer3
Layer2
Layer1
Layer7
Layer6
Layer5
Layer4
Layer 3: IP Header Src. IP: 10.0.0.1, Dest. IP: 192.168.2.10
Layer 2: Ethernet II Header 000A.F310.7102 >> 00D0.FFBA.AD01
Layer 1: Port(s):
1. The device sends an IP fragment with the FO 480, a payload length 480 bytes, and a total length 500 bytes.
Challenge Me
<< Previous Layer
Next Layer >>


PDU Information at Device: R1
OSI Model
Outbound PDU Details
PDU Formats
EthernetII
0
4
8
Bytes
PREAMBLE: 101010..10
DEST ADDR:00D0.FFBA.AD01
SRC ADDR:000A.F310.
TY PE
DATA (VARIABLE LEN
FCS:0x00000000
IP
0
4
8
16
20
24
Bits
VER:4
IHL:5
DSCP:0x00
TL:68
ID:0x0001
F
FRAG OFFSET:0x3c0
TTL:128
PRO:0x01
CHKSUM
SRC IP:10.0.0.1
DST IP:192.168.2.10
DATA (VARIABLE LENGTH)
ICMP
0
8
16
Bits
TYPE:0x08
CODE:0x00
CHECKSUM
ID:0x0002
SEQ NUMBER:1
Variable Size PDU
0
8
16
Bytes
DATA (VARIABLE LENGTH)


PDU Information at Device: R1
OSI Model
Outbound PDU Details
At Device: R1
Source: R1
Destination: 192.168.2.10
In Layers
Out Layers
Layer7
Layer6
Layer5
Layer4
Layer3
Layer2
Layer1
Layer7
Layer6
Layer5
Layer4
Layer 3: IP Header Src. IP: 10.0.0.1, Dest. IP: 192.168.2.10 ICMP Message Type: 8
Layer 2: Ethernet II Header 000A.F310.7102 >> 00D0.FFBA.AD01
Layer 1: Port(s):
1. The device sends an IP fragment with the FO 960, a payload length 48 bytes, and a total length 68 bytes.
Challenge Me
<< Previous Layer
Next Layer >>