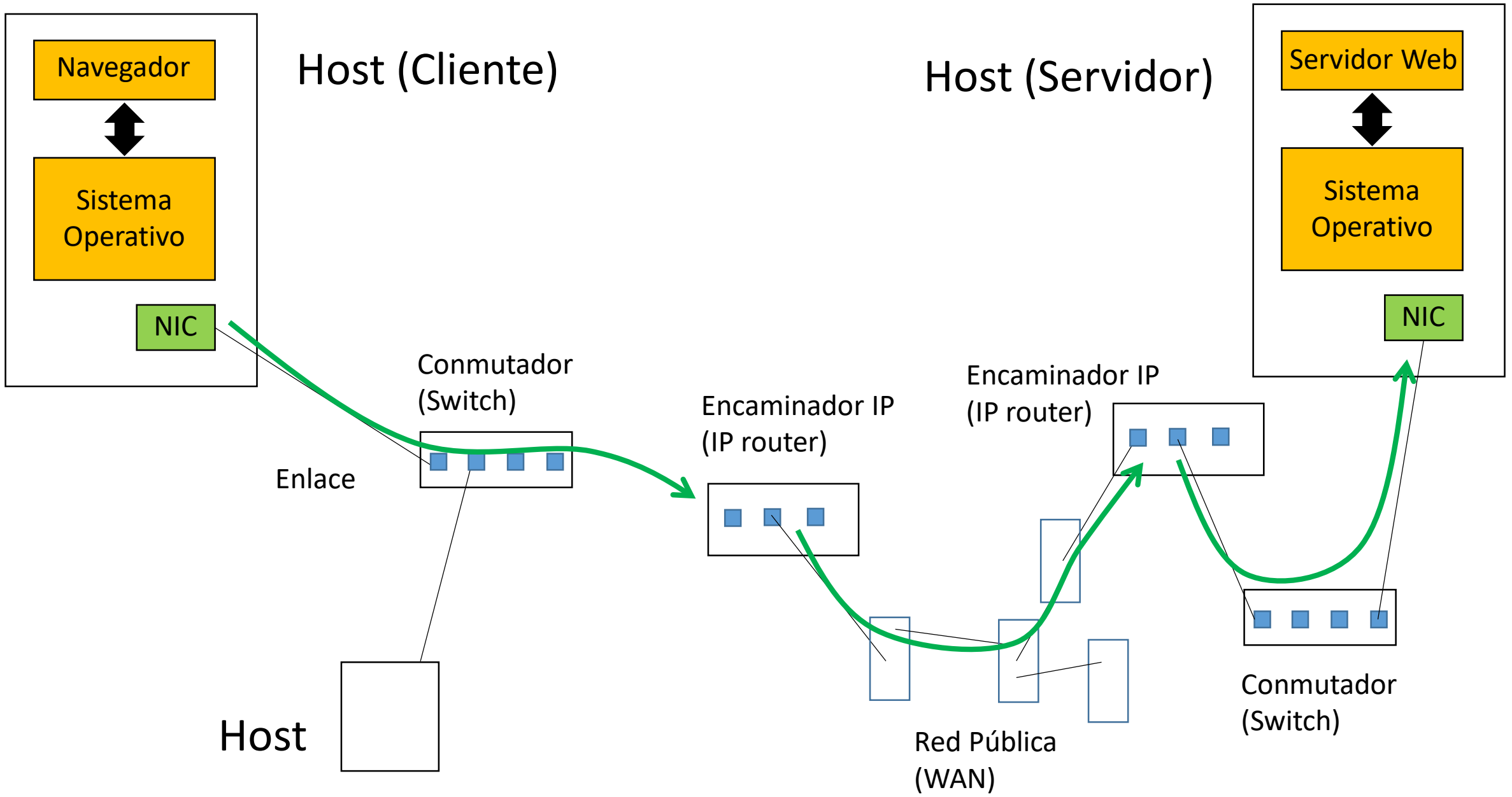
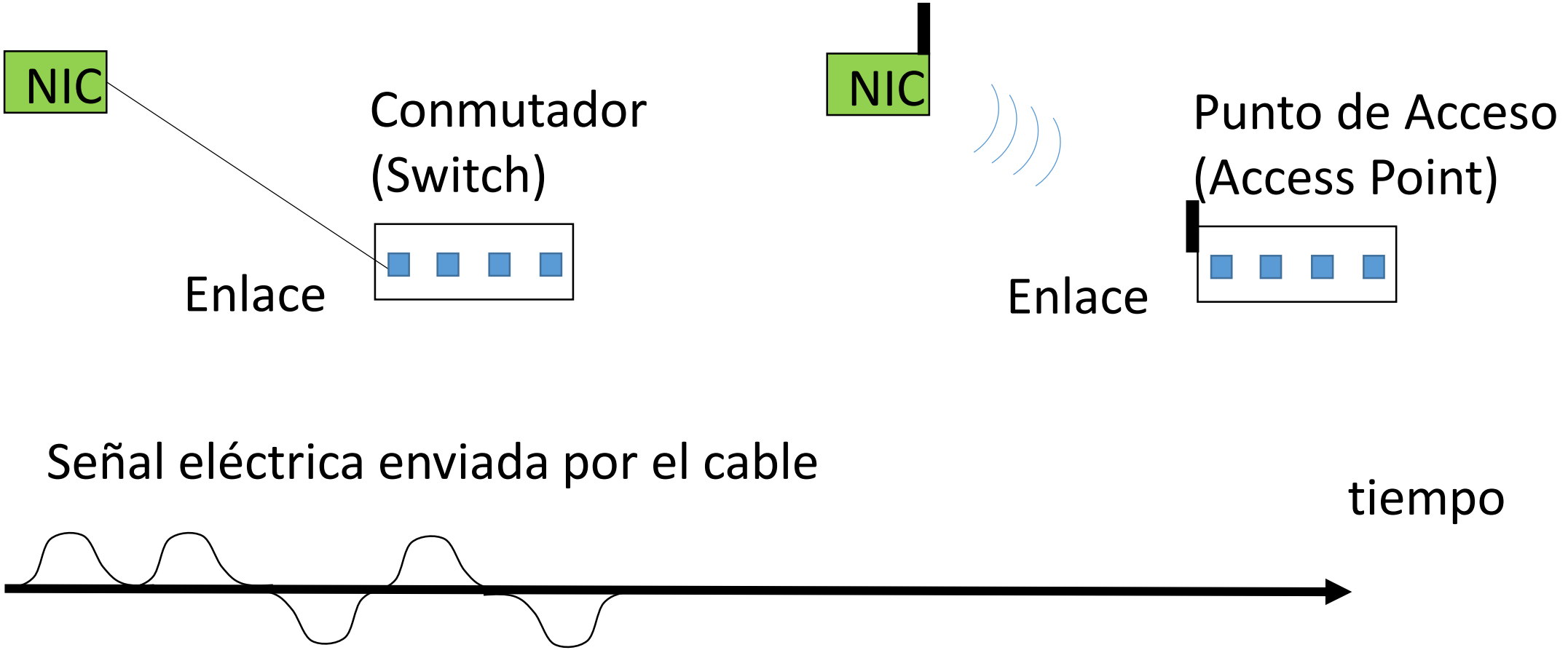
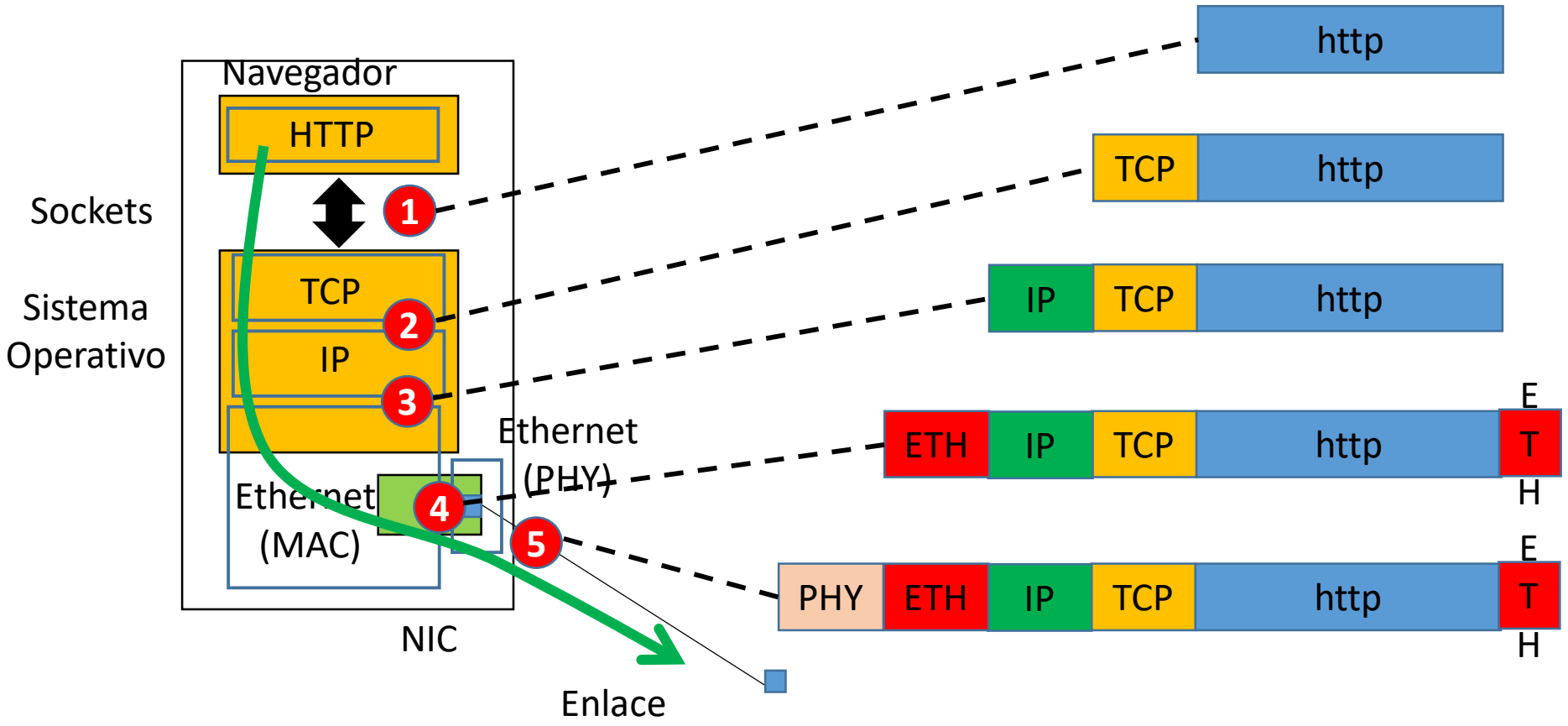
