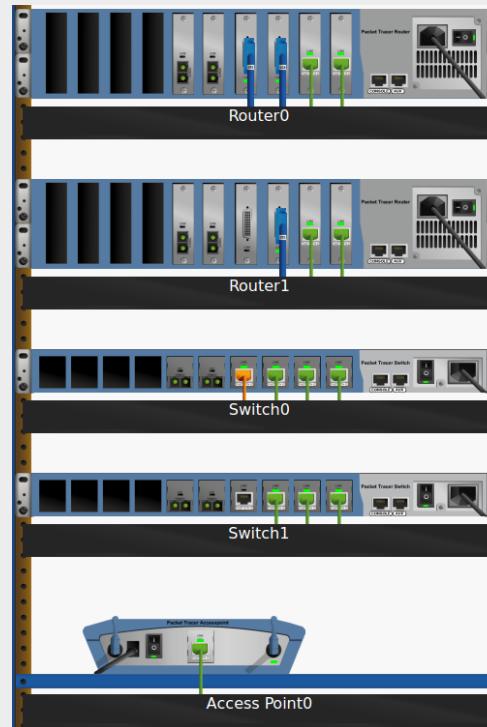


Treball de Xarxes: Simulació d'una xarxa



Guillem Casassas
Pau Sanchez
Albert Espín

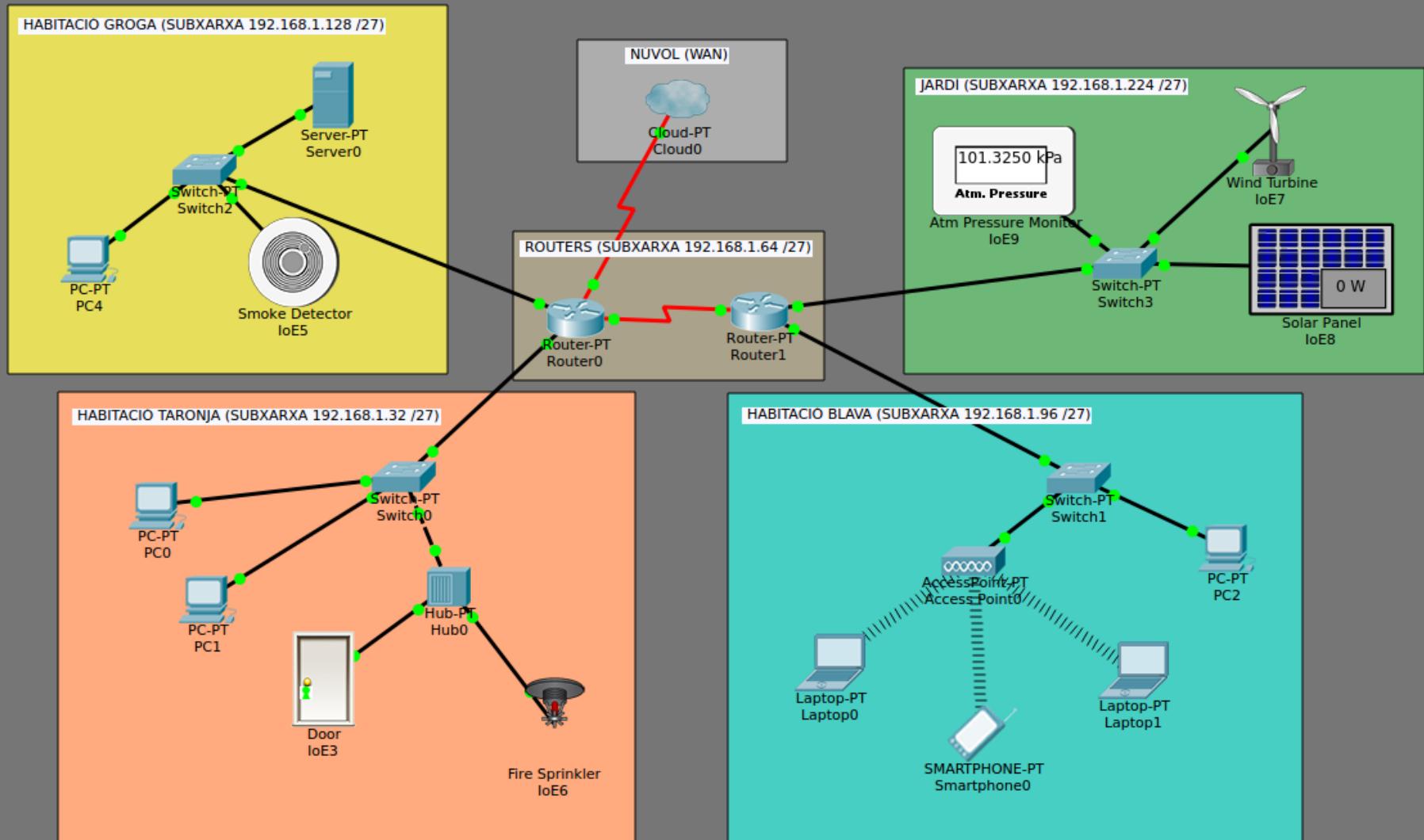
Continguts de la presentació

- 1) Visió general de la xarxa construïda
- 2) Estudi de l'enrutament o encaminament a la xarxa
- 3) Anàlisi dels camins, el tràfic i l'encapsulament de les dades

Simulador usat: Cisco Packet Tracer

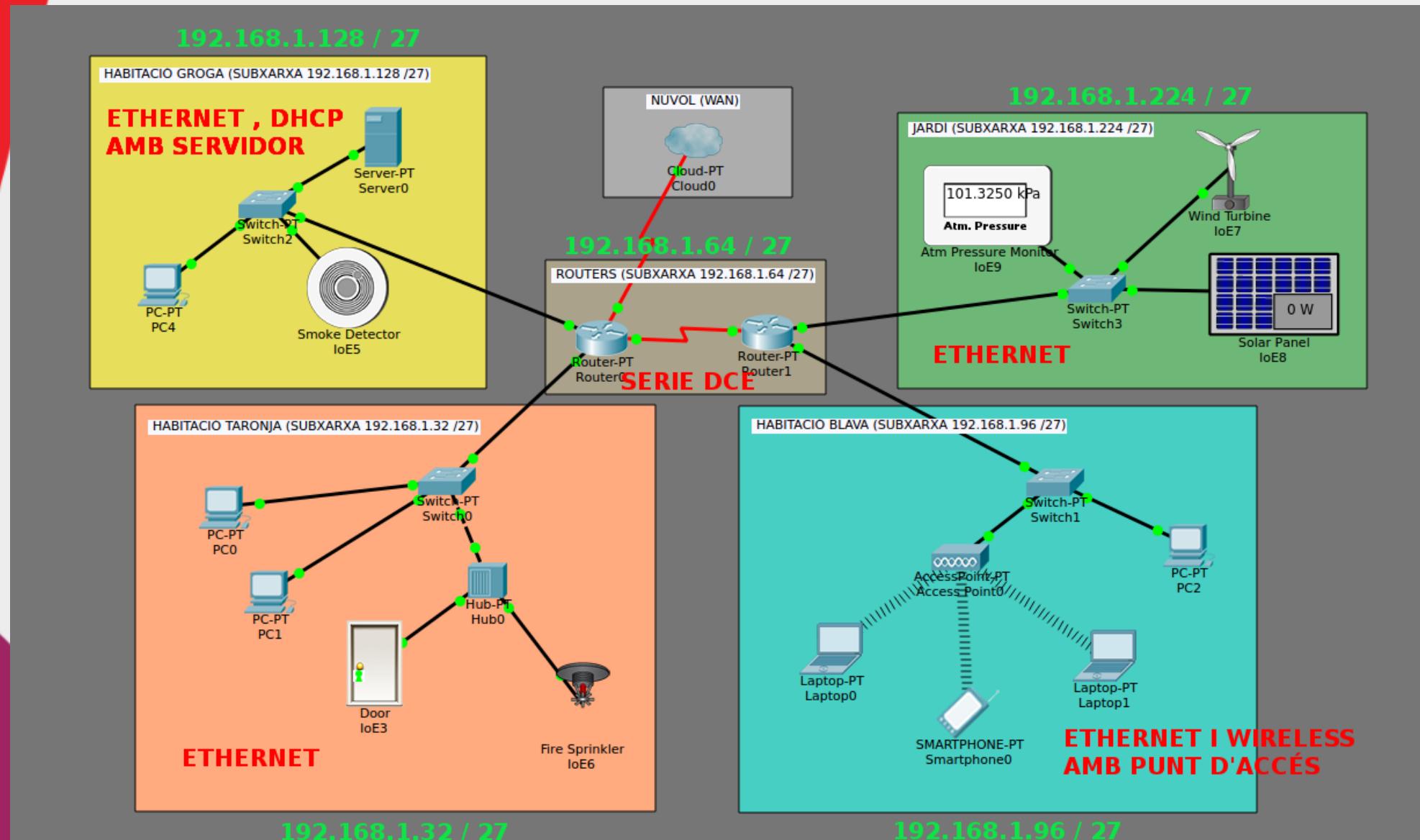
Visió general de la xarxa

Xarxa d'una “smart house”, amb diversos routers; cada espai o habitació té la seva pròpia subxarxa



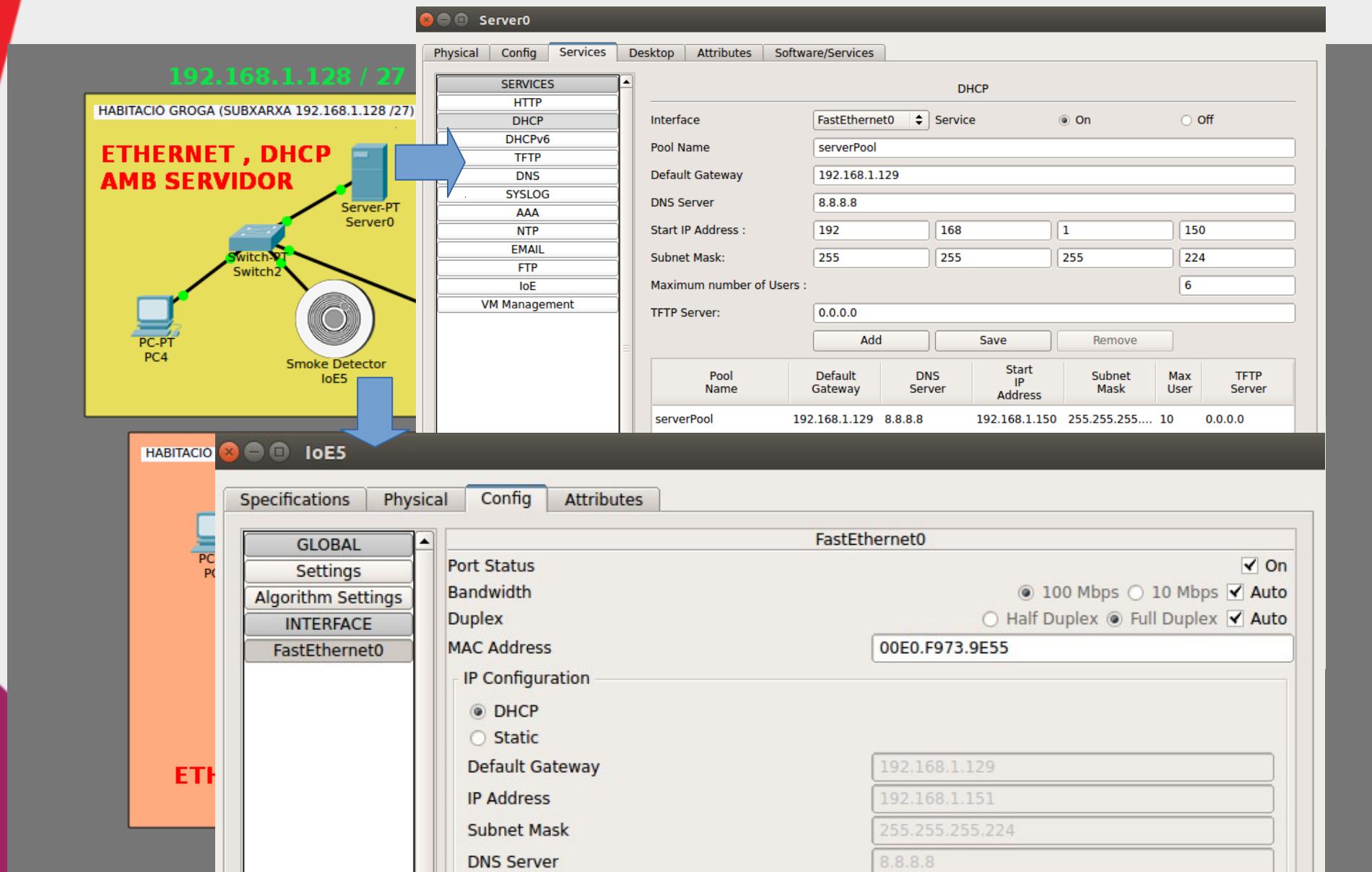
Visió general de la xarxa

IP privada de tipus C; màscara /24+3 bits per representar subxarxes (tenim subxarxes d'Ethernet, wireless, etc.)



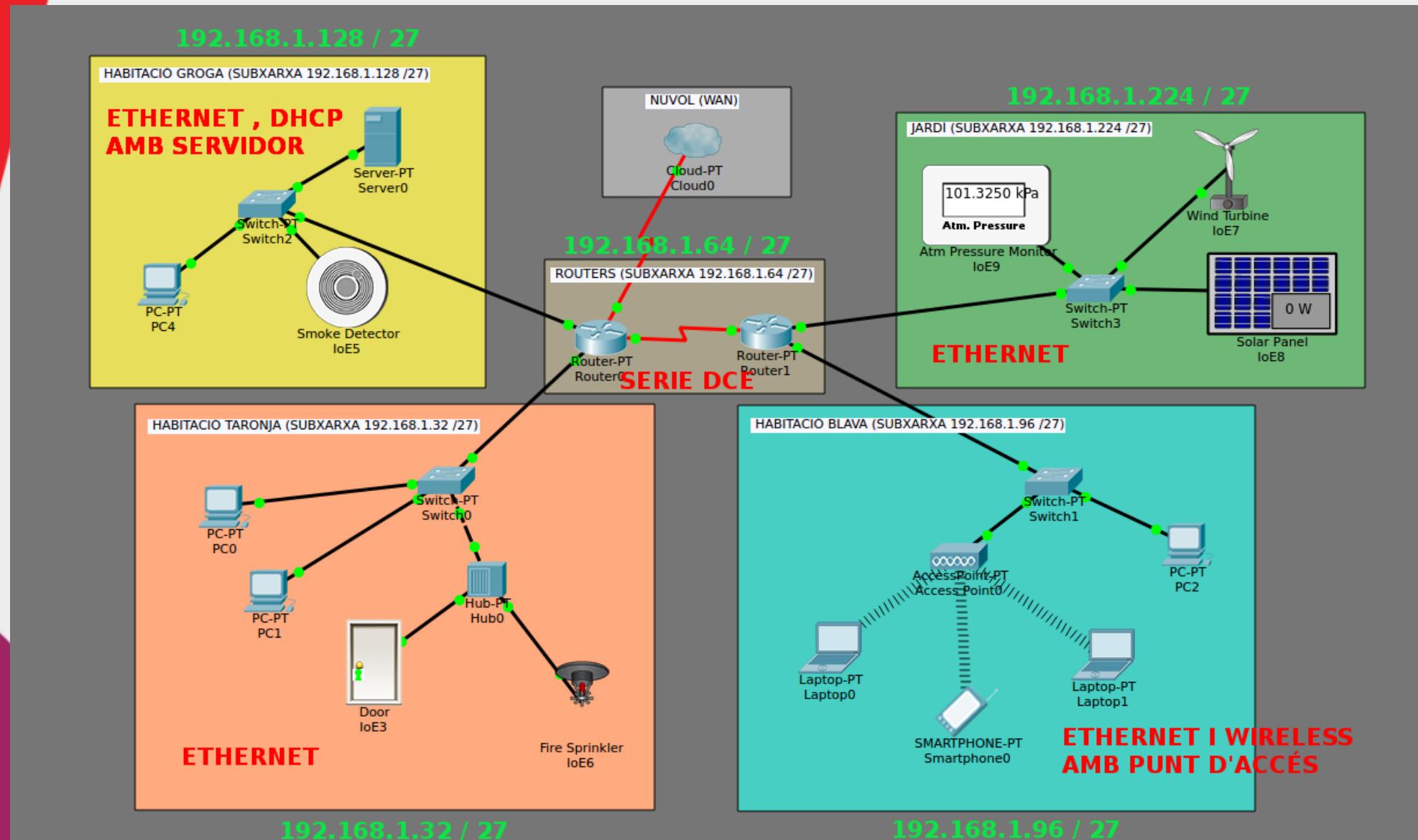
Visió general de la xarxa

Habitació groga: configuració del servei DHCP del servidor perquè atorgui IPs dinàmiques als dispositius