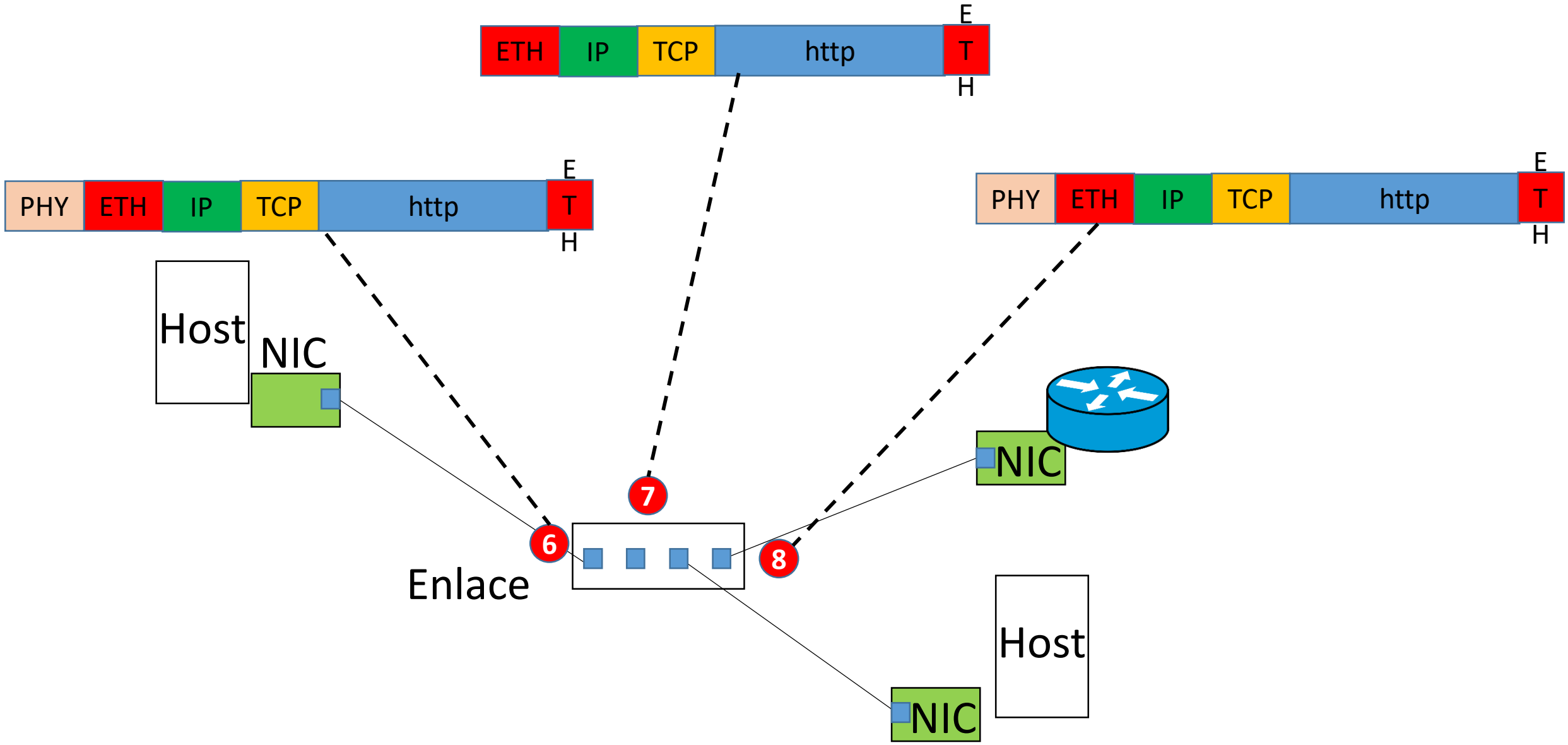
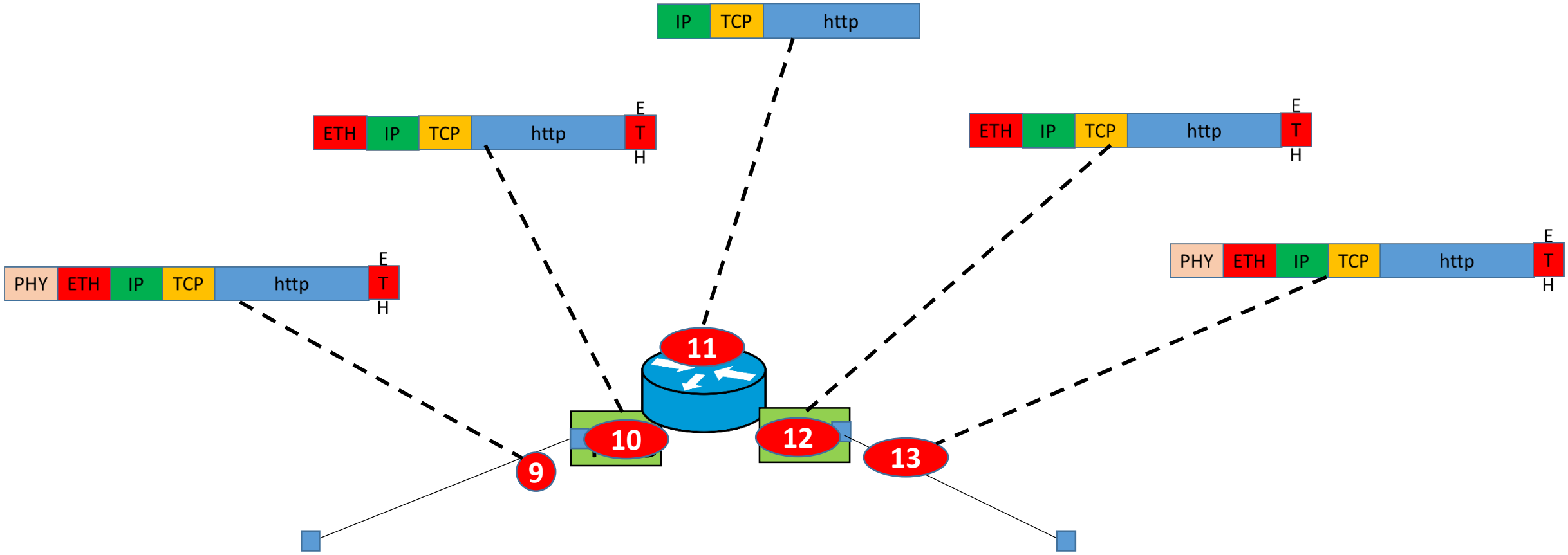

Navegador
Sistema Operativo
NIC
Host (Cliente)
Conmutador (Switch)
Enlace
Host
Encaminador IP (IP router)
Red Pública (WAN)
Encaminador IP (IP router)
Host (Servidor)
Servidor Web
Sistema Operativo
NIC
Conmutador (Switch)


NIC
Conmutador
(Switch)
Enlace
NIC
Punto de Acceso
(Access Point)
Enlace
Señal eléctrica enviada por el cable
tiempo
1101 0100 0101 0100 0001 1010 1110 1110 1110 0110 1010 1110 1101 1010 0001 0101 0011 0101 0100
Cabecera (Header)
Campo de datos (Payload)

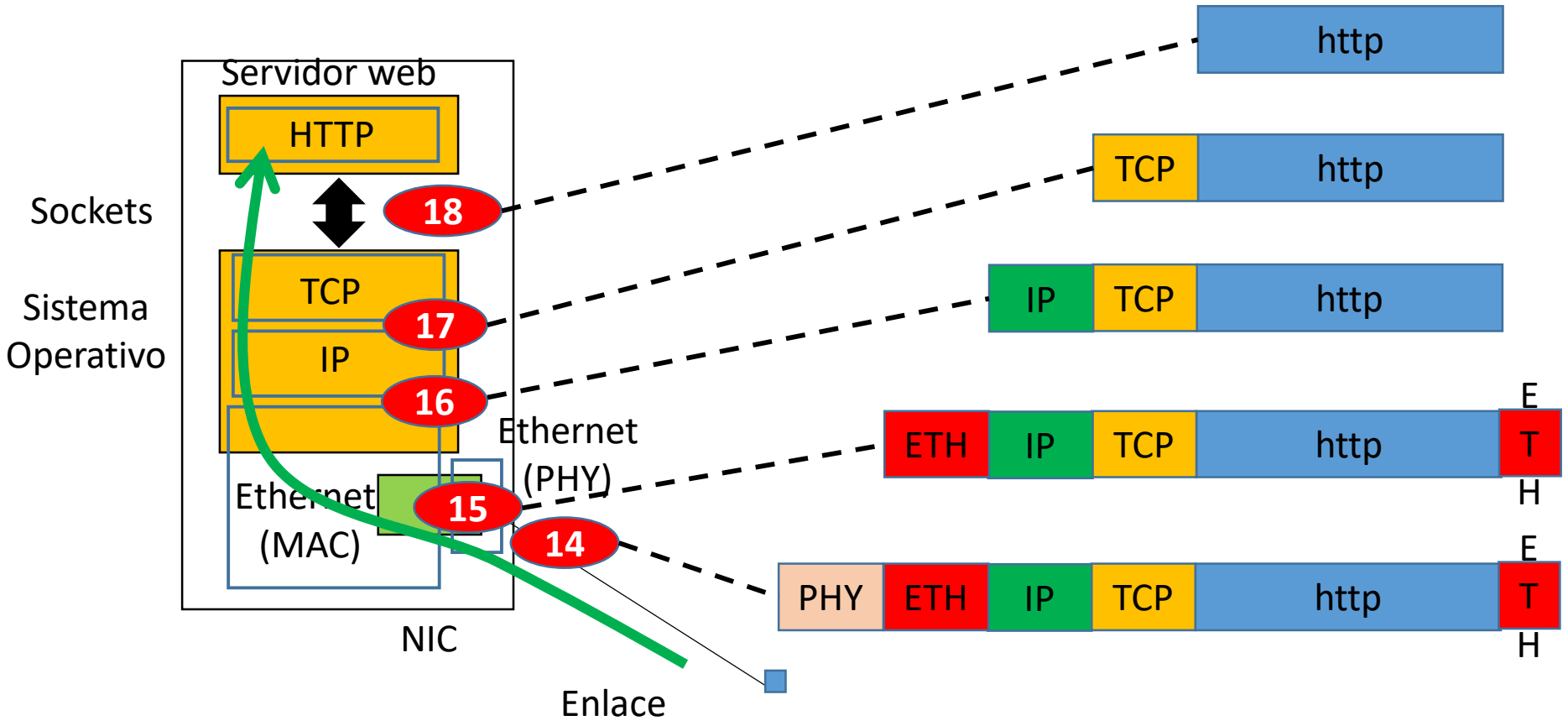
Generación de paquetes

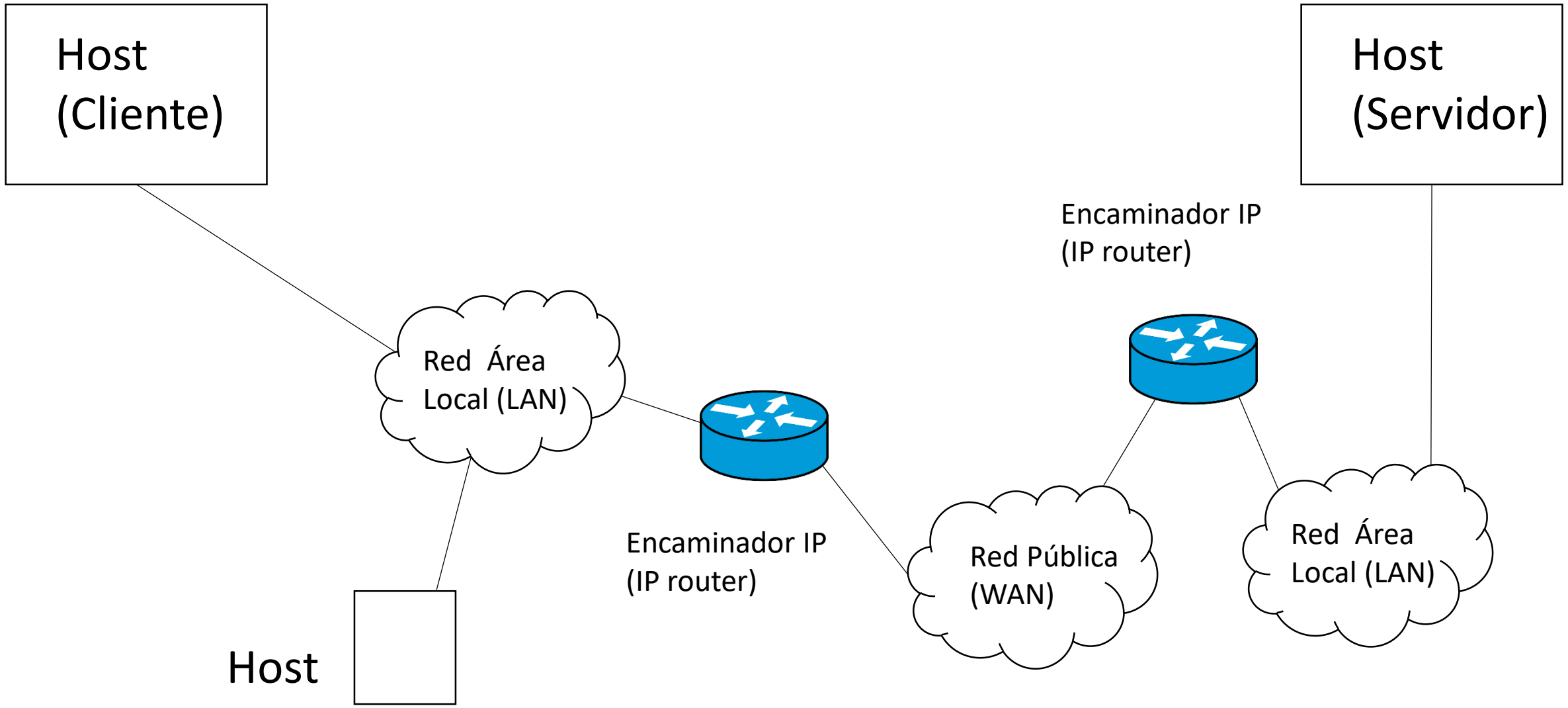


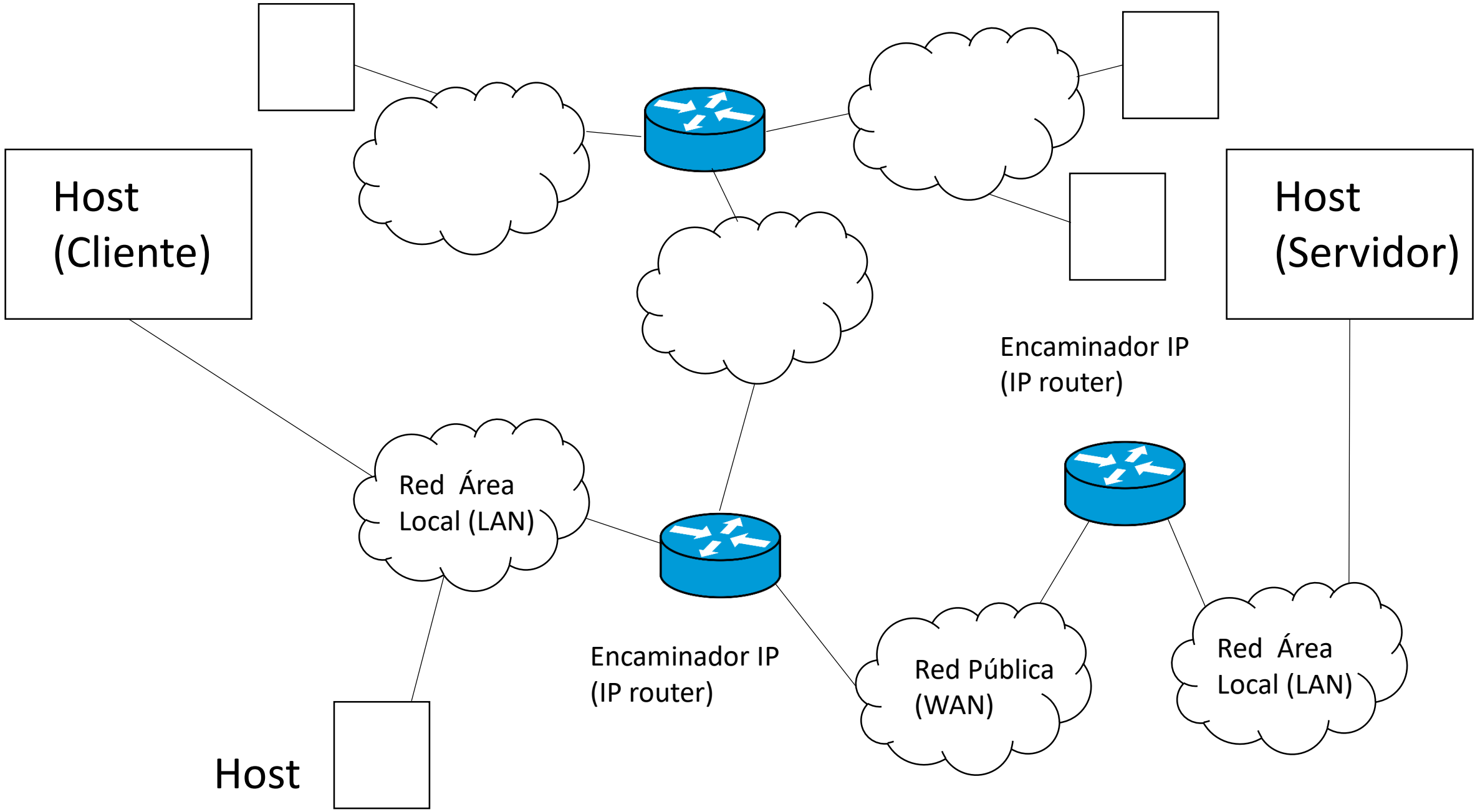

ETH
IP
TCP
http
E
T
H
PHY
ETH
IP
TCP
http
E
T
H
PHY
ETH
IP
TCP
http
E
T
H
Host
NIC
NIC
7
6
8
Enlace
NIC
Host