Visió general de la xarxa

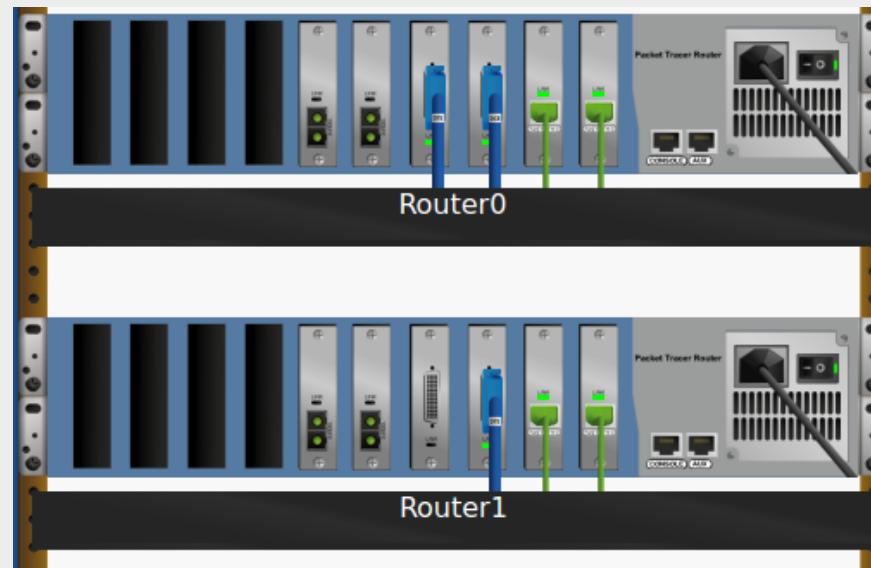
La resta d'estàncies fan servir IPs estàtiques i connexions Ethernet; l'habitació blava, a més, ofereix wireless



Encaminament a la xarxa

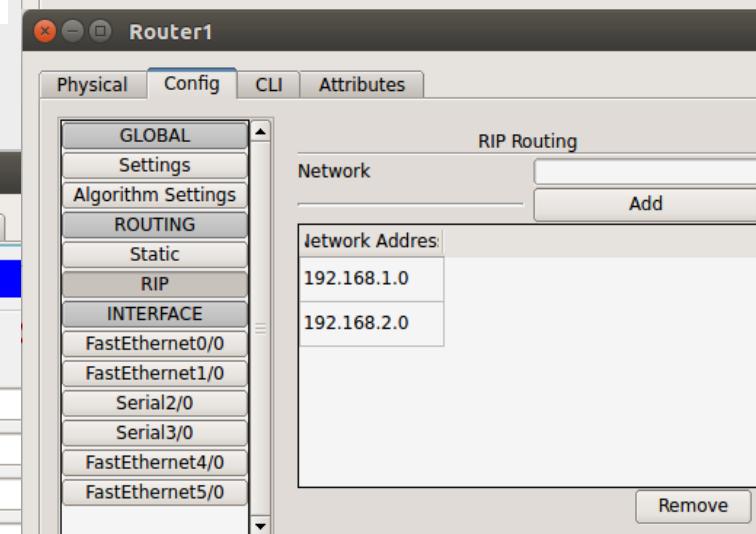
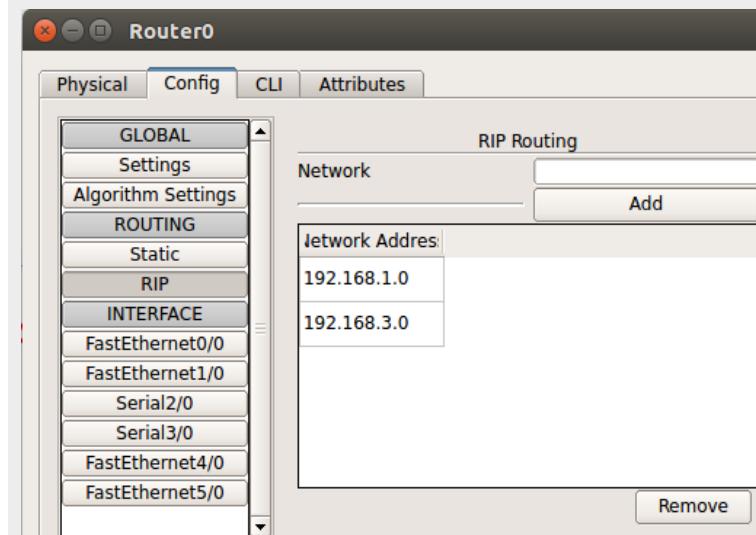
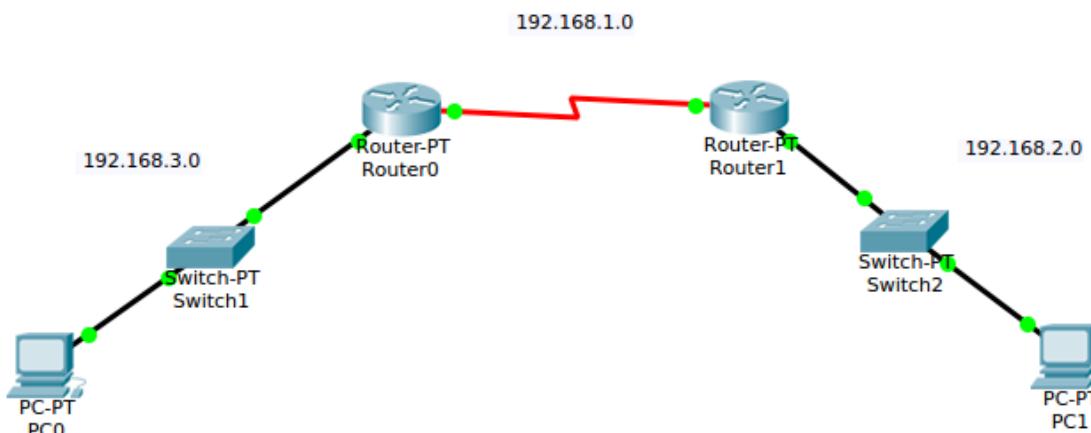
Els routers poden ser configurats per utilitzar diferents protocols o tècniques d'enrutament per determinar el camí a seguir per part dels paquets, n'estudiarem dos:

- a) RIP (Routing Information Protocol)
- b) Taula d'enrutament estàtica amb “next hop”



Configuració RIP

Els routers intercanvien informació sobre les xarxes a què estan connectats, establertes en una taula. La millor ruta es calcula fent servir vectors de distància



PC0

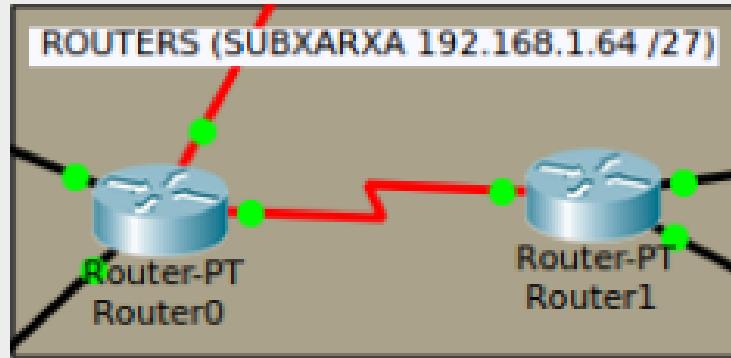
Physical	Config	Desktop	Attributes	Software/Services
IP Configuration				
IP Configuration				
<input type="radio"/> DHCP	<input checked="" type="radio"/> Static			
IP Address	192.168.3.2			
Subnet Mask	255.255.255.0			
Default Gateway	192.168.3.1			
DNS Server				

PC1

Physical	Config	Desktop	Attributes	Software/Services
IP Configuration				
IP Configuration				
<input type="radio"/> DHCP	<input checked="" type="radio"/> Static			
IP Address	192.168.2.2			
Subnet Mask	255.255.255.0			
Default Gateway	192.168.2.1			
DNS Server				

Configuració "next hop"

Els routers tenen una taula on indiquem, manualment, quin ha de ser el següent pas (hop) a fer a la xarxa per un paquet dirigit a una certa xarxa o subxarxa



Router0 Configuration:

Network	Mask	Next Hop
192.168.1.96/27		192.168.1.66
0.0.0.0/0		Serial3/0

Router1 Configuration:

Network	Mask	Next Hop
192.168.1.32/27		192.168.1.65
192.168.1.128/27		192.168.1.65

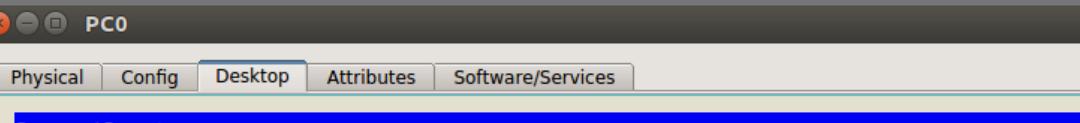
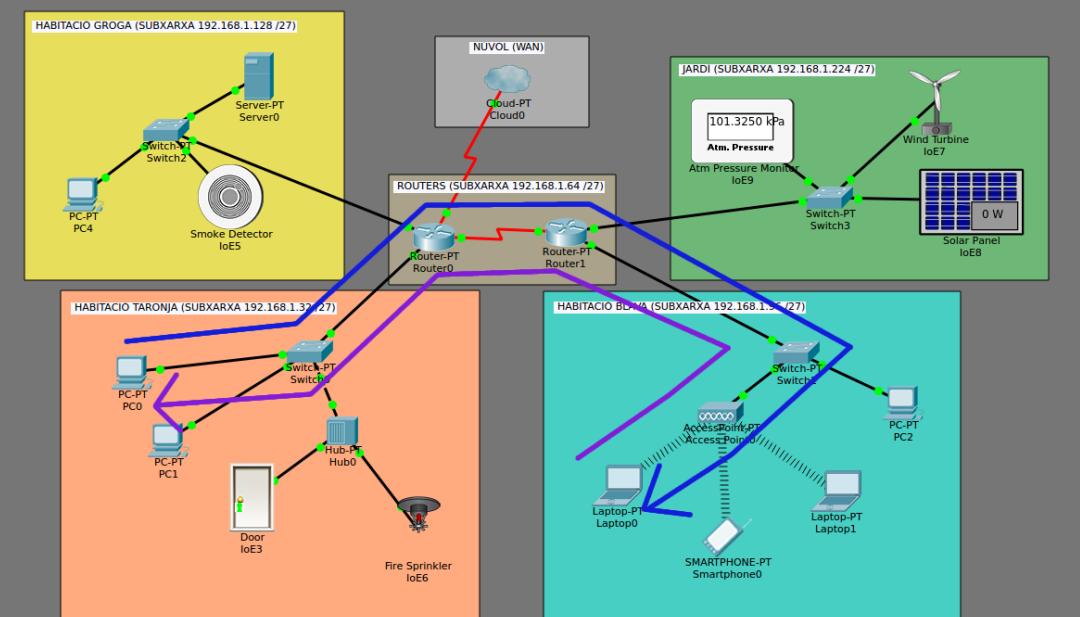
Anàlisi dels camins, el tràfic i l'encapsulament de les dades

Analitzem detalladament el tràfic generat a la xarxa en enviar missatges, estudiant com els diferents protocols i desencapsulen les dades. En particular, partim de protocols de la capa d'aplicació:

- a) Ping entre ordinadors de diferents subxarxes
- b) Correu SMTP fent servir un servidor amb domini

Exemple amb Ping

Un ordinador de l'habitació taronja enviarà un missatge de Ping a un portàtil de l'habitació blava



Command Prompt

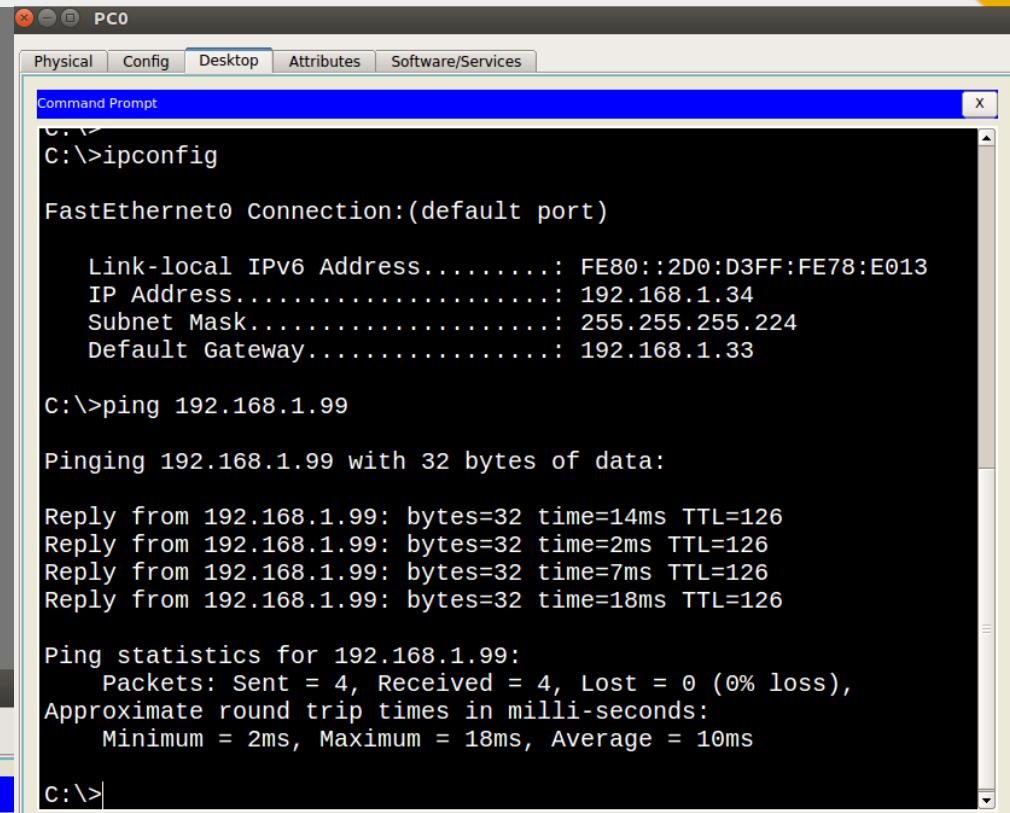
```
C:\>tracert 192.168.1.99
```

Tracing route to 192.168.1.99 over a maximum of 30 hops:

1	0 ms	0 ms	0 ms	192.168.1.33
2	0 ms	1 ms	0 ms	192.168.1.66
3	6 ms	8 ms	10 ms	192.168.1.99

Trace complete.

```
C:\>
```



Top

PDU Settings

Select Application: PING

Destination IP Address: 192.168.1.99

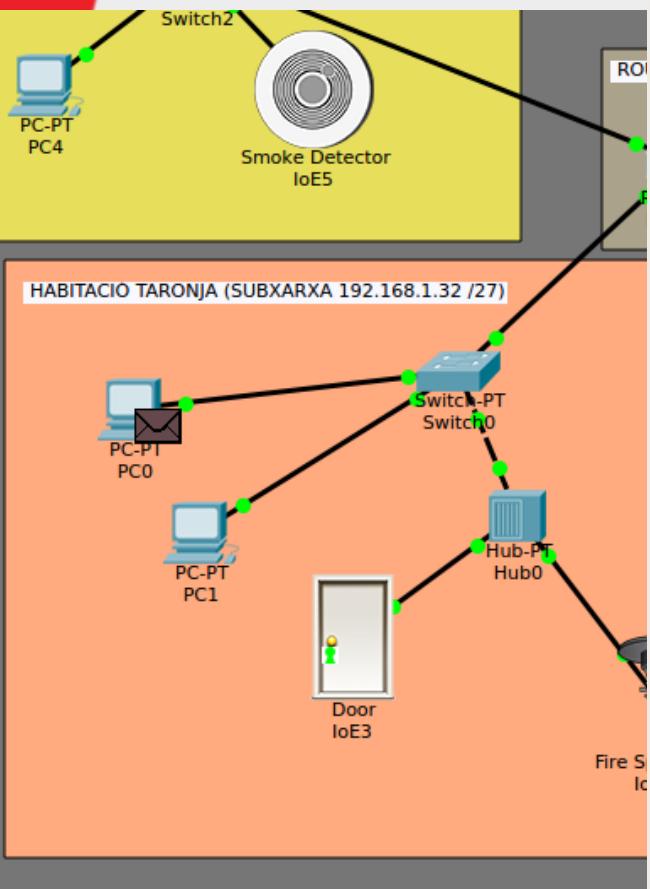
Source IP Address: 192.168.1.34

TTL: 32

TOS: 0

Sequence Number: 1

Exemple amb Ping (pas 1)



PDU Information at Device: PC0

OSI Model Outbound PDU Details

At Device: PC0
Source: PC0
Destination: 192.168.1.99

In Layers	Out Layers
Layer7	Layer7
Layer6	Layer6
Layer5	Layer5
Layer4	Layer4
Layer3	Layer 3: IP Header Src. IP: 192.168.1.34, Dest. IP: 192.168.1.99 ICMP Message Type: 8
Layer2	Layer 2: Ethernet II Header 00D0.D378.E013 >> 00D0.9757.B5AD
Layer1	Layer 1: Port(s): FastEthernet0

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 sets TTL in the packet header.
4. The destination IP address is not in the same subnet and is not the broadcast address.
5. The default gateway is set. The device sets the next-hop to default gateway.