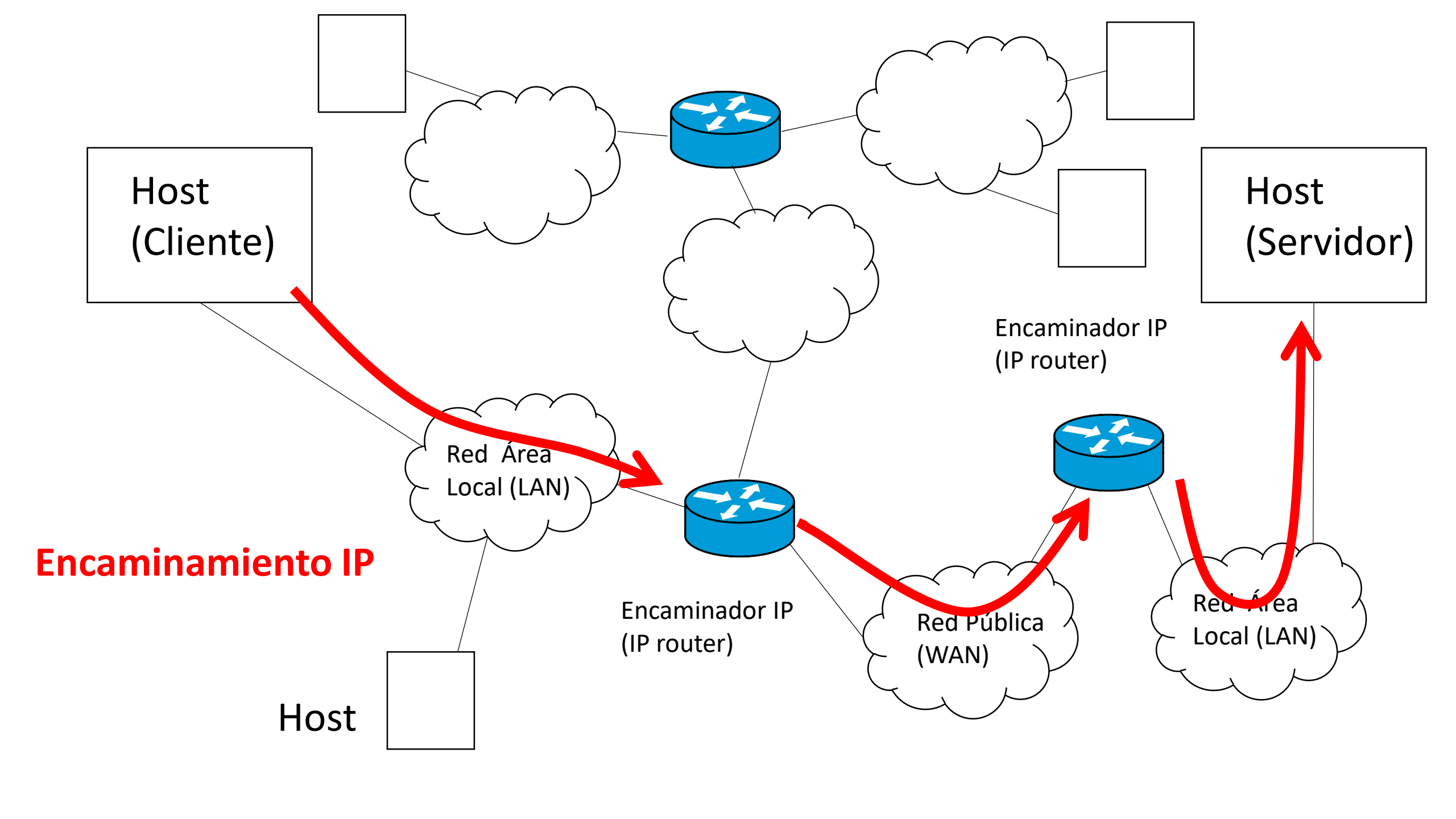

IP
TCP
http
ETH
IP
TCP
http
ETH
IP
TCP
http
PHY
ETH
IP
TCP
http
PHY
ETH
IP
TCP
http
11
10
12
9
13

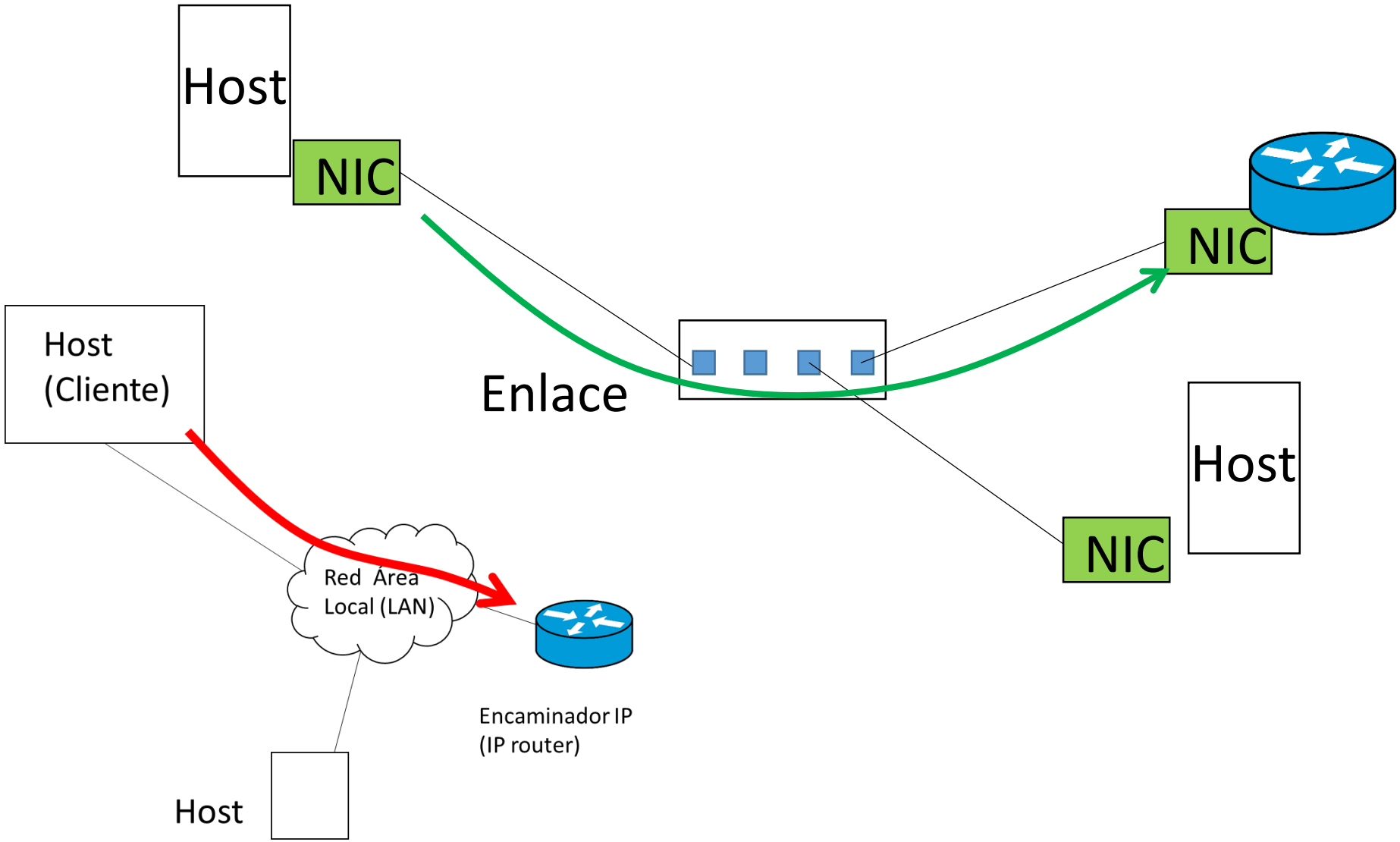
Proceso de paquetes

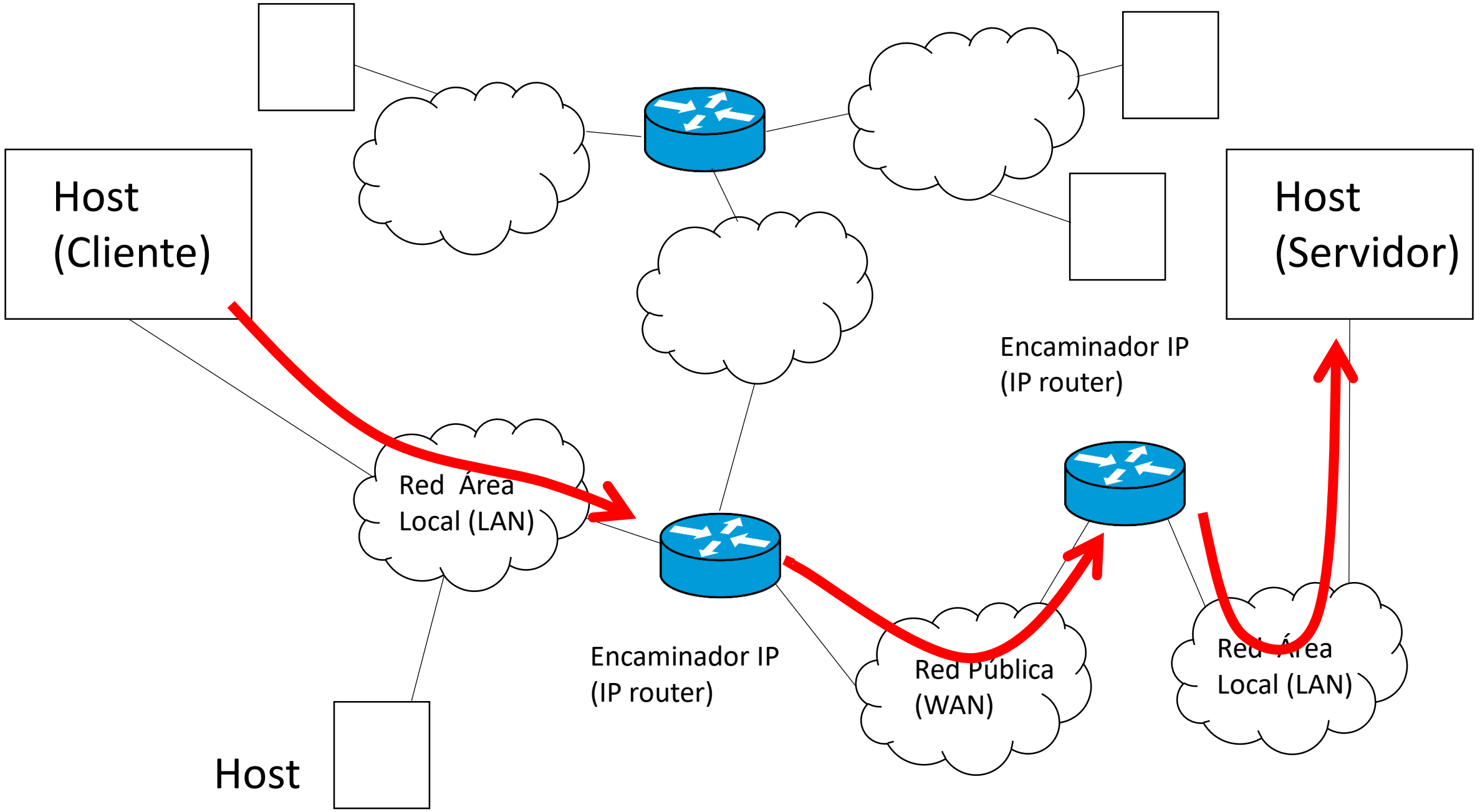



Host
(Cliente)
Host
(Servidor)
Encaminador IP
(IP router)
Red Área
Local (LAN)
Encaminador IP
(IP router)
Red Pública
(WAN)
Red Área
Local (LAN)
Host


Host
(Cliente)
Host
(Servidor)
Encaminador IP
(IP router)
Red Área
Local (LAN)
Encaminador IP
(IP router)
Red Pública
(WAN)
Red Área
Local (LAN)
Host


Host
(Cliente)
Host
(Servidor)
Encaminador IP
(IP router)
Red Área
Local (LAN)
Encaminamiento IP
Encaminador IP
(IP router)
Red Pública
(WAN)
Red Área
Local (LAN)
Host


Host
NIC
Host
(Cliente)
Enlace
NIC
Host
NIC
Red Área
Local (LAN)
Encaminador IP
(IP router)
Host


Host
(Cliente)
Host
(Servidor)
Red Área
Local (LAN)
Encaminador IP
(IP router)
Encaminador IP
(IP router)
Red Pública
(WAN)
Red Área
Local (LAN)
Host

Etiqueta, dirección, nombre

- **Etiqueta**: secuencia de bits única (ethernet: a2:10:4e:33:30:03)
- **Dirección**: Etiqueta que contiene información de encaminamiento

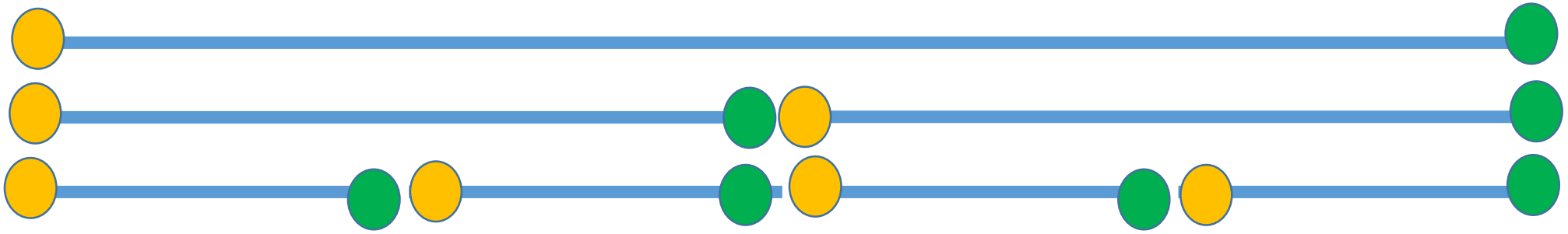
(93 401 6978, direcciones IP: 172.45.67.69)

- **Nombre**: legible por humanos (http://www.upc.edu)

256 = 2^8

1 bit de subnet

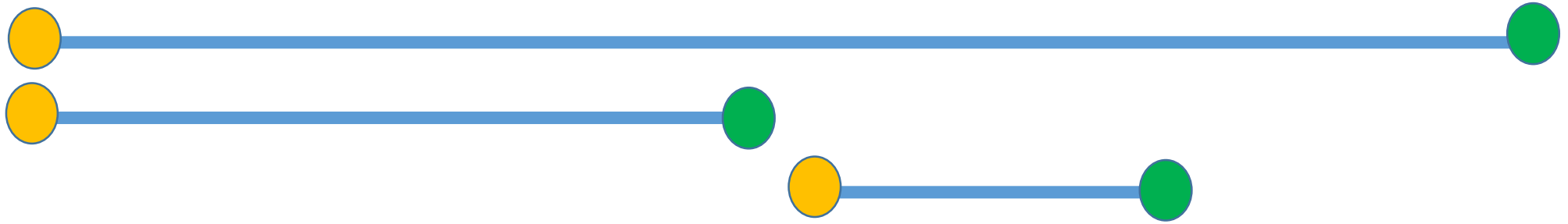
2 bits de subnet



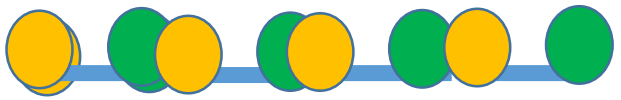
256 = 2^8

1 bit de subnet

2 bits de subnet



4 bits de subnet



R1

destination	genmask	gateway	interface
200.10.10.0	255.255.255.0 /24	0.0.0.0	eth0
200.20.20.0	255.255.255.0 /24	0.0.0.0	eth1
0.0.0.0	0.0.0.0 /0	200.20.20.1	ppp0

Por el **eth0**, recibimos un paquete IP con @ destino= 200.20.20.10 (al PC2)

Se recorre la table de encaminamiento. Para cada entrada de la tabla se hace lo siguiente

(1) Aplicamos (AND logico bit a bit) **genmask** a la @destino
(2) Comparamos con **destination.** Hay match?
(3) No match: pasamos a la siguiente entrada de la table
(4) Sí match: **interface**= posible interface de salida; **gateway**: posible next node

Se escoge como ruta la entrada que ha hecho match y tiene más bits de prefijo de genmask (“Longest Prefix Match”)

R1

	destination	genmask	gateway	interface
a	200.10.10.0	255.255.255.0 /24	0.0.0.0	eth0
b	200.20.20.0	255.255.255.0 /24	0.0.0.0	eth1
c	0.0.0.0	0.0.0.0 /0	**200.30.30.1**	ppp0

Por el **eth0**, recibimos un paquete IP con @ destino= 200.20.20.10 (al PC2)

Se recorre la table de encaminamiento. Para cada entrada de la tabla se hace lo siguiente

(1) Aplicamos (AND logico bit a bit) **genmask** a la @destino

(a) 200.20.20.0

(b) 200.20.20.0

(c) 0.0.0.0

(2) Comparamos con **destination.** Hay match?

(3) No match: pasamos a la siguiente entrada de la table

Sí match: **interface**= posible interface de salida; **gateway**: posible next node

(a) NO match

(b) **SÍ match**: posible interface: eth1, posible gateway: directa

(c) **SÍ match**: posible interface: pp0, posible gateway: **200.30.30.1**

Escogemos la ruta (b)

R1

	destination	genmask	gateway	interface
a	200.10.10.0	255.255.255.0 /24	0.0.0.0	eth0
b	200.20.20.0	255.255.255.0 /24	0.0.0.0	eth1
c	0.0.0.0	0.0.0.0 /0	**200.30.30.1**	eth2

Por el **eth0**, recibimos un paquete IP con @ destino= 147.82.20.1

Se recorre la table de encaminamiento. Para cada entrada de la tabla se hace lo siguiente

(1) Aplicamos (AND logico bit a bit) **genmask** a la @destino

(a) 147.82.20.0

(b) 147.82.20.0

(c) 0.0.0.0

(2) Comparamos con **destination.** Hay match?

(3) No match: pasamos a la siguiente entrada de la table

Sí match: **interface**= posible interface de salida; **gateway**: posible next node

(a) NO match

(b) NO match

(c) **SÍ match**: posible interface: pp0, posible gateway: **200.30.30.1**

Escogemos la ruta (c) (ruta por defecto)

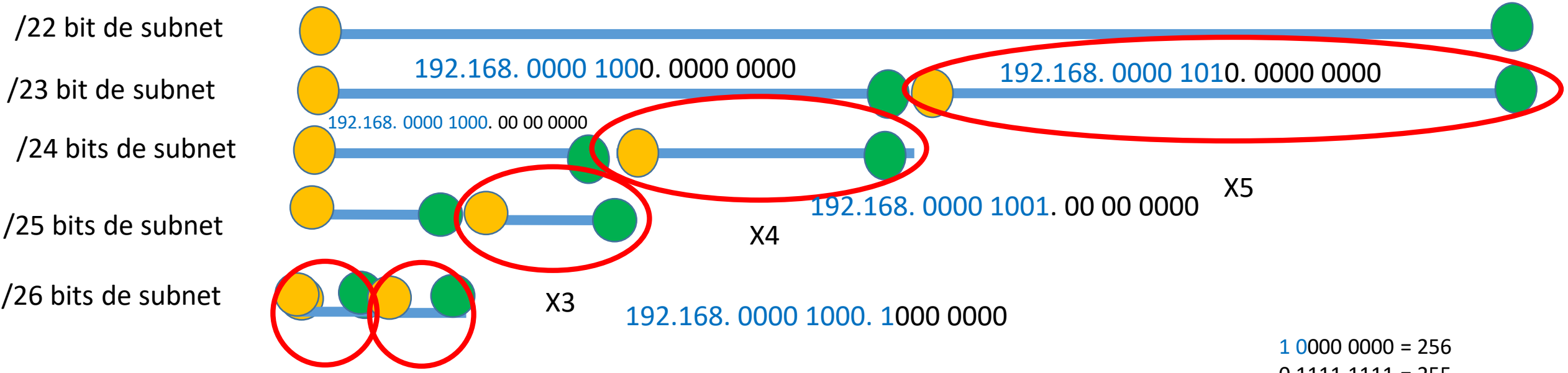
- 192.168.8.0/26
- 192.168. 0000 1000. 00 00 0000

- 192.168.8. 00 00 0001 => 192.168.8.1
- 192.168.8. 00 11 1110 => 192.168.8.62

- Rango assignable: 192.168.8.1 a 192.168.8.62
- Dirección de red: 192.168.8.0 /26
- Dirección de broadcast => 192.168.8.63

- 0100 0000 => 64

1024 = 2 ^{10} 192.168. 0000 10 00. 0000 0000



1 0000 0000 = 256
0 1111 1111 = 255

1000 000 = 128
0111 111 = 127

Etc..