Challenge Me << Previous Layer Next Layer >>

PDU Information at Device: PC0

OSI Model Outbound PDU Details

PDU Formats

Ethernet II

0	4	8	14	19 Bytes
PREAMBLE: 101010...1011	DEST MAC: 00D0.9757.B5AD	SRC MAC: 00D0.D378.E013		
TYPE: 0x800	DATA (VARIABLE LENGTH)			FCS: 0x0

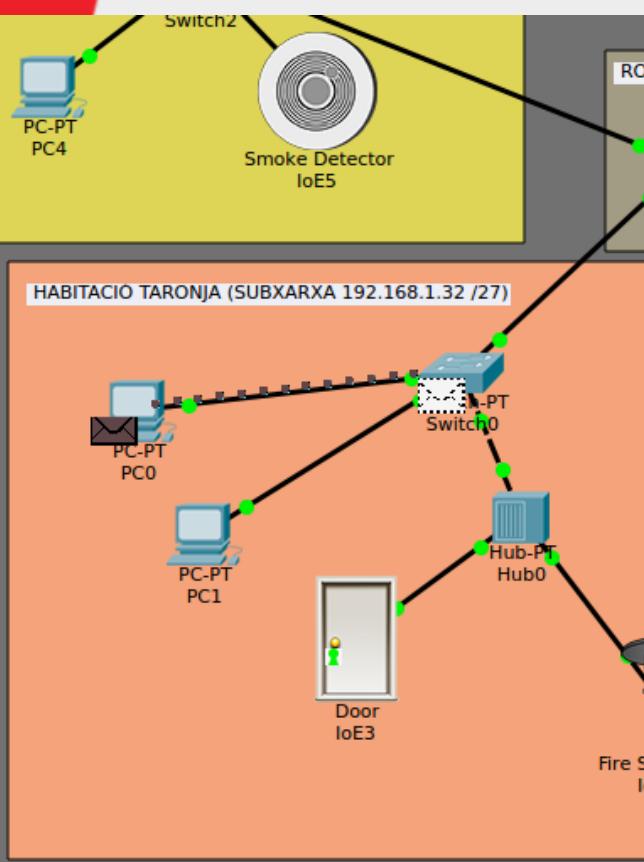
IP

0	4	8	16	19	31 Bits
IHL: 4	DSCP: 0x0	TL: 28			
TTL: 32	ID: 0x9	0x0	0x0		CHKSUM
SRC IP: 192.168.1.34					DST IP: 192.168.1.99
OPT: 0x0					0x0
DATA (VARIABLE LENGTH)					

ICMP

0	8	16	31 Bits
TYPE: 0x8	CODE: 0x0	CHECKSUM	
ID: 0xa	SEQ NUMBER: 9		

Exemple amb Ping (pas 2)



PDU Information at Device: Switch0

OSI Model Inbound PDU Details Outbound PDU Details

At Device: Switch0
Source: PC0
Destination: 192.168.1.99

In Layers

- Layer7
- Layer6
- Layer5
- Layer4
- Layer3

Out Layers

- Layer7
- Layer6
- Layer5
- Layer4
- Layer3

Layer 2: Ethernet II Header
00D0.D378.E013 >>
00D0.9757.B5AD

Layer 1: Port FastEthernet0/1

Layer 2: Ethernet II Header
00D0.D378.E013 >>
00D0.9757.B5AD

Layer 1: Port(s): FastEthernet2/1

1. The frame source MAC address was found in the MAC table of Switch.
2. This is a unicast frame. Switch looks in its MAC table for the destination MAC address.

Challenge Me << Previous Layer Next Layer >>

PDU Information at Device: Switch0

OSI Model Inbound PDU Details Outbound PDU Details

PDU Formats

Ethernet II

0	4	8	14	19 Bytes
PREAMBLE:		DEST MAC:		SRC MAC:
101010...1011		00D0.9757.B5AD		00D0.D378.E013
TYPE: 0x800		DATA (VARIABLE LENGTH)		FCS: 0x0

IP

0	4	8	16	19	31 Bits
4 IHL		DSCP: 0x0	TL: 28		
ID: 0x9		0x0	0x0		
TTL: 32	PRO: 0x1	CHKSUM			
SRC IP: 192.168.1.34					
DST IP: 192.168.1.99					
OPT: 0x0		0x0			
DATA (VARIABLE LENGTH)					

ICMP

0	8	16	31 Bits
TYPE: 0x8		CODE: 0x0	CHECKSUM
ID: 0xa		SEQ NUMBER: 9	

Exemple amb Ping (pas 3)

PDU Information at Device: Router0

OSI Model Inbound PDU Details Outbound

At Device: Router0
Source: PC0
Destination: 192.168.1.99

In Layers

- Layer7
- Layer6
- Layer5
- Layer4

Out Layers

- Layer7
- Layer6
- Layer5
- Layer4

Layer 3: IP Header
Src. IP: 192.168.1.34,
Dest. IP: 192.168.1.99
ICMP Message Type: 8

Layer 2: Ethernet II
Header
00D0.D378.E013 >>
00D0.9757.B5AD

Layer 1: Port
FastEthernet0/0

1. The device looks up the destination IP address in the CEF table.
2. The CEF table does not have an entry for the destination IP address.
3. The device looks up the destination IP address in the routing table.

Challenge Me << Previous Layer Next Layer >>

PDU Information at Device: Router0

OSI Model Inbound PDU Details Outbound PDU Details

PDU Formats

HDLC

0	8	16	32	32+x	48+x	56+x Bits
FLG: 0111 1110	ADR: 0x8f	CONTROL: 0x0	DATA: (VARIABLE LENGTH)	FCS: 0x0	FLG: 0111 1110	

IP

0	4	8	16	19	31 Bits
4	IHL: 0x3	DSCP: 0x0	TL: 28		
TTL: 31	ID: 0x0	0x0	0x0		
PRO: 0x1		CHKSUM			
SRC IP: 192.168.1.34					
DST IP: 192.168.1.99					
OPT: 0x0		0x0			
DATA (VARIABLE LENGTH)					

ICMP

0	8	16	31 Bits
TYPE: 0x8	CODE: 0x0	CHECKSUM	
ID: 0x4		SEQ NUMBER: 3	

Exemple amb Ping (pas 4)

PDU Information at Device: Router1

OSI Model Inbound PDU Details Outbound PDU Details

At Device: Router1
Source: PC0
Destination: 192.168.1.99

In Layers

- Layer7
- Layer6
- Layer5
- Layer4

Out Layers

- Layer7
- Layer6
- Layer5
- Layer4

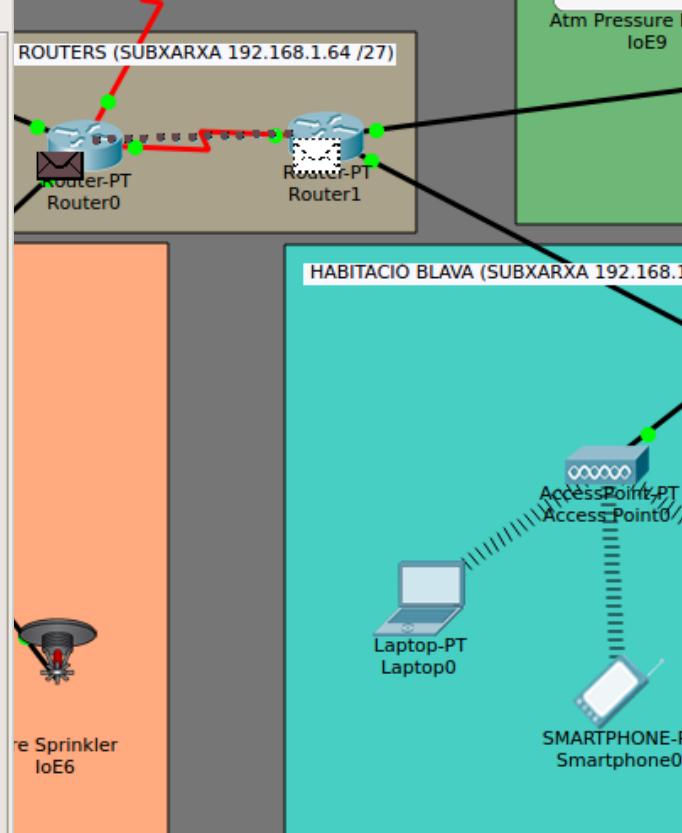
Layer 3: IP Header Src. IP: 192.168.1.34, Dest. IP: 192.168.1.99 ICMP Message Type: 8

Layer 2: HDLC Frame HDLC

Layer 1: Port Serial2/0

1. The next-hop IP address is in the adjacency table. The device sets the frame's destination MAC address to the one found in the table.
2. The device encapsulates the PDU into an Ethernet frame.

Challenge Me << Previous Layer Next Layer >>



PDU Information at Device: Router1

OSI Model Inbound PDU Details Outbound PDU Details

PDU Formats

Ethernet II

0	4	8	14	19 Bytes
PREAMBLE:		DEST MAC:	SRC MAC:	
101010...1011		0001.63A9.9483	0000.0C85.0055	
TYPE: 0x800		DATA (VARIABLE LENGTH)		FCS: 0x0

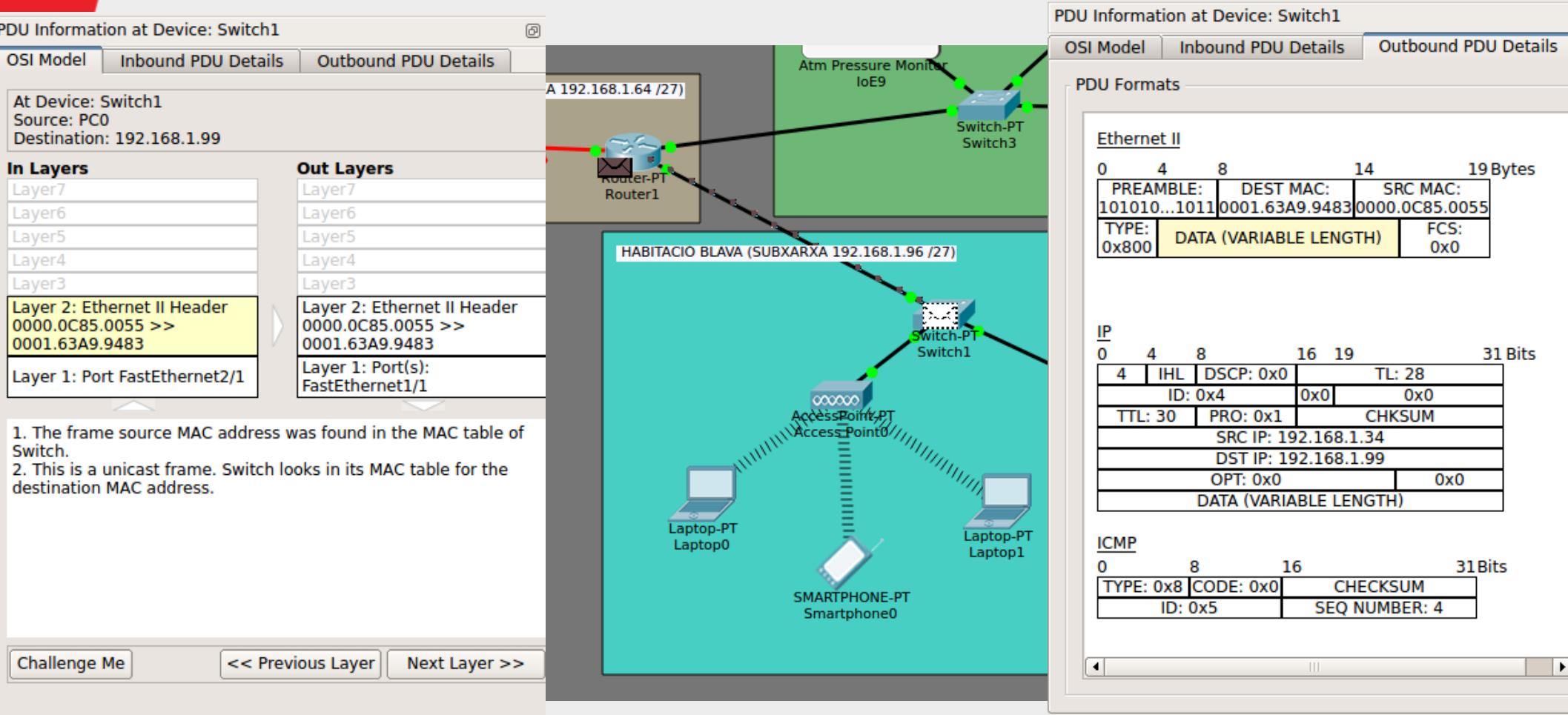
IP

0	4	8	16	19	31 Bits
4	IHL	DSCP: 0x0	TL: 28		
ID: 0x3		0x0	0x0		
TTL: 30	PRO: 0x1	CHKSUM			
SRC IP: 192.168.1.34					
DST IP: 192.168.1.99					
OPT: 0x0		0x0			
DATA (VARIABLE LENGTH)					