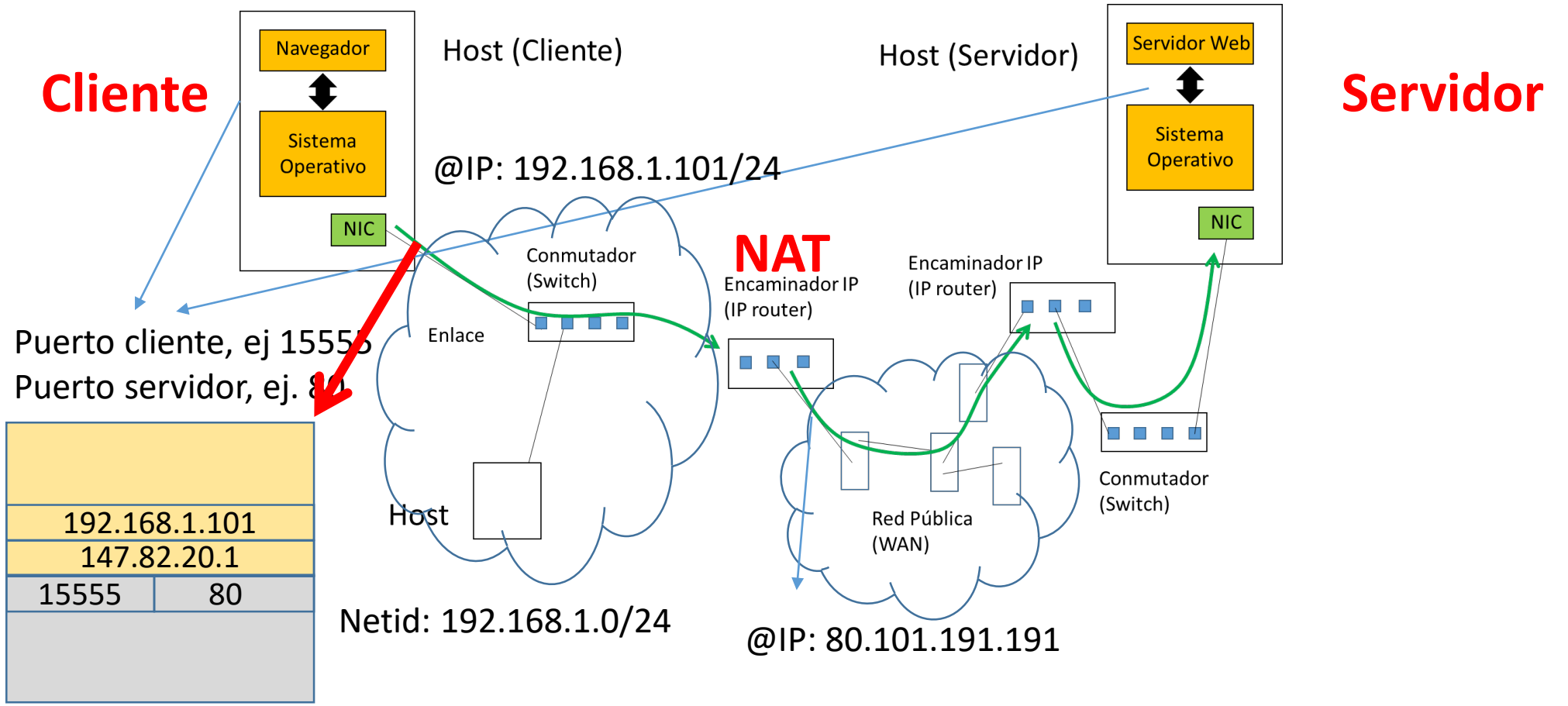
X3:
 # equipos configurables: 2^7 – 2= 128-2 = 126
@ de subred: 192.168. 0000 1000. 1000 0000 => 192.168. 8. 128/25
@ broadcast: 192.168.8.255/25
@ router (1a dirección asignable) 192.168.8.129

- 80.80.181.178 /18

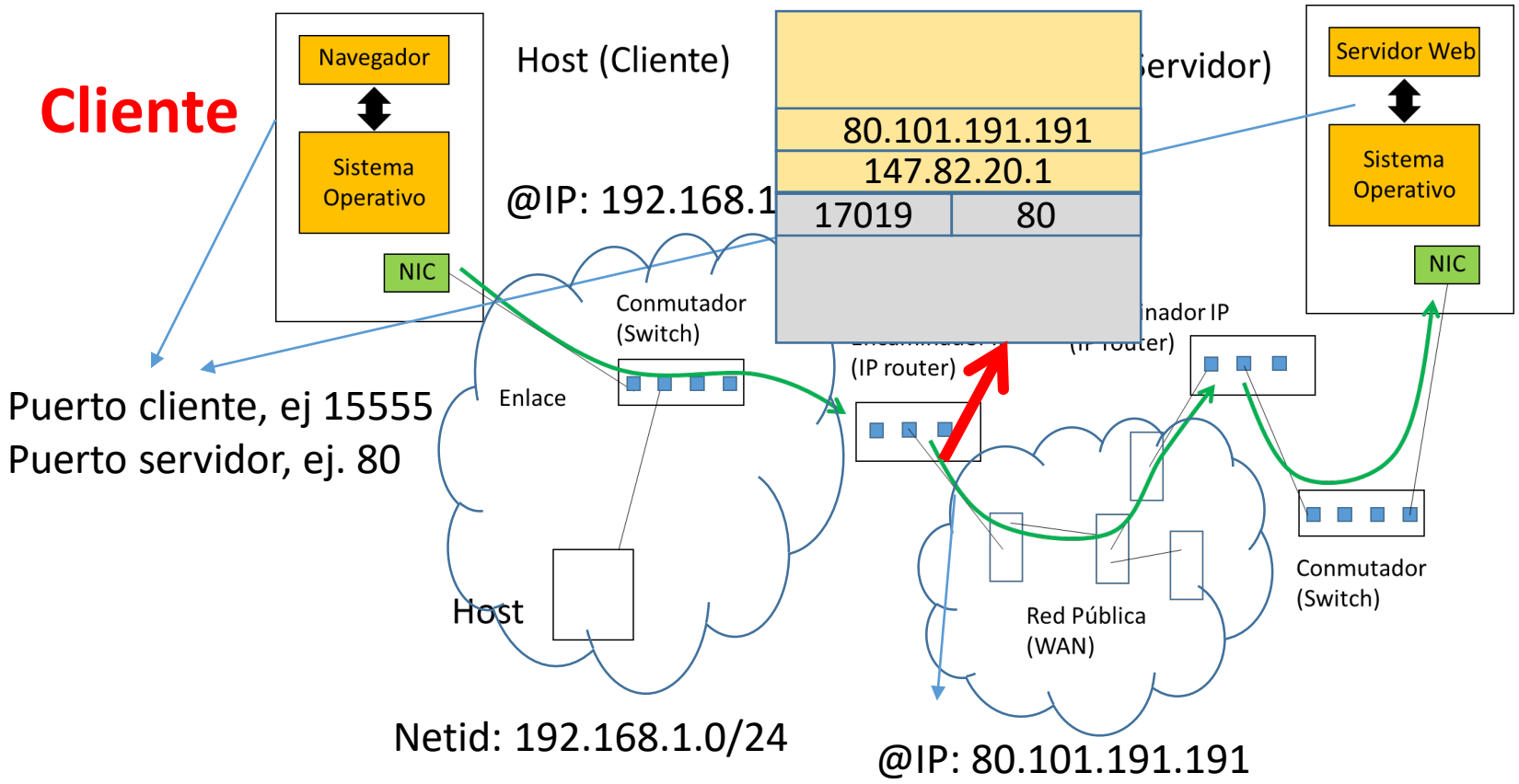
- Direccion de red: 80.80.128.0/18

- 80.80. 10 11 1111. 255 => @ de broadcast = 80.80.191.255
- 128 + 63= 191

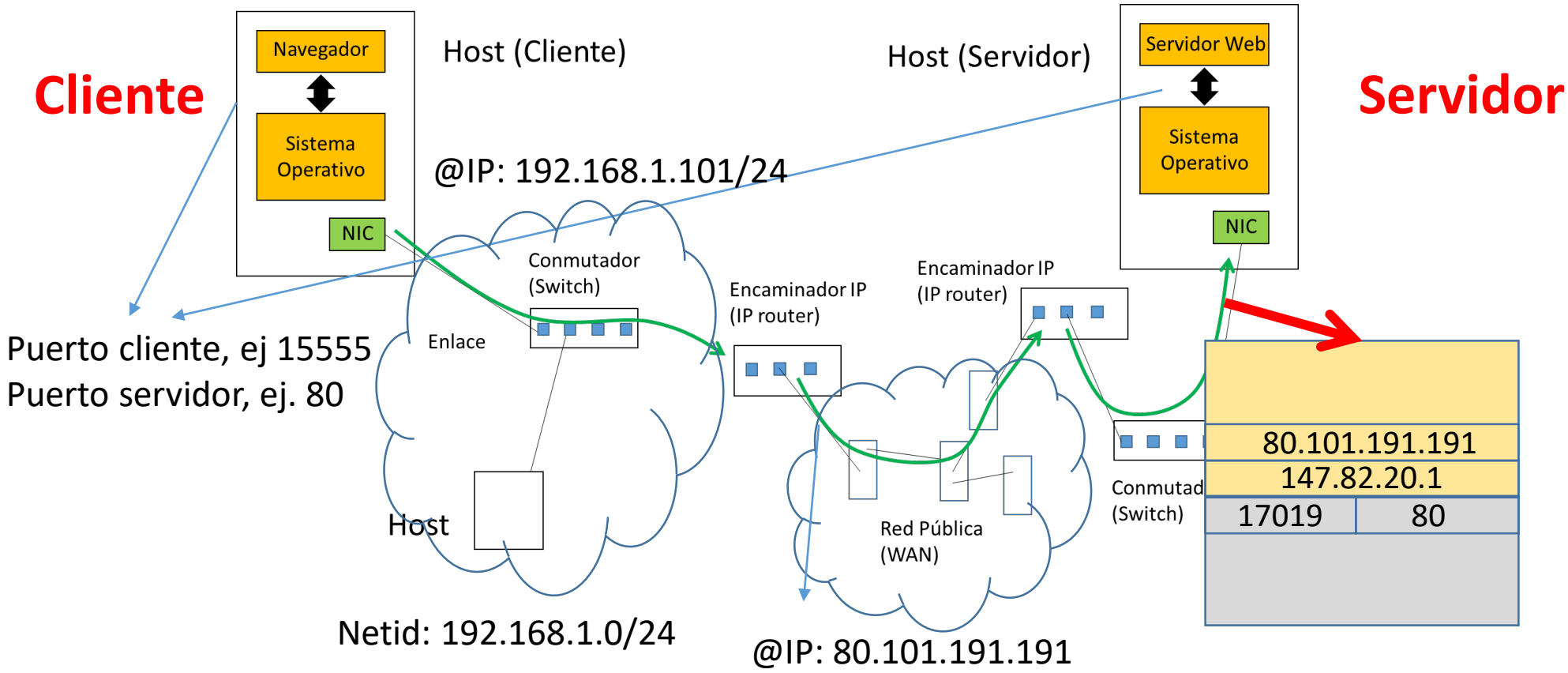
- 128 = 1000 0000
- 64 = 0100 0000
- 181 = 10 11 0101