ICMP

0	8	16	31 Bits
TYPE: 0x8		CODE: 0x0	CHECKSUM
ID: 0x4		SEQ NUMBER: 3	

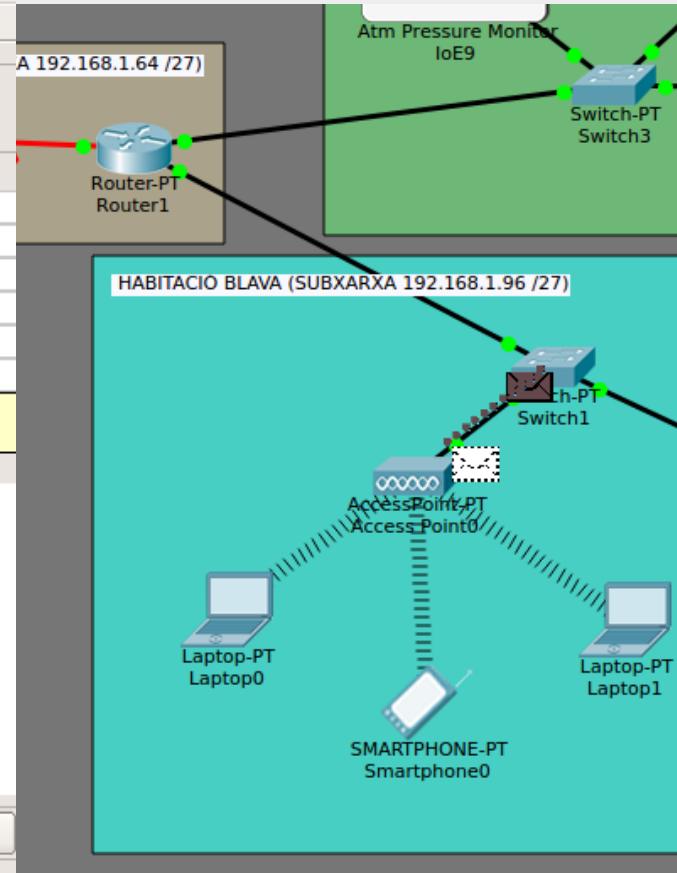
Exemple amb Ping (pas 5)



Exemple amb Ping (pas 6)

PDU Information at Device: Access Point0

OSI Model	Inbound PDU Details	Outbound PDU Details
At Device: Access Point0 Source: PC0 Destination: 192.168.1.99		
In Layers Layer7 Layer6 Layer5 Layer4 Layer3 Layer2 Layer 1: Port Port 0		
Out Layers Layer7 Layer6 Layer5 Layer4 Layer3 Layer2 Layer 1: Port(s):		
1. The access point forwards the frame to all ports. 2. The port Port 1 is sending another frame at this time. The device buffers the frame to be sent later.		
Challenge Me << Previous Layer Next Layer >>		



PDU Information at Device: Access Point0

OSI Model	Inbound PDU Details	Outbound PDU Details			
PDU Formats					
802.11 Wireless					
0	2	4Bytes			
FRAME CONTROL DURATION / ID ADDRESS 1: 0001.63A9.9483 ADDRESS 2: 0002.1686.D5D8 ADDRESS 3: 0000.0C85.0055 SEQUENCE CONTROL ADDRESS 4: DATA (VARIABLE LENGTH) FCS					
IP					
0	4	8	16	19	31 Bits
IHL DSCP: 0x0 TL: 28 ID: 0x4 0x0 0x0 TTL: 30 PRO: 0x1 CHKSUM SRC IP: 192.168.1.34 DST IP: 192.168.1.99 OPT: 0x0 0x0 DATA (VARIABLE LENGTH)					
ICMP					
0	8	16	31 Bits		
TYPE: 0x8 CODE: 0x0 CHECKSUM ID: 0x5 SEQ NUMBER: 4					

Exemple amb Ping (pas 7)

PDU Information at Device: Laptop0

OSI Model Inbound PDU Details Outbound PDU Details

At Device: Laptop0
Source: PC0
Destination: 192.168.1.99

In Layers

- Layer7
- Layer6
- Layer5
- Layer4
- Layer 3: IP Header Src. IP: 192.168.1.34, Dest. IP: 192.168.1.99 ICMP Message Type: 8
- Layer 2: Wireless
- Layer 1: Port Wireless0

Out Layers

- Layer7
- Layer6
- Layer5
- Layer4
- Layer 3: IP Header Src. IP: 192.168.1.99, Dest. IP: 192.168.1.34 ICMP Message Type: 0
- Layer 2: Wireless
- Layer 1: Port(s):

1. The ICMP process replies to the Echo Request by setting ICMP type to Echo Reply.
 2. The ICMP process sends an Echo Reply.
 3. The destination IP address is not in the same subnet and is not the broadcast address.
 4. The default gateway is set. The device sets the next-hop to default gateway.

PDU Information at Device: Laptop0

OSI Model Inbound PDU Details Outbound PDU Details

PDU Formats

802.11 Wireless

0	2	4Bytes
FRAME CONTROL	DURATION / ID	
ADDRESS 1: 0002.1686.D5D8		
ADDRESS 2: 0001.63A9.9483		
ADDRESS 3: 0000.0C85.0055		
SEQUENCE CONTROL		
ADDRESS 4:		
DATA (VARIABLE LENGTH)		
FCS		

IP

0	4	8	16	19	31 Bits
4	IHL	DSCP: 0x0	TL: 28		
ID: 0x6		0x0	0x0		
TTL: 128	PRO: 0x1		CHKSUM		
			SRC IP: 192.168.1.99		
			DST IP: 192.168.1.34		
			OPT: 0x0	0x0	
			DATA (VARIABLE LENGTH)		

ICMP

0	8	16	31 Bits
TYPE: 0x0	CODE: 0x0	CHECKSUM	
ID: 0x5		SEQ NUMBER: 4	

The network diagram illustrates a path from Laptop0 to Laptop1. The path starts at Laptop0, which is connected to an AccessPoint-PT (Access Point 0). This access point is connected to a Router-PT (Router 1), which is further connected to another Router-PT (Router A). Router A is connected to a Switch-PT (Switch 3), which is connected to an Atm Pressure Monitor (IoE9). From IoE9, the path continues through another Switch-PT (Switch 1) and then to Laptop1. The entire path is contained within a green area labeled "HABITACIO BLAVA (SUBXARXA 192.168.1.96 /27)".

Exemple amb Ping (pas 8)

PDU Information at Device: Access Point0

OSI Model Inbound PDU Details Outbound PDU Details

At Device: Access Point0
Source: PC0
Destination: 192.168.1.99

In Layers Out Layers

Layer7	Layer7
Layer6	Layer6
Layer5	Layer5
Layer4	Layer4
Layer3	Layer3
Layer2	Layer2
Layer 1: Port Port 1	Layer 1: Port(s): Port 0

1. The access point forwards the frame to the wireless port.
 2. The port Port 1 is sending another frame at this time. The device buffers the frame to be sent later.
 3. Port 0 sends out the frame.

PDU Information at Device: Access Point0

OSI Model Inbound PDU Details Outbound PDU Details

PDU Formats

Ethernet II

0	4	8	14	19 Bytes
PREAMBLE:		DEST MAC:	SRC MAC:	
101010...1011		0000.0C85.0055	0001.63A9.9483	
TYPE: 0x800		DATA (VARIABLE LENGTH)		FCS: 0x0

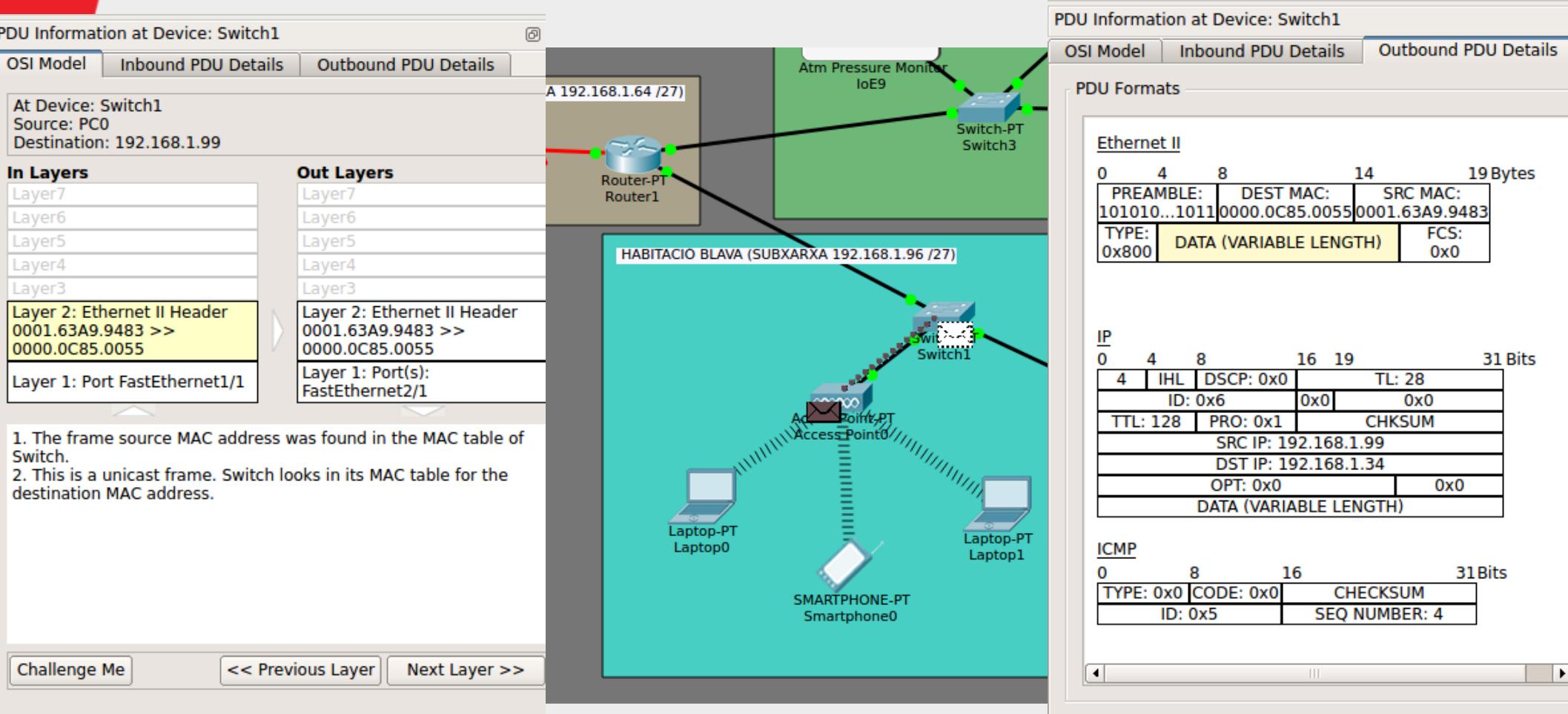
IP

0	4	8	16	19	31 Bits
4	IHL	DSCP: 0x0	TL: 28		
		ID: 0x6	0x0	0x0	
TTL: 128	PRO: 0x1	CHKSUM			
SRC IP: 192.168.1.99					
DST IP: 192.168.1.34					
OPT: 0x0		0x0			
DATA (VARIABLE LENGTH)					

ICMP

0	8	16	31 Bits
TYPE: 0x0		CODE: 0x0	CHECKSUM
ID: 0x5		SEQ NUMBER: 4	

Exemple amb Ping (pas 9)



Exemple amb Ping (pas 10)

PDU Information at Device: Router1

OSI Model Inbound PDU Details Outbound PDU Details

At Device: Router1
Source: PC0
Destination: 192.168.1.99

In Layers	Out Layers
Layer7	Layer7
Layer6	Layer6
Layer5	Layer5
Layer4	Layer4
Layer 3: IP Header Src. IP: 192.168.1.99, Dest. IP: 192.168.1.34 ICMP Message Type: 0	Layer 3: IP Header Src. IP: 192.168.1.99, Dest. IP: 192.168.1.34 ICMP Message Type: 0
Layer 2: Ethernet II Header 0001.63A9.9483 >> 0000.0C85.0055	Layer 2: HDLC Frame HDLC
Layer 1: Port FastEthernet0/0	Layer 1: Port(s): Serial2/0

1. The device looks up the destination IP address in the CEF table.
 2. The CEF table does not have an entry for the destination IP address.
 3. The device looks up the destination IP address in the routing table.

PDU Information at Device: Router1

OSI Model Inbound PDU Details Outbound PDU Details

PDU Formats

HDLC

0	8	16	32	32+x	48+x
FLG: 0111 1110	ADR: 0x8f	CONTROL: 0x0	DATA: (VARIABLE LENGTH)	FCS: 0x0	FLG: 0111 1110

IP

0	4	8	16	19	31
4	IHL: 0x6	DSCP: 0x0	TL: 28		
ID: 0x6			0x0	0x0	
TTL: 127	PRO: 0x1		CHKSUM		
		SRC IP: 192.168.1.99			
		DST IP: 192.168.1.34			
		OPT: 0x0	0x0		
		DATA (VARIABLE LENGTH)			

ICMP

0	8	16	31 Bits
TYPE: 0x0	CODE: 0x0	CHECKSUM	
ID: 0x5		SEQ NUMBER: 4	

The network diagram illustrates a path from Router1 to a laptop. Router1 is connected to a switch (Switch3) which is connected to an Atm Pressure Monitor (IoE9). Router1 is also connected to a switch (Switch1) which is connected to a laptop (Laptop0) and a smartphone (Smartphone0). The laptop is also connected to another laptop (Laptop1). The network is divided into two subnets: A (192.168.1.64 /27) and HABITACIO BLAVA (SUBXARXA 192.168.1.96 /27).

Exemple amb Ping (pas 11)

PDU Information at Device: Router0

OSI Model Inbound PDU Details Outbound PDU Details

At Device: Router0
Source: PC0
Destination: 192.168.1.99

In Layers

- Layer7
- Layer6
- Layer5
- Layer4
- Layer 3: IP Header Src. IP: 192.168.1.99, Dest. IP: 192.168.1.34 ICMP Message Type: 0
- Layer 2: HDLC Frame HDLC
- Layer 1: Port Serial2/0

Out Layers

- Layer7
- Layer6
- Layer5
- Layer4
- Layer 3: IP Header Src. IP: 192.168.1.99, Dest. IP: 192.168.1.34 ICMP Message Type: 0
- Layer 2: Ethernet II Header 00D0.9757.B5AD >> 00D0.D378.E013
- Layer 1: Port(s): FastEthernet0/0

1. The next-hop IP address is in the adjacency table. The device sets the frame's destination MAC address to the one found in the table.
 2. The device encapsulates the PDU into an Ethernet frame.

PDU Information at Device: Router0

OSI Model Inbound PDU Details Outbound PDU Details

PDU Formats

Ethernet II

0	4	8	14	19 Bytes
PREAMBLE: 101010...1011		DEST MAC: 00D0.D378.E013	SRC MAC: 00D0.9757.B5AD	
TYPE: 0x800		DATA (VARIABLE LENGTH)		FCS: 0x0

IP

0	4	8	16	19	31 Bytes
4 IHL DSCP: 0x0		TL: 28			
ID: 0x6		0x0	0x0		
TTL: 126		PRO: 0x1	CHKSUM		
		SRC IP: 192.168.1.99			DST IP: 192.168.1.34
		OPT: 0x0			0x0
DATA (VARIABLE LENGTH)					

ICMP

0	8	16	31 Bits
TYPE: 0x0 CODE: 0x0		CHECKSUM	
ID: 0x5		SEQ NUMBER: 4	

Exemple amb Ping (pas 12)

PDU Information at Device: Switch0

OSI Model Inbound PDU Details Outbound PDU Details

At Device: Switch0
Source: PC0
Destination: 192.168.1.99

In Layers

- Layer7
- Layer6
- Layer5
- Layer4
- Layer3
- Layer 2: Ethernet II Header
00D0.9757.B5AD >>
00D0.D378.E013
- Layer 1: Port
FastEthernet2/1

Out Layers

- Layer7
- Layer6
- Layer5
- Layer4
- Layer3
- Layer 2: Ethernet II Header
00D0.9757.B5AD >>
00D0.D378.E013
- Layer 1: Port(s):
FastEthernet0/1

1. The frame source MAC address was found in the MAC table of Switch.
2. This is a unicast frame. Switch looks in its MAC table for the destination MAC address.

PDU Information at Device: Switch0

OSI Model Inbound PDU Details Outbound PDU Detail

PDU Formats

Ethernet II

0	4	8	14	19 Byte
PREAMBLE:		DEST MAC:	SRC MAC:	
101010...1011		00D0.D378.E013	00D0.9757.B5AD	
TYPE:	DATA (VARIABLE LENGTH)			FCS: 0x0
0x800				

IP

0	4	8	16	19	31 Bit
4	IHL	DSCP: 0x0	TL: 28		
ID: 0x6		0x0	0x0		
TTL: 126	PRO: 0x1	CHKSUM			
SRC IP: 192.168.1.99					
DST IP: 192.168.1.34					
OPT: 0x0					
DATA (VARIABLE LENGTH)					

ICMP

0	8	16	31 Bits
TYPE: 0x0	CODE: 0x0	CHECKSUM	
ID: 0x5		SEQ NUMBER: 4	

Exemple amb Ping (pas 13)

PDU Information at Device: PC0

OSI Model **Inbound PDU Details**

At Device: PC0
Source: PC0
Destination: 192.168.1.99

In Layers

Layer7
Layer6
Layer5
Layer4
Layer 3: IP Header Src. IP: 192.168.1.99, Dest. IP: 192.168.1.34 ICMP Message Type: 0
Layer 2: Ethernet II Header 00D0.9757.B5AD >> 00D0.D378.E013
Layer 1: Port FastEthernet0

Out Layers

Layer7
Layer6
Layer5
Layer4
Layer3
Layer2
Layer1

1. The packet's destination IP address matches the device's IP address or the broadcast address. The device de-encapsulates the packet.
 2. The packet is an ICMP packet. The ICMP process processes it.
 3. The ICMP process received an Echo Reply message.
 4. The Ping process received an Echo Reply message.

PDU Information at Device: PC0

OSI Model **Inbound PDU Details**

PDU Formats

Ethernet II

0	4	8	14	19 Bytes
PREAMBLE:		DEST MAC:	SRC MAC:	
101010...1011		00D0.D378.E013	00D0.9757.B5AD	
TYPE:		DATA (VARIABLE LENGTH)	FCS:	0x0
0x800				

IP

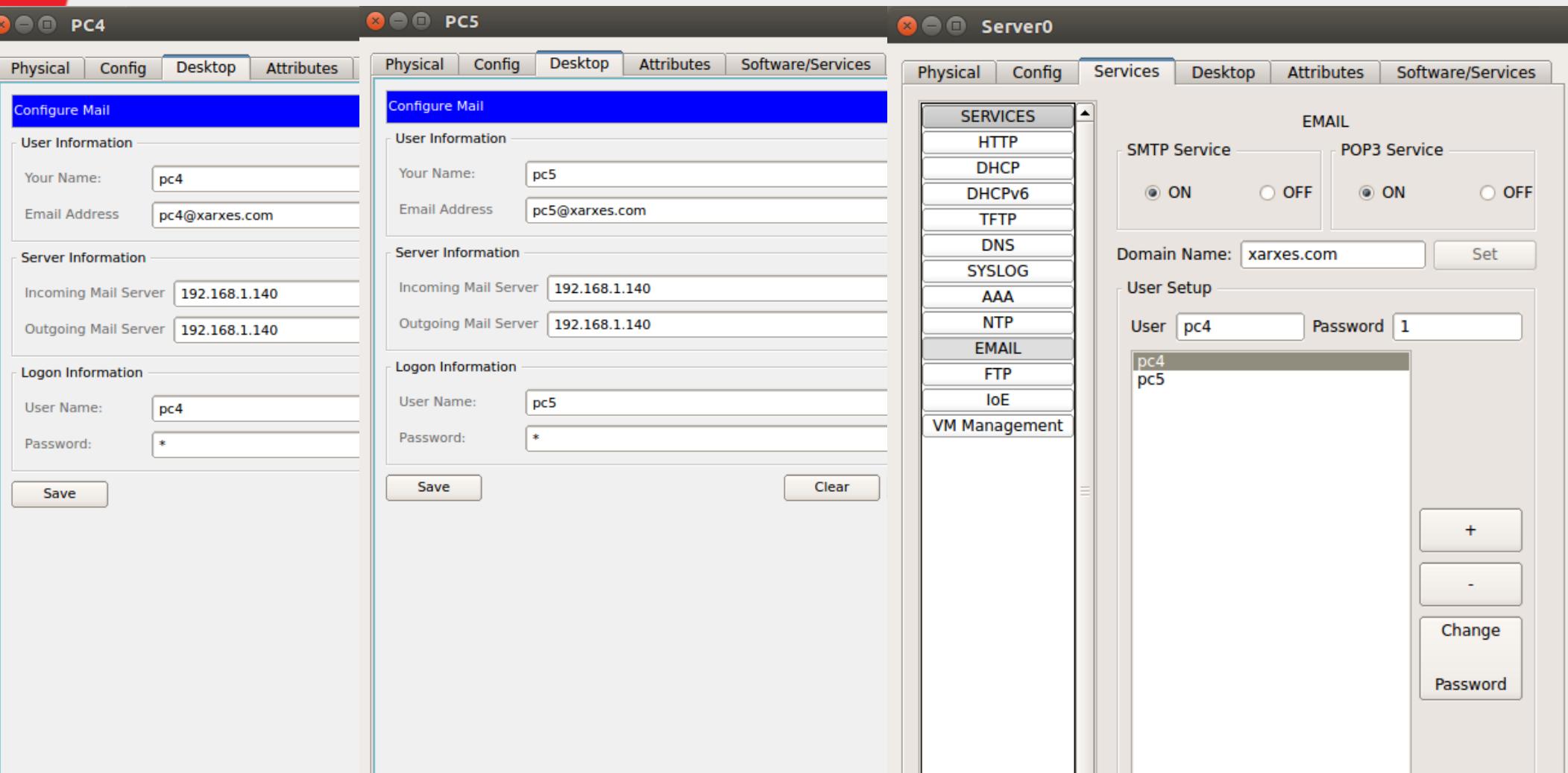
0	4	8	16	19	31 Bits
4 IHL		DSCP: 0x0	TL: 28		
		ID: 0x6	0x0	0x0	
TTL: 126		PRO: 0x1	CHKSUM		
		SRC IP: 192.168.1.99			
		DST IP: 192.168.1.34			
		OPT: 0x0	0x0		
		DATA (VARIABLE LENGTH)			

ICMP

0	8	16	31 Bits
TYPE: 0x0		CODE: 0x0	CHECKSUM
		ID: 0x5	SEQ NUMBER: 4

Exemple amb SMTP

Configurem el servidor perquè permeti als ordinadors enviar i rebre correus electrònics; veurem com un dels ordinadors de l'habitació groga envia al servidor un correu per a l'altre ordinador (que pot preguntar al servidor si té missatges nous i obtenir-lo)



Exemple amb SMTP

The image shows two desktop environments, PC4 and PC5, illustrating the exchange of an email message via SMTP.

PC4 (Left): A window titled "Compose Mail" is open. It contains fields for "To" (p5@xarxes.com) and "Subject" (Test). A "Send" button is visible. The message body area contains the text "TestTestTest".

PC5 (Right): A window titled "MAIL BROWSER" is open. It displays a list of received emails. The first email in the list has the following details:

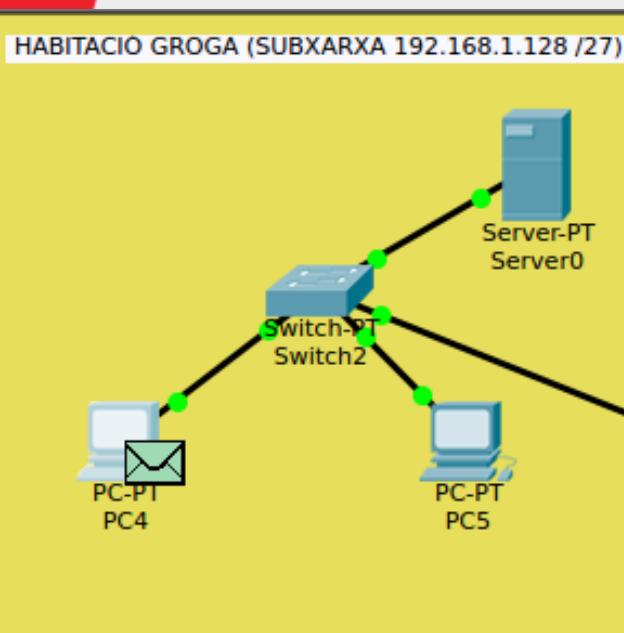
From	Subject	Received
pc4@xarxes.com	Test	lun ene 16 2017 15:58:20

The message body of the received email is displayed below the list:

Test
pc4@xarxes.com
Sent : lun ene 16 2017 15:58:20
TestTestTest

A status message at the bottom of the PC5 window indicates: "Receiving mail from POP3 Server 192.168.1.140" and "Receive Mail Success."

Exemple amb SMTP (pas 1)



PDU Information at Device: PC4

OSI Model Outbound PDU Details

At Device: PC4
Source: PC4
Destination: 192.168.1.140

In Layers

- Layer7
- Layer6
- Layer5
- Layer4
- Layer3
- Layer2
- Layer1

Out Layers

- Layer7
- Layer6
- Layer5
- Layer 4: TCP Src Port: 1025, Dst Port: 25**
- Layer 3: IP Header Src. IP: 192.168.1.151, Dest. IP: 192.168.1.140**
- Layer 2: Ethernet II Header** 0001.637A.14DC >> 000C.CF28.C99A
- Layer 1: Port(s): FastEthernet0**

1. The device tries to make a TCP connection to 192.168.1.140 on port 25.
 2. The device sets the connection state to SYN_SENT.
 3. TCP accepts a window size up to 65535 bytes.
 4. TCP adds Maximum Segment Size Option to the TCP SYN header with Maximum Segment Size equal to 1460 bytes.
 5. The device sends a TCP SYN segment.
 6. Sent segment information: the sequence number 0, the ACK number 0, and the data length 24.

Challenge Me << Previous Layer Next Layer >>

PDU Information at Device: PC4

OSI Model Outbound PDU Details

PDU Formats

Ethernet II

0	4	8	14	19 Bytes
PREAMBLE:	DEST MAC:		SRC MAC:	
101010...1011	000C.CF28.C99A		0001.637A.14DC	
TYPE:	DATA (VARIABLE LENGTH)			FCS: 0x0
0x800				

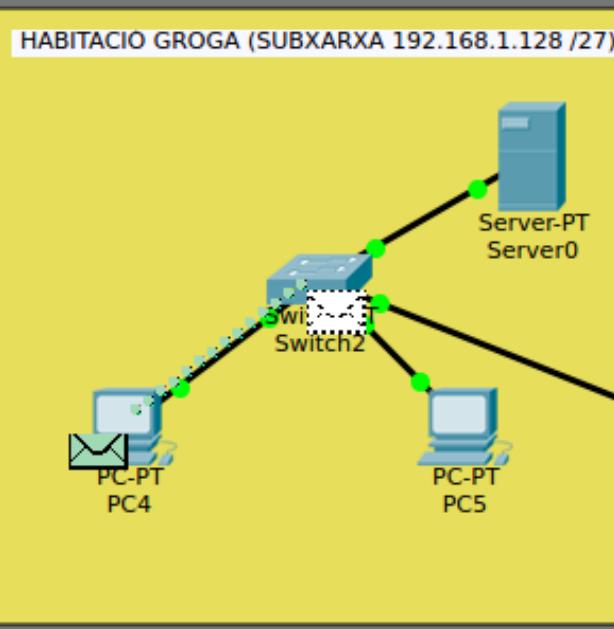
IP

0	4	8	16	19	31 Bits
IHL	DSCP: 0x0	TL: 44			
4		ID: 0xa	0x2	0x0	
		TTL: 128	PRO: 0x6	CHKSUM	
				SRC IP: 192.168.1.151	
				DST IP: 192.168.1.140	
				OPT: 0x0	0x0
				DATA (VARIABLE LENGTH)	

TCP

0	16	31 Bits
SRC PORT: 1025	DEST PORT: 25	
SEQUENCE NUM: 0		
ACK NUM: 0		
OFF. RES. SYN	WINDOW	
CHECKSUM: 0x0	URGENT POINTER	
OPTION	PADDING	
DATA (VARIABLE)		

Exemple amb SMTP (pas 2)



PDU Information at Device: Switch2

OSI Model Inbound PDU Details Outbound PDU Details

At Device: Switch2
Source: PC4
Destination: 192.168.1.140

In Layers	Out Layers
Layer7	Layer7
Layer6	Layer6
Layer5	Layer5
Layer4	Layer4
Layer3	Layer3
Layer 2: Ethernet II Header 0001.637A.14DC >> 000C.CF28.C99A	Layer 2: Ethernet II Header 0001.637A.14DC >> 000C.CF28.C99A
Layer 1: Port FastEthernet0/1	Layer 1: Port(s): FastEthernet2/1

1. The frame source MAC address was found in the MAC table of Switch.
2. This is a unicast frame. Switch looks in its MAC table for the destination MAC address.

Challenge Me << Previous Layer Next Layer >>

PDU Information at Device: Switch2

OSI Model Inbound PDU Details Outbound PDU Details

PDU Formats

Ethernet II

0	4	8	14	19 Bytes
PREAMBLE: 101010...1011	DEST MAC: 000C.CF28.C99A	SRC MAC: 0001.637A.14DC		
TYPE: 0x800	DATA (VARIABLE LENGTH)			FCS: 0x0

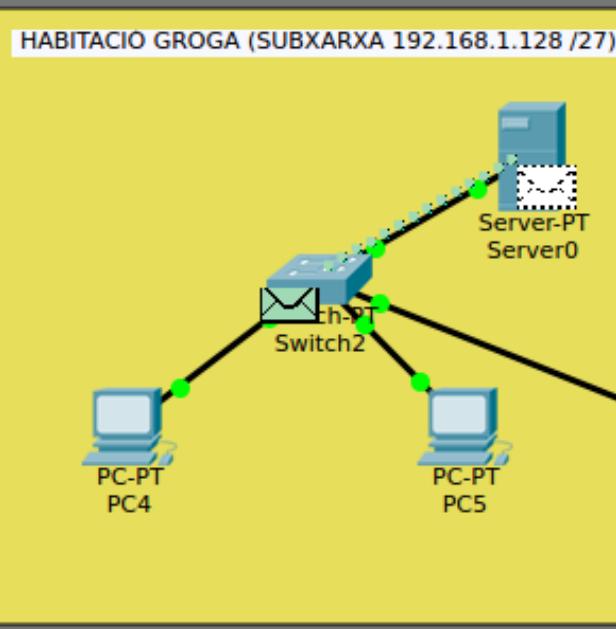
IP

0	4	8	16	19	31 Bits
4	IHL	DSCP: 0x0	TL: 44		
		ID: 0xa	0x2	0x0	
TTL: 128	PRO: 0x6	CHKSUM			
SRC IP: 192.168.1.151					
DST IP: 192.168.1.140					
OPT: 0x0					
DATA (VARIABLE LENGTH)					

TCP

0	16	31 Bits	
SRC PORT: 1025	DEST PORT: 25		
SEQUENCE NUM: 0			
ACK NUM: 0			
OFF.	RES.	SYN	WINDOW
CHECKSUM: 0x0		URGENT POINTER	
OPTION			PADDING
DATA (VARIABLE)			

Exemple amb SMTP (pas 3)



PDU Information at Device: Server0

OSI Model	Inbound PDU Details	Outbound PDU Details
At Device: Server0 Source: PC4 Destination: 192.168.1.140		
In Layers	Out Layers	
Layer7	Layer7	
Layer6	Layer6	
Layer5	Layer5	
Layer 4: TCP Src Port: 1025, Dst Port: 25	Layer 4: TCP Src Port: 25, Dst Port: 1025	
Layer 3: IP Header Src. IP: 192.168.1.151, Dest. IP: 192.168.1.140	Layer 3: IP Header Src. IP: 192.168.1.140, Dest. IP: 192.168.1.151	
Layer 2: Ethernet II Header 0001.637A.14DC >> 000C.CF28.C99A	Layer 2: Ethernet II Header 000C.CF28.C99A >> 0001.637A.14DC	
Layer 1: Port FastEthernet0	Layer 1: Port(s): FastEthernet0	

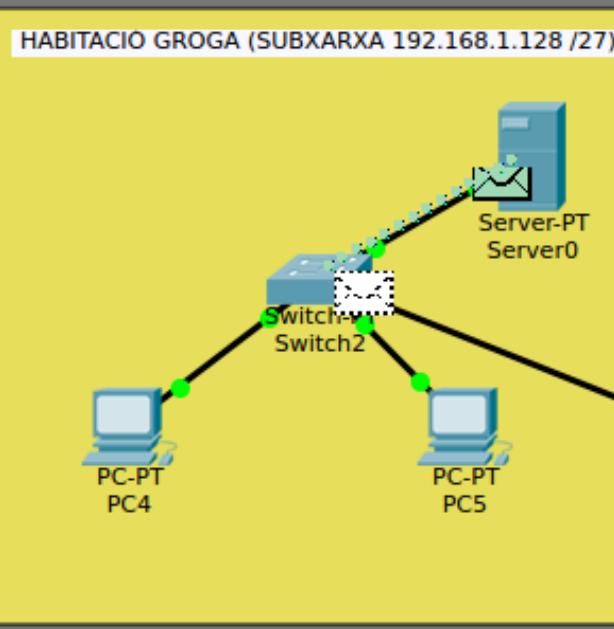
1. TCP accepts a window size up to 16384 bytes.
 2. TCP adds Maximum Segment Size Option to the TCP SYN-ACK header with Maximum Segment Size equal to 536 bytes.
 3. The device sends a TCP SYN+ACK segment.
 4. Sent segment information: the sequence number 0, the ACK number 1, and the data length 24.