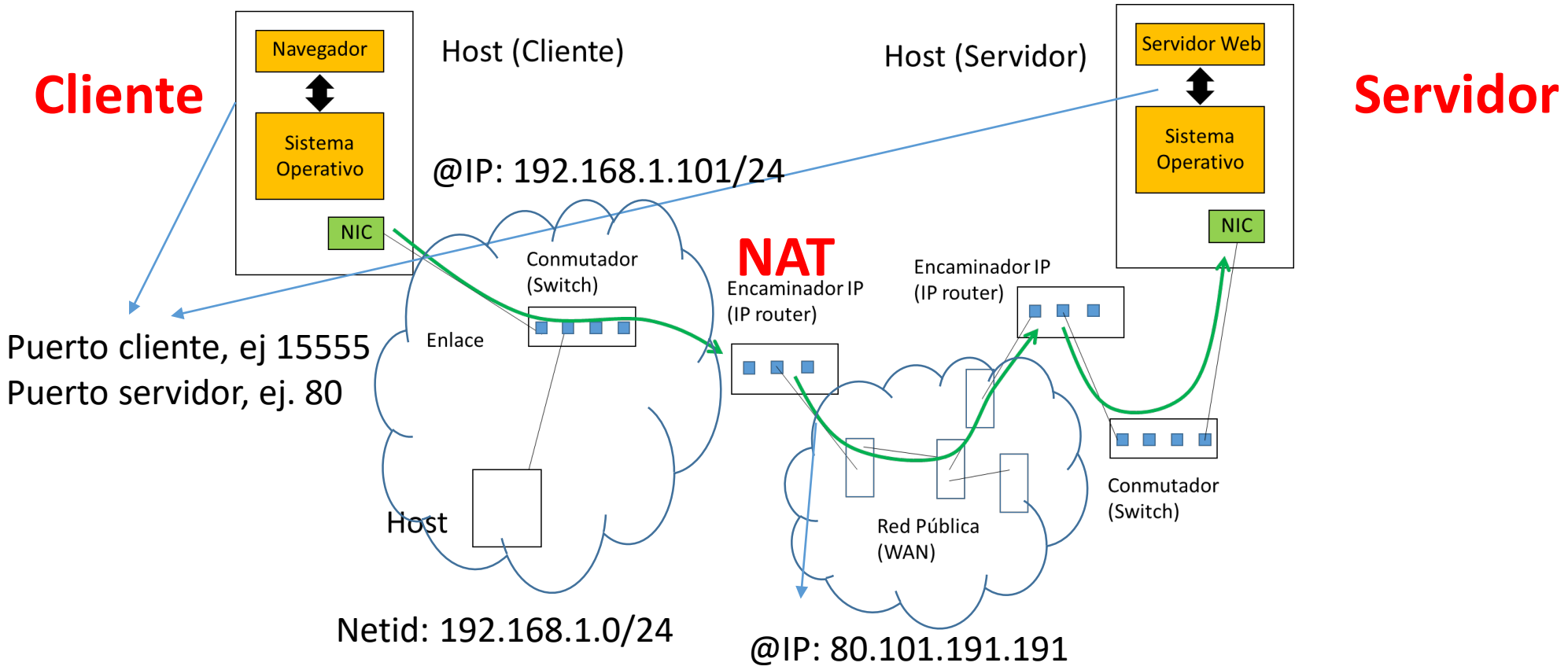
@IP interna	@IP externa	Port interno	Port externo



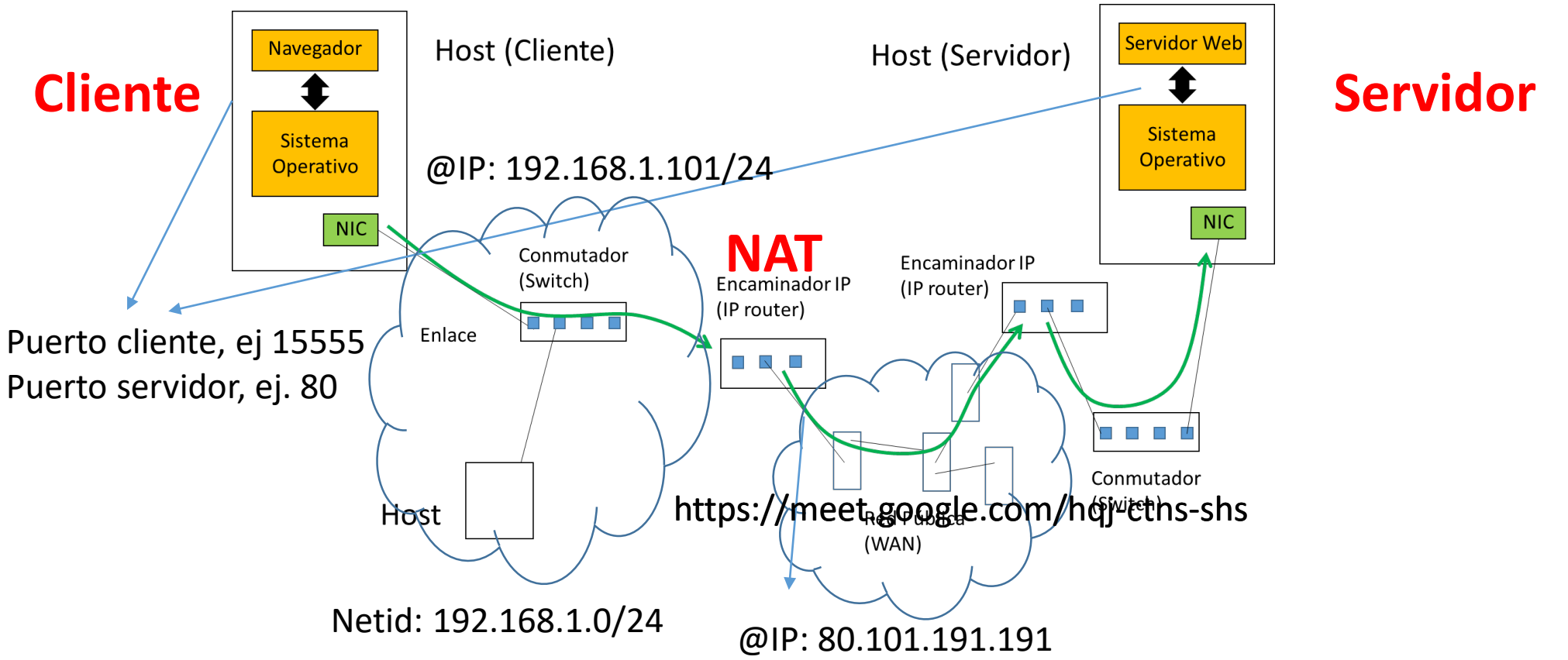
@IP interna	@IP externa	Port interno	Port externo
192.168.1.101	80.101.191.191	15555	17019



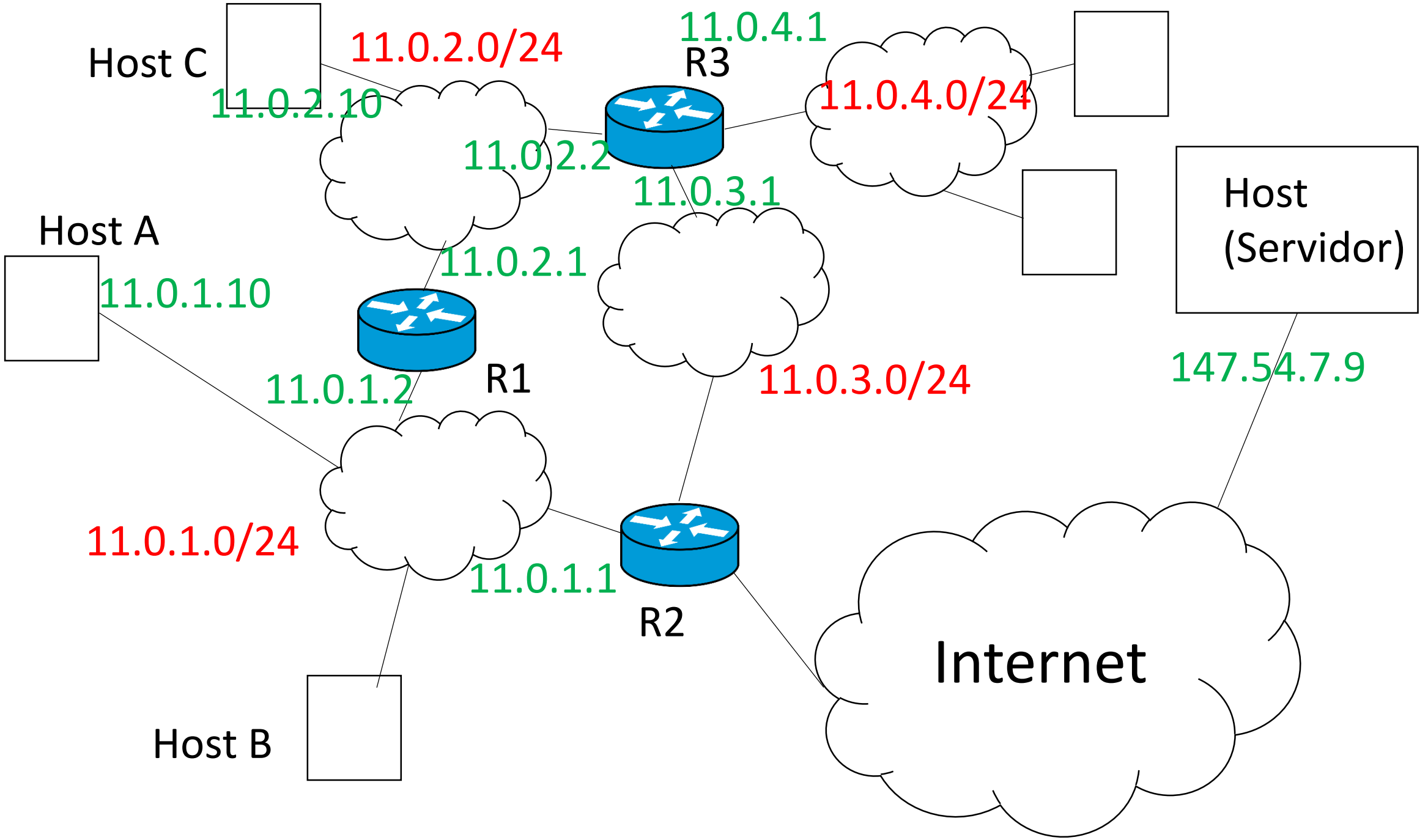
@IP interna	@IP externa	Port interno	Port externo
192.168.1.101	80.101.191.191	15555	17019