Challenge Me << Previous Layer Next Layer >>

PDU Information at Device: Server0

OSI Model	Inbound PDU Details	Outbound PDU Details
PDU Formats		
Ethernet II		
0 4 8 14 19 Bytes		
PREAMBLE: 101010...1011	DEST MAC: 0001.637A.14DC	SRC MAC: 000C.CF28.C99A
TYPE: 0x800	DATA (VARIABLE LENGTH)	
		FCS: 0x0
IP		
0 4 8 16 19 31 Bits		
4 IHL DSCP: 0x0 TL: 44		
ID: 0xc 0x2 0x0		
TTL: 128 PRO: 0x6 CHKSUM		
SRC IP: 192.168.1.140		
DST IP: 192.168.1.151		
OPT: 0x0 0x0		
DATA (VARIABLE LENGTH)		
TCP		
0 16 31 Bits		
SRC PORT: 25 DEST PORT: 1025		
SEQUENCE NUM: 0		
ACK NUM: 1		
OFF. RES. SYN + ACK WINDOW		
CHECKSUM: 0x0 URGENT POINTER		
OPTION PADDING		
DATA (VARIABLE)		

Exemple amb SMTP (pas 4)



PDU Information at Device: Switch2

OSI Model	Inbound PDU Details	Outbound PDU Details
At Device: Switch2 Source: PC4 Destination: 192.168.1.140		
In Layers	Out Layers	
Layer7	Layer7	
Layer6	Layer6	
Layer5	Layer5	
Layer4	Layer4	
Layer3	Layer3	
Layer 2: Ethernet II Header 000C.CF28.C99A >> 0001.637A.14DC		Layer 2: Ethernet II Header 000C.CF28.C99A >> 0001.637A.14DC
Layer 1: Port FastEthernet2/1		Layer 1: Port(s): FastEthernet0/1

1. The outgoing port is an access port. Switch sends the frame out that port.

Challenge Me **<< Previous Layer** **Next Layer >>**

PDU Information at Device: Switch2

OSI Model	Inbound PDU Details	Outbound PDU Details			
PDU Formats					
Ethernet II					
0	4	8	14	19 Bytes	
PREAMBLE:		DEST MAC:	SRC MAC:		
101010...1011		0001.637A.14DC	000C.CF28.C99A		
TYPE:	0x800	DATA (VARIABLE LENGTH)		FCS: 0x0	
IP					
0	4	8	16	19	31 Bits
4	IHL	DSCP: 0x0	TL: 44		
		ID: 0xc	0x2	0x0	
TTL: 128	PRO: 0x6	CHKSUM			
		SRC IP: 192.168.1.140			
		DST IP: 192.168.1.151			
		OPT: 0x0			0x0
DATA (VARIABLE LENGTH)					
TCP					
0	16		31 Bits		
SRC PORT: 25		DEST PORT: 1025			
SEQUENCE NUM: 0					
ACK NUM: 1					
OFF.	RES.	SYN + ACK	WINDOW		
CHECKSUM: 0x0		URGENT POINTER			
OPTION			PADDING		
DATA (VARIABLE)					

Exemple amb SMTP (pas 5)

PDU Information at Device: PC4

OSI Model **Inbound PDU Details** **Outbound PDU Details**

At Device: PC4
Source: PC4
Destination: 192.168.1.140

In Layers	Out Layers
Layer7	Layer7
Layer6	Layer6
Layer5	Layer5
Layer 4: TCP Src Port: 25, Dst Port: 1025	Layer 4: TCP Src Port: 1025, Dst Port: 25
Layer 3: IP Header Src. IP: 192.168.1.140, Dest. IP: 192.168.1.151	Layer 3: IP Header Src. IP: 192.168.1.151, Dest. IP: 192.168.1.140
Layer 2: Ethernet II Header 000C.CF28.C99A >> 0001.637A.14DC	Layer 2: Ethernet II Header 0001.637A.14DC >> 000C.CF28.C99A
Layer 1: Port FastEthernet0	Layer 1: Port(s): FastEthernet0

1. The device receives a TCP SYN+ACK segment on the connection to 192.168.1.140 on port 25.
 2. Received segment information: the sequence number 0, the ACK number 1, and the data length 24.
 3. The TCP segment has the expected peer sequence number.
 4. The TCP connection is successful.
 5. TCP retrieves the MSS value of 536 bytes from the Maximum Segment Size Option in the TCP header.
 6. The device sets the connection state to ESTABLISHED.

PDU Information at Device: PC4

OSI Model **Inbound PDU Details** **Outbound PDU Details**

PDU Formats

Ethernet II

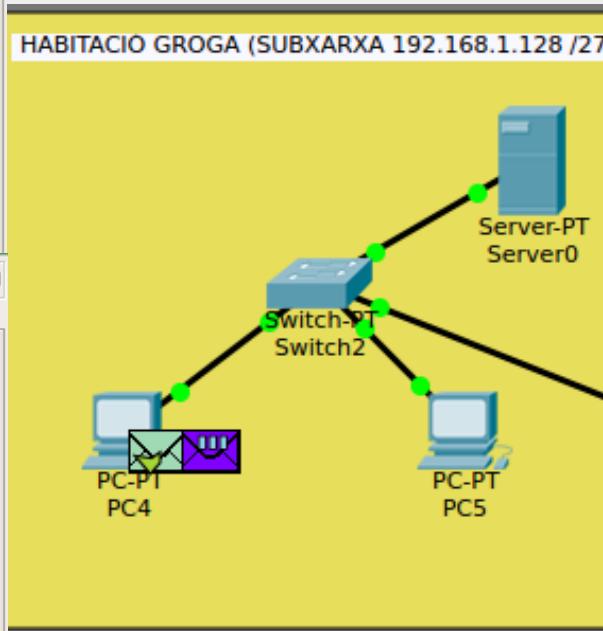
0	4	8	14	19 Bytes
PREAMBLE:	DEST MAC:	SRC MAC:		
101010...1011	000C.CF28.C99A	0001.637A.14DC		
TYPE:	DATA (VARIABLE LENGTH)	FCS:		
0x800		0x0		

IP

0	4	8	16	19	31 Bits
4	IHL	DSCP: 0x0		TL: 40	
ID: 0xb	0x2		0x0		
TTL: 128	PRO: 0x6		CHKSUM		
SRC IP: 192.168.1.151					
DST IP: 192.168.1.140					
OPT: 0x0		0x0			
DATA (VARIABLE LENGTH)					

TCP

0	16	31 Bits
SRC PORT: 1025	DEST PORT: 25	
SEQUENCE NUM: 1		
ACK NUM: 1		
OFF: 0x0	RES: 0x0	PSH + ACK
		WINDOW
CHECKSUM: 0x0		URGENT POINTER
OPTION		PADDING
DATA (VARIABLE)		



PDU Information at Device: PC4

OSI Model **Outbound PDU Details**

At Device: PC4
Source: PC4
Destination: SMTP CLIENT

In Layers	Out Layers
Layer7	Layer 7: SMTP
Layer6	Layer6
Layer5	Layer5
Layer4	Layer 4: TCP Src Port: 1025, Dst Port: 25
Layer3	Layer 3: IP Header Src. IP: 192.168.1.151, Dest. IP: 192.168.1.140
Layer2	Layer 2: Ethernet II Header 0001.637A.14DC >> 000C.CF28.C99A
Layer1	Layer 1: Port(s):

1. The device sends out a SMTP packet.

PDU Information at Device: PC4

OSI Model **Outbound PDU Details**

PDU Formats

Ethernet II

0	4	8	14	19 Bytes
PREAMBLE:	DEST MAC:	SRC MAC:		
101010...1011	000C.CF28.C99A	0001.637A.14DC		
TYPE:	DATA (VARIABLE LENGTH)	FCS:		
0x800		0x0		

IP

0	4	8	16	19	31 Bits
4	IHL	DSCP: 0x0		TL: 78	
ID: 0xc	0x2		0x0		
TTL: 128	PRO: 0x6		CHKSUM		
SRC IP: 192.168.1.151					
DST IP: 192.168.1.140					
OPT: 0x0		0x0			
DATA (VARIABLE LENGTH)					

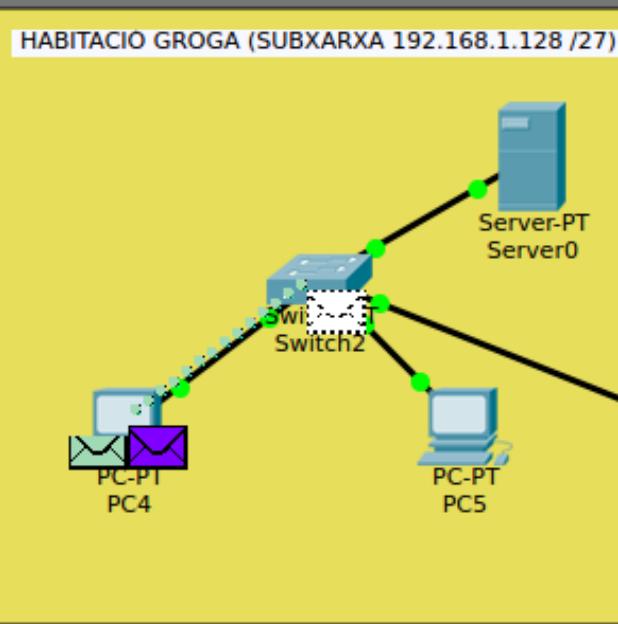
TCP

0	16	31 Bits
SRC PORT: 1025	DEST PORT: 25	
SEQUENCE NUM: 1		
ACK NUM: 1		
OFF: 0x0	RES: 0x0	PSH + ACK
		WINDOW
CHECKSUM: 0x0		URGENT POINTER
OPTION		PADDING
DATA (VARIABLE)		

SMTP

SMTP DATA	
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Exemple amb SMTP (pas 6)



PDU Information at Device: Switch2

OSI Model **Inbound PDU Details** **Outbound PDU Details**

At Device: Switch2
Source: PC4
Destination: 192.168.1.140

In Layers		Out Layers	
Layer7		Layer7	
Layer6		Layer6	
Layer5		Layer5	
Layer4		Layer4	
Layer3		Layer3	
Layer 2: Ethernet II Header 0001.637A.14DC >> 000C.CF28.C99A		Layer 2: Ethernet II Header 0001.637A.14DC >> 000C.CF28.C99A	
Layer 1: Port FastEthernet0/1		Layer 1: Port(s): FastEthernet2/1	

1. FastEthernet2/1 sends out the frame.

Challenge Me **<< Previous Layer** **Next Layer >>**

PDU Information at Device: Switch2

OSI Model **Inbound PDU Details** **Outbound PDU Details**

PDU Formats

Ethernet II

0	4	8	14	19 Bytes
PREAMBLE: 101010...1011	DEST MAC: 000C.CF28.C99A	SRC MAC: 0001.637A.14DC		
TYPE: 0x800	DATA (VARIABLE LENGTH)			FCS: 0x0

IP

0	4	8	16	19	31 Bits
IHL: 4	DSCP: 0x0	TL: 40			
ID: 0xb	0x2	0x0			
TTL: 128	PRO: 0x6	CHKSUM			
SRC IP: 192.168.1.151					
DST IP: 192.168.1.140					
OPT: 0x0					0x0
DATA (VARIABLE LENGTH)					

TCP

0	16	31 Bits		
SRC PORT: 1025	DEST PORT: 25			
SEQUENCE NUM: 1				
ACK NUM: 1				
OFF:	RES.:	ACK	WINDOW	
CHECKSUM: 0x0			URGENT POINTER	
OPTION			PADDING	
DATA (VARIABLE)				

Exemple amb SMTP (pas 7)

PDU Information at Device: Switch2

OSI Model Inbound PDU Details Outbound PDU Details

At Device: Switch2
Source: PC4
Destination: SMTP CLIENT

In Layers	Out Layers
Layer7	Layer7
Layer6	Layer6
Layer5	Layer5
Layer4	Layer4
Layer3	Layer3
Layer 2: Ethernet II Header 0001.637A.14DC >> 000C.CF28.C99A	Layer 2: Ethernet II Header 0001.637A.14DC >> 000C.CF28.C99A
Layer 1: Port FastEthernet0/1	Layer 1: Port(s): FastEthernet2/1

1. The outgoing port is an access port. Switch sends the frame out that port.

PDU Information at Device: Switch2

OSI Model Inbound PDU Details Outbound PDU Details

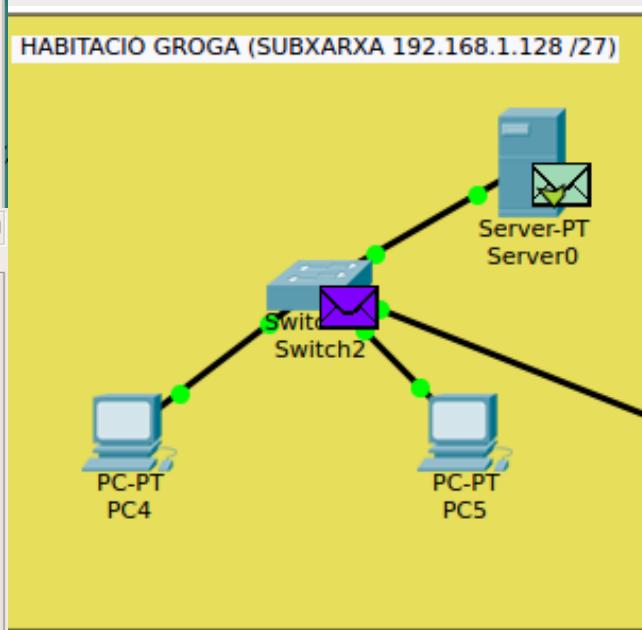
PDU Formats

Ethernet II					
0	4	8	14	19 Bytes	
PREAMBLE:	DEST MAC:	SRC MAC:			
101010...1011	000C.CF28.C99A	0001.637A.14DC			
TYPE: 0x800	DATA (VARIABLE LENGTH)			FCS: 0x0	

IP					
0	4	8	16	19	31 Bits
4	IHL	DSCP: 0x0	TL: 78		
ID: 0xc	0x2	0x0			
TTL: 128	PRO: 0x6	CHKSUM			
SRC IP: 192.168.1.151				DST IP: 192.168.1.140	
OPT: 0x0	0x0				
DATA (VARIABLE LENGTH)					

TCP					
0	16		31 Bits		
SRC PORT: 1025	DEST PORT: 25				
SEQUENCE NUM: 1					
ACK NUM: 1					
OFF.	RES.	PSH + ACK	WINDOW		
CHECKSUM: 0x0		URGENT POINTER			
OPTION		PADDING			
DATA (VARIABLE)					

SMTP					
SMTP DATA					



PDU Information at Device: Server0

OSI Model Inbound PDU Details

At Device: Server0
Source: PC4
Destination: 192.168.1.140

In Layers	Out Layers
Layer7	Layer7
Layer6	Layer6
Layer5	Layer5
Layer 4: TCP Src Port: 1025, Dst Port: 25	Layer 4: TCP Src Port: 1025, Dst Port: 25
Layer 3: IP Header Src. IP: 192.168.1.151, Dest. IP: 192.168.1.140	Layer 3: IP Header Src. IP: 192.168.1.151, Dest. IP: 192.168.1.140
Layer 2: Ethernet II Header 0001.637A.14DC >> 000C.CF28.C99A	Layer 2: Ethernet II Header 0001.637A.14DC >> 000C.CF28.C99A
Layer 1: Port FastEthernet0/1	Layer 1: Port FastEthernet0/1

1. The device receives a TCP ACK segment on the connection to 192.168.1.151 on port 1025.
2. Received segment information: the sequence number 1, the ACK number 1, and the data length 20.
3. The TCP segment has the expected peer sequence number.
4. The TCP connection is successful.
5. The device sets the connection state to ESTABLISHED.

PDU Information at Device: Server0

OSI Model Inbound PDU Details

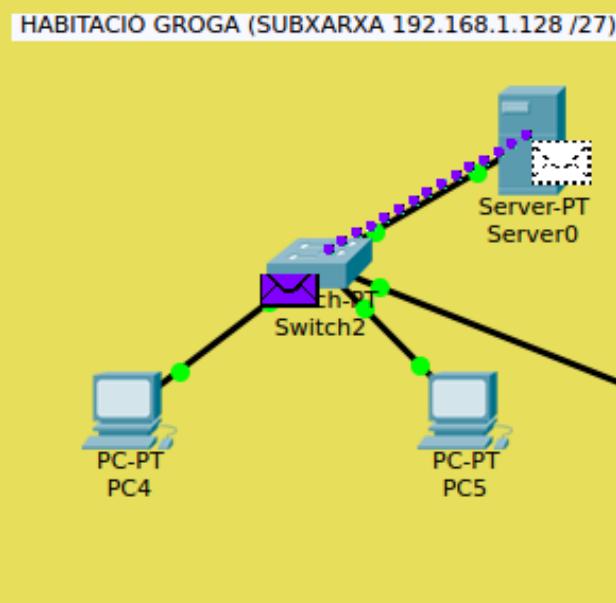
PDU Formats

Ethernet II					
0	4	8	14	19 Bytes	
PREAMBLE:	DEST MAC:	SRC MAC:			
101010...1011	000C.CF28.C99A	0001.637A.14DC			
TYPE: 0x800	DATA (VARIABLE LENGTH)			FCS: 0x0	

IP					
0	4	8	16	19	31 Bits
4	IHL	DSCP: 0x0	TL: 40		
ID: 0xb	0x2	0x0			
TTL: 128	PRO: 0x6	CHKSUM			
SRC IP: 192.168.1.151				DST IP: 192.168.1.140	
OPT: 0x0	0x0				
DATA (VARIABLE LENGTH)					

TCP					
0	16		31 Bits		
SRC PORT: 1025	DEST PORT: 25				
SEQUENCE NUM: 1					
ACK NUM: 1					
OFF.	RES.	ACK	WINDOW		
CHECKSUM: 0x0		URGENT POINTER			
OPTION		PADDING			
DATA (VARIABLE)					

Exemple amb SMTP (pas 8)



PDU Information at Device: Server0

OSI Model **Inbound PDU Details** **Outbound PDU Details**

At Device: Server0
Source: PC4
Destination: SMTP CLIENT

In Layers

Layer 7: SMTP
Layer6
Layer5
Layer 4: TCP Src Port: 1025, Dst Port: 25
Layer 3: IP Header Src. IP: 192.168.1.151, Dest. IP: 192.168.1.140
Layer 2: Ethernet II Header 0001.637A.14DC >> 000C.CF28.C99A
Layer 1: Port FastEthernet0

Out Layers

Layer 7: SMTP
Layer6
Layer5
Layer 4: TCP Src Port: 25, Dst Port: 1025
Layer 3: IP Header Src. IP: 192.168.1.140, Dest. IP: 192.168.1.151
Layer 2: Ethernet II Header 000C.CF28.C99A >> 0001.637A.14DC
Layer 1: Port(s): FastEthernet0

1. The device receives a TCP PUSH+ACK segment on the connection to 192.168.1.151 on port 1025.
 2. Received segment information: the sequence number 1, the ACK number 1, and the data length 58.
 3. The TCP segment has the expected peer sequence number.
 4. TCP processes payload data.
 5. TCP reassembles all data segments and passes to the upper layer.

Challenge Me **<< Previous Layer** **Next Layer >>**

PDU Information at Device: Server0

OSI Model **Inbound PDU Details** **Outbound PDU Details**

PDU Formats

Ethernet II

0	4	8	14	19 Bytes
PREAMBLE: 101010...1011		DEST MAC: 0001.637A.14DC	SRC MAC: 000C.CF28.C99A	
TYPE: 0x800		DATA (VARIABLE LENGTH)		FCS: 0x0

IP

0	4	8	16	19	31 Bits
4	IHL	DSCP: 0x0	TL: 44		
ID: 0xd		0x2	0x0		
TTL: 128	PRO: 0x6	CHKSUM			
SRC IP: 192.168.1.140					
DST IP: 192.168.1.151					
OPT: 0x0		0x0			
DATA (VARIABLE LENGTH)					

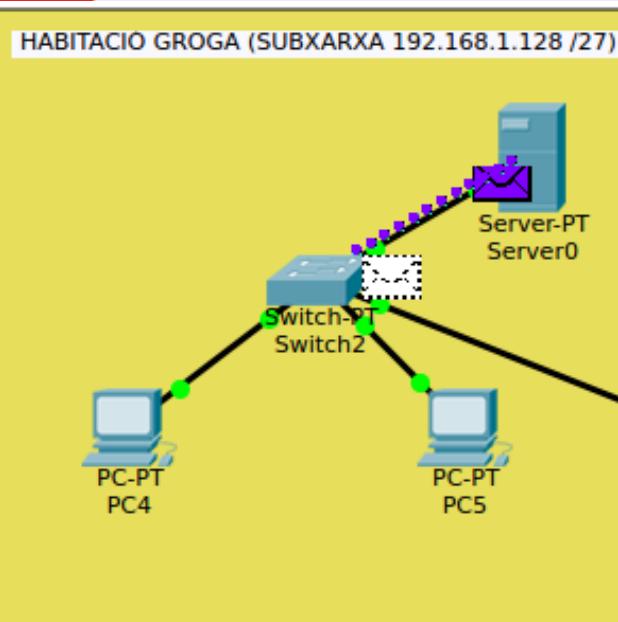
TCP

0	16	31 Bits		
SRC PORT: 25	DEST PORT: 1025			
SEQUENCE NUM: 1				
ACK NUM: 59				
OFF	RES.	PSH + ACK	WINDOW	
CHECKSUM: 0x0		URGENT POINTER		
OPTION		PADDING		
DATA (VARIABLE)				

SMTP

SMTP DATA	
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Exemple amb SMTP (pas 9)



PDU Information at Device: Switch2

OSI Model **Inbound PDU Details** **Outbound PDU Details**

At Device: Switch2
Source: PC4
Destination: SMTP CLIENT

In Layers		Out Layers	
Layer7		Layer7	
Layer6		Layer6	
Layer5		Layer5	
Layer4		Layer4	
Layer3		Layer3	
Layer 2: Ethernet II Header 000C.CF28.C99A >> 0001.637A.14DC		Layer 2: Ethernet II Header 000C.CF28.C99A >> 0001.637A.14DC	
Layer 1: Port FastEthernet2/1		Layer 1: Port(s): FastEthernet0/1	

1. The frame source MAC address was found in the MAC table of Switch.
2. This is a unicast frame. Switch looks in its MAC table for the destination MAC address.

Challenge Me **<< Previous Layer** **Next Layer >>**

PDU Information at Device: Switch2

OSI Model **Inbound PDU Details** **Outbound PDU Details**

PDU Formats

Ethernet II

0	4	8	14	19 Bytes
PREAMBLE: 101010...1011	DEST MAC: 0001.637A.14DC	SRC MAC: 000C.CF28.C99A		
TYPE: 0x800	DATA (VARIABLE LENGTH)			FCS: 0x0

IP

0	4	8	16	19	31 Bits
4	IHL: 0xd	DSCP: 0x0	TL: 44		
TTL: 128	ID: 0xd	0x2	0x0		
PRO: 0x6	CHKSUM				
SRC IP: 192.168.1.140					
DST IP: 192.168.1.151					
OPT: 0x0	0x0				
DATA (VARIABLE LENGTH)					

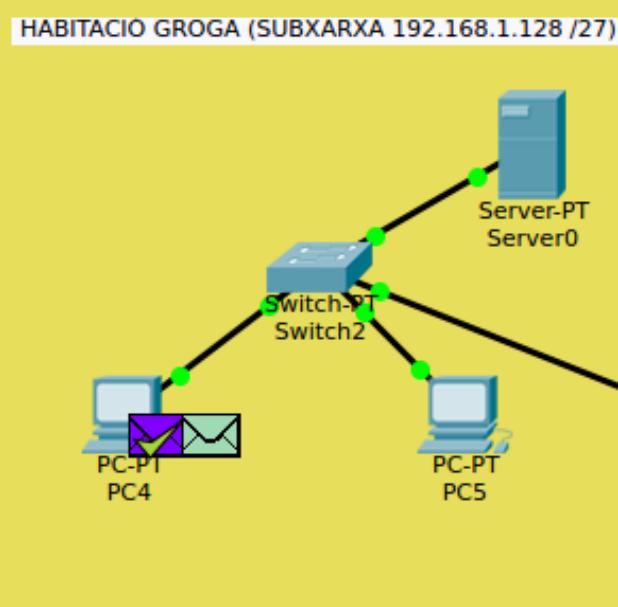
TCP

0	16	31 Bits		
SRC PORT: 25	DEST PORT: 1025			
SEQUENCE NUM: 1				
ACK NUM: 59				
OFF.	RES.	PSH + ACK	WINDOW	
CHECKSUM: 0x0		URGENT POINTER		
OPTION		PADDING		
DATA (VARIABLE)				

SMTP

SMTP DATA	
<<>>	

Exemple amb SMTP (pas 10)



PDU Information at Device: PC4

OSI Model Inbound PDU Details

At Device: PC4
Source: PC4
Destination: SMTP CLIENT

In Layers

- Layer 7: SMTP
- Layer6
- Layer5
- Layer 4: TCP Src Port: 25, Dst Port: 1025
- Layer 3: IP Header Src. IP: 192.168.1.140, Dest. IP: 192.168.1.151
- Layer 2: Ethernet II Header 000C.CF28.C99A >> 0001.637A.14DC
- Layer 1: Port FastEthernet0

Out Layers

- Layer7
- Layer6
- Layer5
- Layer4
- Layer3
- Layer2
- Layer1

1. The device receives a SMTP packet.

Challenge Me << Previous Layer Next Layer >>

PDU Information at Device: PC4

OSI Model Inbound PDU Details

PDU Formats

Ethernet II

0	4	8	14	19 Bytes
PREAMBLE: 101010...1011		DEST MAC: 0001.637A.14DC		SRC MAC: 000C.CF28.C99A
TYPE: 0x800		DATA (VARIABLE LENGTH)		FCS: 0x0

IP

0	4	8	16	19	31 Bits
4 IHL		DSCP: 0x0	TL: 44		
		ID: 0xd	0x2	0x0	
TTL: 128	PRO: 0x6		CHKSUM		
		SRC IP: 192.168.1.140			
		DST IP: 192.168.1.151			
		OPT: 0x0		0x0	
DATA (VARIABLE LENGTH)					

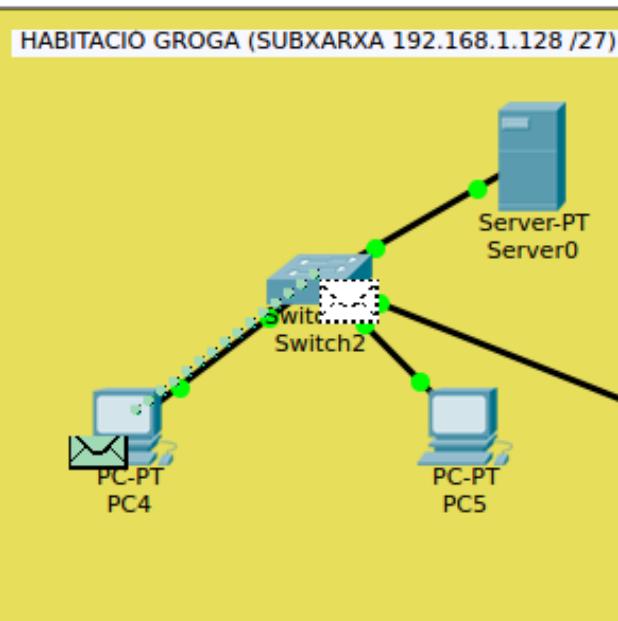
TCP

0	16		31 Bits
SRC PORT: 25		DEST PORT: 1025	
		SEQUENCE NUM: 1	
		ACK NUM: 59	
OFF.	RES.	PSH + ACK	WINDOW
		CHECKSUM: 0x0	
		URGENT POINTER	
		OPTION	PADDING
DATA (VARIABLE)			

SMTP

SMTP DATA	
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Exemple amb SMTP (pas 11)



PDU Information at Device: Switch2

OSI Model Inbound PDU Details Outbound PDU Details

At Device: Switch2
Source: PC4
Destination: 192.168.1.140

In Layers Out Layers

Layer7	Layer7
Layer6	Layer6
Layer5	Layer5
Layer4	Layer4
Layer3	Layer3
Layer 2: Ethernet II Header 0001.637A.14DC >> 000C.CF28.C99A	Layer 2: Ethernet II Header 0001.637A.14DC >> 000C.CF28.C99A
Layer 1: Port FastEthernet0/1	Layer 1: Port(s): FastEthernet2/1

1. FastEthernet2/1 sends out the frame.

Challenge Me << Previous Layer Next Layer >>

PDU Information at Device: Switch2

OSI Model Inbound PDU Details Outbound PDU Details

PDU Formats

Ethernet II

0	4	8	14	19 Bytes
PREAMBLE: 101010...1011			DEST MAC: 000C.CF28.C99A	SRC MAC: 0001.637A.14DC
TYPE: 0x800			DATA (VARIABLE LENGTH)	FCS: 0x0

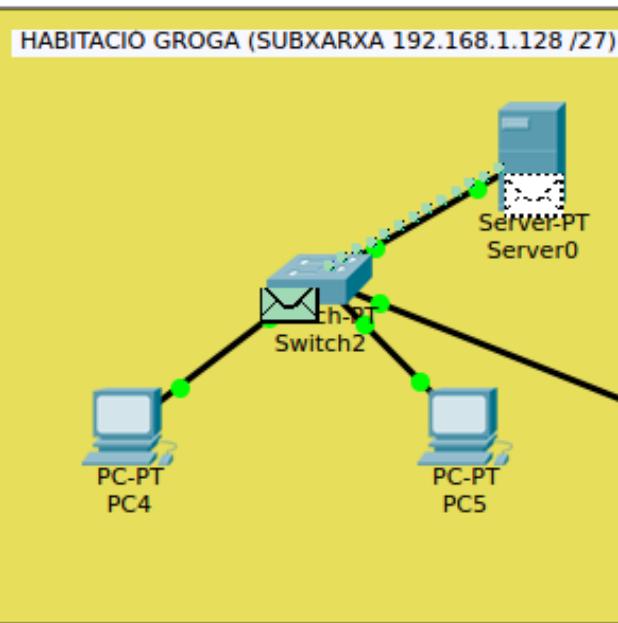
IP

0	4	8	16	19	31 Bits
4	IHL	DSCP: 0x0	TL: 40		
ID: 0xd	0x2			0x0	
TTL: 128	PRO: 0x6	CHKSUM			
SRC IP: 192.168.1.151					
DST IP: 192.168.1.140					
OPT: 0x0			0x0		
DATA (VARIABLE LENGTH)					

TCP

0	16	31 Bits			
SRC PORT: 1025	DEST PORT: 25				
SEQUENCE NUM: 59					
ACK NUM: 25					
OFF.	RES.	FIN + ACK	WINDOW		
CHECKSUM: 0x0			URGENT POINTER		
OPTION			PADDING		
DATA (VARIABLE)					

Exemple amb SMTP (pas 12)



PDU Information at Device: Server0

OSI Model	Inbound PDU Details	Outbound PDU Details
At Device: Server0 Source: PC4 Destination: 192.168.1.140		
In Layers	Out Layers	
Layer7	Layer7	
Layer6	Layer6	
Layer5	Layer5	
Layer 4: TCP Src Port: 1025, Dst Port: 25	Layer 4: TCP Src Port: 25, Dst Port: 1025	
Layer 3: IP Header Src. IP: 192.168.1.151, Dest. IP: 192.168.1.140	Layer 3: IP Header Src. IP: 192.168.1.140, Dest. IP: 192.168.1.151	
Layer 2: Ethernet II Header 0001.637A.14DC >> 000C.CF28.C99A	Layer 2: Ethernet II Header 000C.CF28.C99A >> 0001.637A.14DC	
Layer 1: Port FastEthernet0	Layer 1: Port(s): FastEthernet0	

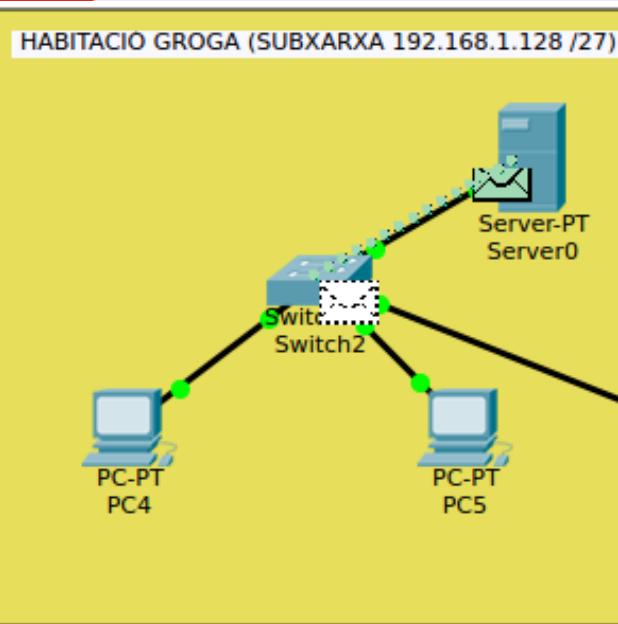
1. The device receives a TCP FIN+ACK segment on the connection to 192.168.1.151 on port 1025.
 2. Received segment information: the sequence number 59, the ACK number 25, and the data length 20.
 3. The TCP segment has the expected peer sequence number.
 4. The TCP connection was disconnected.
 5. The device sets the connection state to CLOSE_WAIT.
 6. The device sets the connection state to LAST_ACK.
 7. The TCP segment has the expected ACK number. The device pops the last sent segment from the buffer.

Challenge Me << Previous Layer Next Layer >>

PDU Information at Device: Server0

OSI Model	Inbound PDU Details	Outbound PDU Details					
PDU Formats							
Ethernet II							
0	4	8	14	19 Bytes			
PREAMBLE:	DEST MAC:	SRC MAC:					
101010...1011	0001.637A.14DC	000C.CF28.C99A					
TYPE: 0x800	DATA (VARIABLE LENGTH)			FCS: 0x0			
IP							
0	4	8	16	19	31 Bits		
4	IHL	DSCP: 0x0	TL: 40				
		ID: 0xe	0x2	0x0			
TTL: 128	PRO: 0x6	CHKSUM					
SRC IP: 192.168.1.140					DST IP: 192.168.1.151		
OPT: 0x0					0x0		
DATA (VARIABLE LENGTH)							
TCP							
0	16					31 Bits	
SRC PORT: 25		DEST PORT: 1025					
SEQUENCE NUM: 25							
ACK NUM: 60							
OFF.	RES.	FIN + ACK	WINDOW				
		CHECKSUM: 0x0	URGENT POINTER				
OPTION						PADDING	
DATA (VARIABLE)							

Exemple amb SMTP (pas 13)



PDU Information at Device: Switch2

OSI Model Inbound PDU Details Outbound PDU Details

At Device: Switch2
Source: PC4
Destination: 192.168.1.140

In Layers

- Layer7
- Layer6
- Layer5
- Layer4
- Layer3

Out Layers

- Layer7
- Layer6
- Layer5
- Layer4
- Layer3

Layer 2: Ethernet II Header 000C.CF28.C99A >> 0001.637A.14DC

Layer 1: Port FastEthernet2/1

1. FastEthernet0/1 sends out the frame.

Challenge Me << Previous Layer Next Layer >>

PDU Information at Device: Switch2

OSI Model Inbound PDU Details Outbound PDU Details

PDU Formats

Ethernet II

0	4	8	14	19 Bytes
PREAMBLE: 101010...1011		DEST MAC: 0001.637A.14DC		SRC MAC: 000C.CF28.C99A
TYPE: 0x800		DATA (VARIABLE LENGTH)		FCS: 0x0

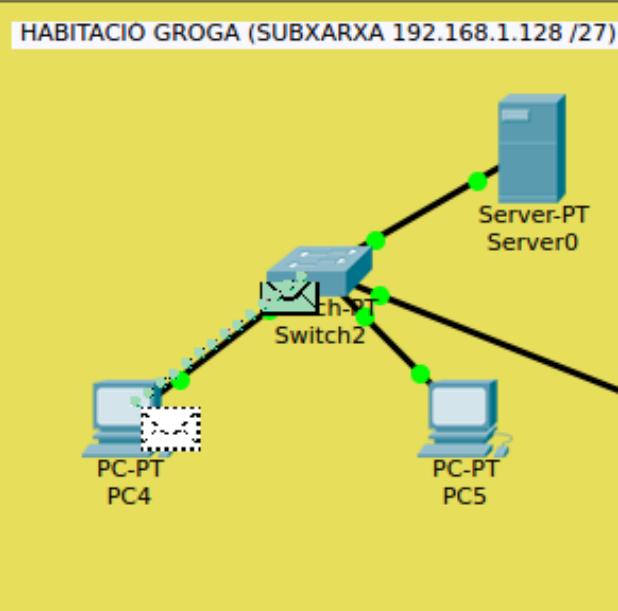
IP

0	4	8	16	19	31 Bits
4	IHL	DSCP: 0x0	TL: 40		
ID: 0xe		0x2	0x0		
TTL: 128	PRO: 0x6	CHKSUM			
SRC IP: 192.168.1.140		DST IP: 192.168.1.151			
OPT: 0x0		0x0			
DATA (VARIABLE LENGTH)					

TCP

0	16	31 Bits		
SRC PORT: 25		DEST PORT: 1025		
SEQUENCE NUM: 25				
ACK NUM: 60				
OFF.	RES.	FIN + ACK	WINDOW	
CHECKSUM: 0x0		URGENT POINTER		
OPTION			PADDING	
DATA (VARIABLE)				

Exemple amb SMTP (pas 14)



PDU Information at Device: PC4

OSI Model	Inbound PDU Details	Outbound PDU Details
At Device: PC4 Source: PC4 Destination: 192.168.1.140		
In Layers	Out Layers	
Layer7	Layer7	
Layer6	Layer6	
Layer5	Layer5	
Layer 4: TCP Src Port: 25, Dst Port: 1025	Layer 4: TCP Src Port: 1025, Dst Port: 25	
Layer 3: IP Header Src. IP: 192.168.1.140, Dest. IP: 192.168.1.151	Layer 3: IP Header Src. IP: 192.168.1.151, Dest. IP: 192.168.1.140	
Layer 2: Ethernet II Header 000C.CF28.C99A >> 0001.637A.14DC	Layer 2: Ethernet II Header 0001.637A.14DC >> 000C.CF28.C99A	
Layer 1: Port FastEthernet0	Layer 1: Port(s): FastEthernet0	

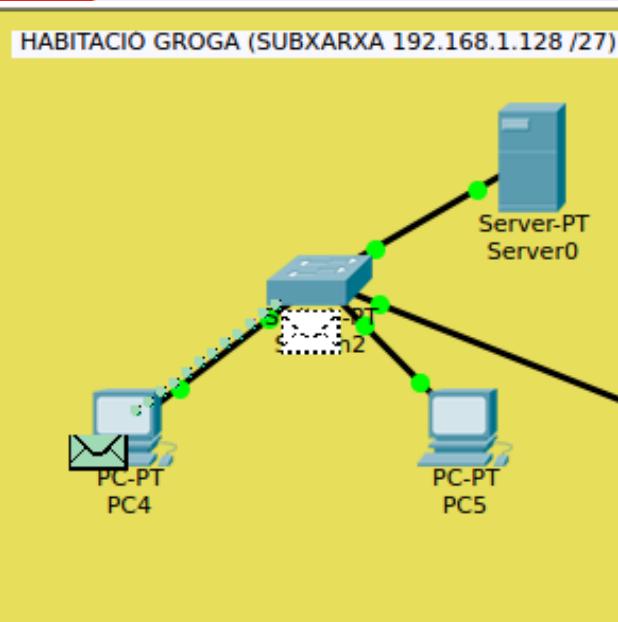
1. The device receives a TCP FIN+ACK segment on the connection to 192.168.1.140 on port 25.
 2. Received segment information: the sequence number 25, the ACK number 60, and the data length 20.
 3. The TCP segment has the expected peer sequence number.
 4. The device sets the connection state to CLOSING.

Challenge Me << Previous Layer Next Layer >>

PDU Information at Device: PC4

OSI Model	Inbound PDU Details	Outbound PDU Details	
PDU Formats			
<u>Ethernet II</u>			
0 4 8 14 19 Bytes			
PREAMBLE: 101010...1011	DEST MAC: 000C.CF28.C99A	SRC MAC: 0001.637A.14DC	
TYPE: 0x800	DATA (VARIABLE LENGTH)	FCS: 0x0	
<u>IP</u>			
0 4 8 16 19 31 Bits			
4 IHL DSCP: 0x0 TL: 40			
ID: 0xe	0x2	0x0	
TTL: 128	PRO: 0x6	CHKSUM	
SRC IP: 192.168.1.151			
DST IP: 192.168.1.140			
OPT: 0x0 0x0			
DATA (VARIABLE LENGTH)			
<u>TCP</u>			
0 16 31 Bits			
SRC PORT: 1025 DEST PORT: 25			
SEQUENCE NUM: 60			
ACK NUM: 25			
OFF.	RES.	ACK	WINDOW
CHECKSUM: 0x0		URGENT POINTER	
OPTION			PADDING
DATA (VARIABLE)			

Exemple amb SMTP (pas 15)



PDU Information at Device: Switch2

OSI Model	Inbound PDU Details	Outbound PDU Details
At Device: Switch2 Source: PC4 Destination: 192.168.1.140		
In Layers	Out Layers	
Layer7	Layer7	
Layer6	Layer6	
Layer5	Layer5	
Layer4	Layer4	
Layer3	Layer3	
Layer 2: Ethernet II Header 0001.637A.14DC >> 000C.CF28.C99A		Layer 2: Ethernet II Header 0001.637A.14DC >> 000C.CF28.C99A
Layer 1: Port FastEthernet0/1		Layer 1: Port(s): FastEthernet2/1

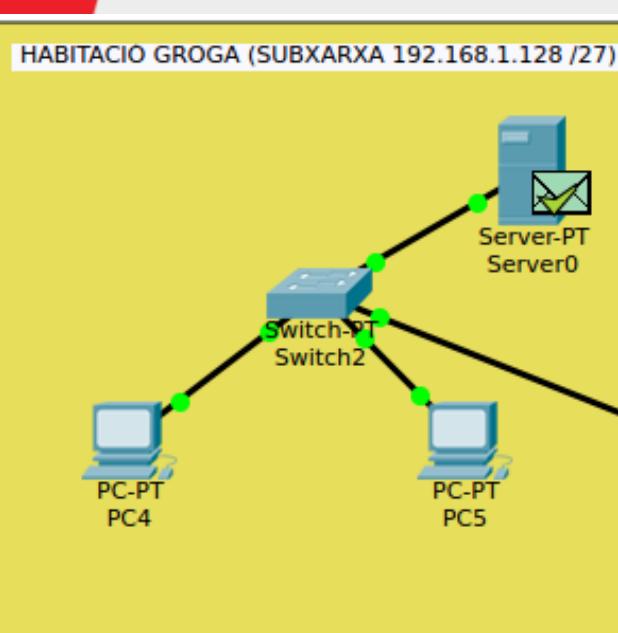
1. FastEthernet0/1 receives the frame.

Challenge Me << Previous Layer Next Layer >>

PDU Information at Device: Switch2

OSI Model	Inbound PDU Details	Outbound PDU Details			
PDU Formats					
Ethernet II					
0	4	8	14	19 Bytes	
PREAMBLE:		DEST MAC:		SRC MAC:	
101010...1011		000C.CF28.C99A		0001.637A.14DC	
TYPE: 0x800		DATA (VARIABLE LENGTH)		FCS: 0x0	
IP					
0	4	8	16	19	31 Bits
4	IHL	DSCP: 0x0	TL: 40		
ID: 0xe		0x2	0x0		
TTL: 128	PRO: 0x6	CHKSUM			
SRC IP: 192.168.1.151					
DST IP: 192.168.1.140					
OPT: 0x0					0x0
DATA (VARIABLE LENGTH)					
TCP					
0	16		31 Bits		
SRC PORT: 1025		DEST PORT: 25			
SEQUENCE NUM: 60					
ACK NUM: 25					
OFF.	RES.	ACK	WINDOW		
CHECKSUM: 0x0		URGENT POINTER			
OPTION					PADDING
DATA (VARIABLE)					

Exemple amb SMTP (pas 16)



PDU Information at Device: Server0

OSI Model Inbound PDU Details

At Device: Server0
Source: PC4
Destination: 192.168.1.140

In Layers	Out Layers
Layer7	Layer7
Layer6	Layer6
Layer5	Layer5
Layer 4: TCP Src Port: 1025, Dst Port: 25	Layer4
Layer 3: IP Header Src. IP: 192.168.1.151, Dest. IP: 192.168.1.140	Layer3
Layer 2: Ethernet II Header 0001.637A.14DC >> 000C.CF28.C99A	Layer2
Layer 1: Port FastEthernet0	Layer1

1. The device receives a TCP ACK segment on the connection to 192.168.1.151 on port 1025.
2. Received segment information: the sequence number 60, the ACK number 25, and the data length 20.
3. The TCP segment has the expected peer sequence number.
4. The device sets the connection state to CLOSED.

Challenge Me << Previous Layer Next Layer >>

PDU Information at Device: Server0

OSI Model Inbound PDU Details

PDU Formats

Ethernet II

0	4	8	14	19 Bytes
PREAMBLE: 101010...1011	DEST MAC: 000C.CF28.C99A	SRC MAC: 0001.637A.14DC		
TYPE: 0x800	DATA (VARIABLE LENGTH)	FCS: 0x0		

IP

0	4	8	16	19	31 Bits
IHL: 4	DSCP: 0x0		TL: 40		
ID: 0xe		0x2	0x0		
TTL: 128	PRO: 0x6		CHKSUM		
SRC IP: 192.168.1.151					
DST IP: 192.168.1.140					
OPT: 0x0 0x0					
DATA (VARIABLE LENGTH)					

TCP

0	16	31 Bits	
SRC PORT: 1025	DEST PORT: 25		
SEQUENCE NUM: 60			
ACK NUM: 25			
OFF.	RES.	ACK	WINDOW
CHECKSUM: 0x0		URGENT POINTER	
OPTION			PADDING
DATA (VARIABLE)			

Conclusions

TCP/IP és un model de comunicacions en xarxa exitós gràcies a la versatilitat dels protocols que utilitza (TCP, UDP, ICMP, IP, etc.), intercanviables uns pels altres per tal d'adaptar-se a un gran nombre de situacions, servint contínuament a moltes aplicacions d'usuari i fent possible l'intercanvi de la seva informació a distància.

Cisco Packet Tracer és un simulador precís i complet per experimentar amb escenaris de construcció i manteniment de xarxes, que ens permet posar en pràctica els conceptes teòrics apresos a l'assignatura, sense el perill de malmetre cap aparell o xarxa real, no virtual.

Gràcies per l'atenció. Alguna pregunta?