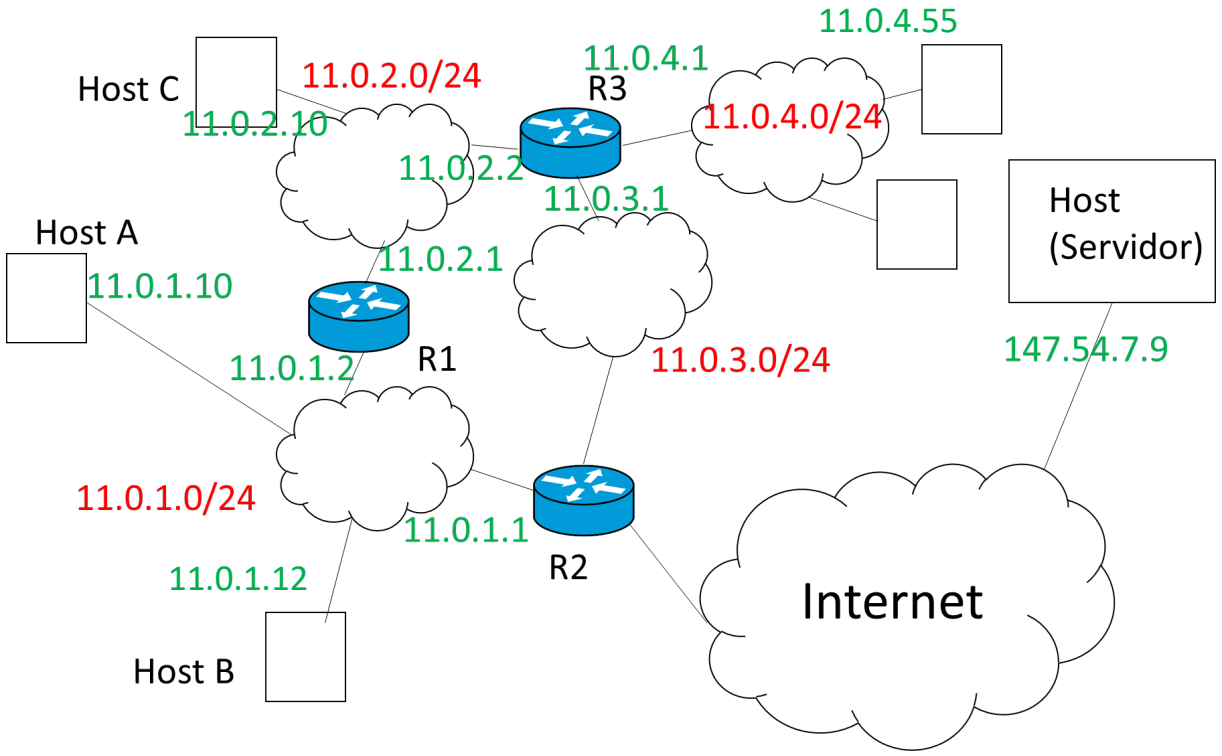


@IP interna	@IP externa	Port interno	Port externo
192.168.1.101	80.101.191.191	15555	17019
192.168.1.102	80.101.191.191	15787	17020



@IP interna	@IP externa	Port interno	Port externo
192.168.1.101	80.101.191.191	15555	17019
192.168.1.102	80.101.191.191	15787	17020
192.168.1.102	80.101.191.191	15555	17021


Host C
11.0.2.0/24
11.0.4.1
R3
11.0.4.0/24
11.0.2.10
11.0.2.2
11.0.3.1
Host A
Host
(Servidor)
11.0.2.1
11.0.1.10
R1
11.0.1.2
11.0.3.0/24
147.54.7.9
11.0.1.0/24
11.0.1.1
R2
Internet
Host B



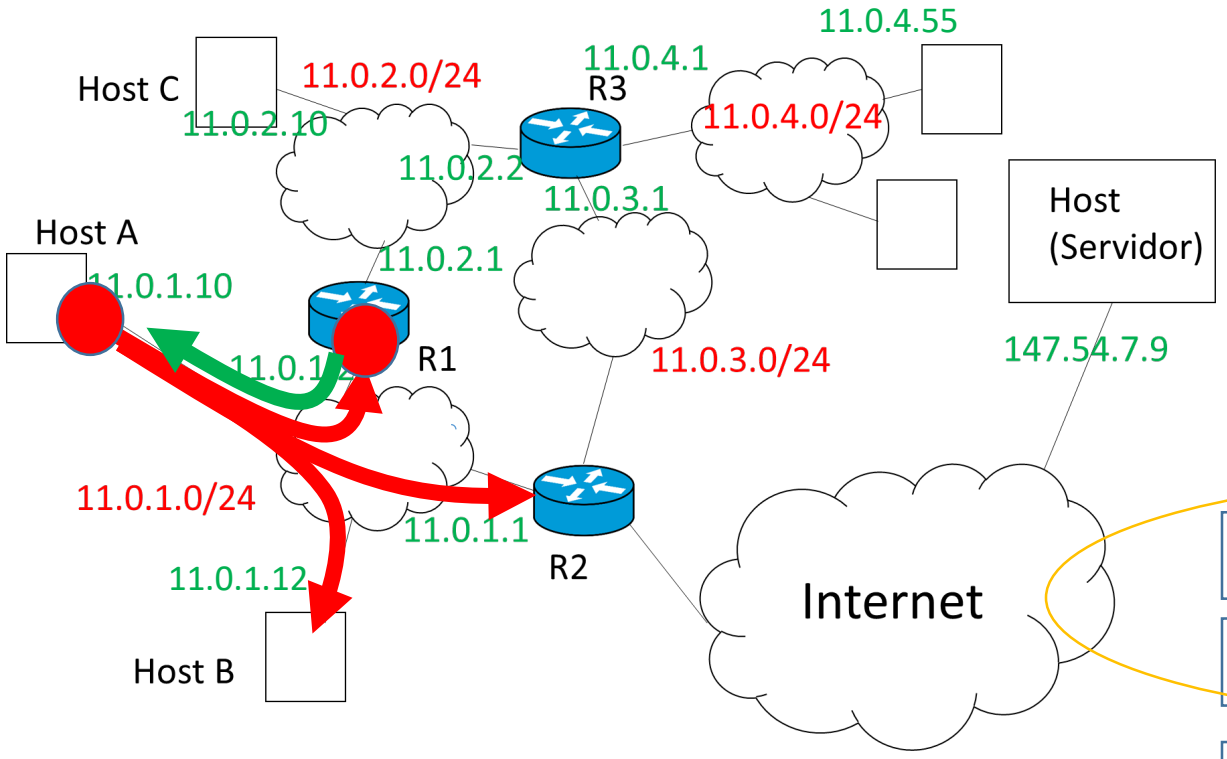
@IP destino (host B): 11.0.2.10

Lookup en la table de encaminatmiento de Host A

(1) Aplicamos 255.0.0.0 : 11.0.0.0 NO MATCH
(2) Aplicamos 255.255.255.0: 11.0.2.0 NO MATCH
(3) Aplicamos 255.255.255.0: 11.0.2.0 MATCH
(4) Aplicamos 0.0.0.0: 0.0.0.0 MATCH

Host A

destination	genmask	gateway	interface
127.0.0.0	255.0.0.0 (/8)	0.0.0.0 (directa)	loopback
11.0.1.0	255.255.255.0 (/24)	0.0.0.0 (directa)	eth0
11.0.2.0	255.255.255.0 (/24)	11.0.1.2 (R1)	eth0
0.0.0.0	0.0.0.0 (/0)	11.0.1.1 (R2)	eth0

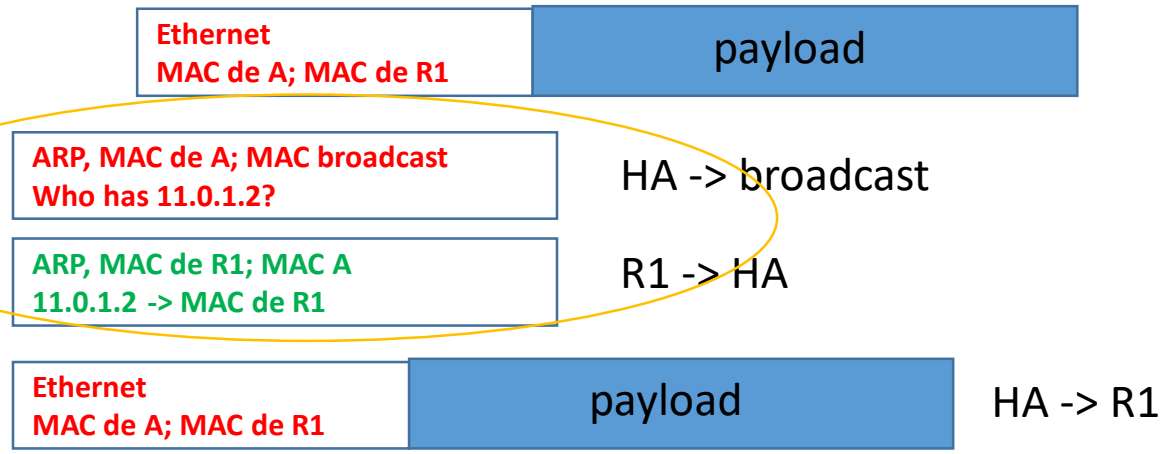


HostA > ping 11.0.2.10

IP: @org: 11.0.1.10

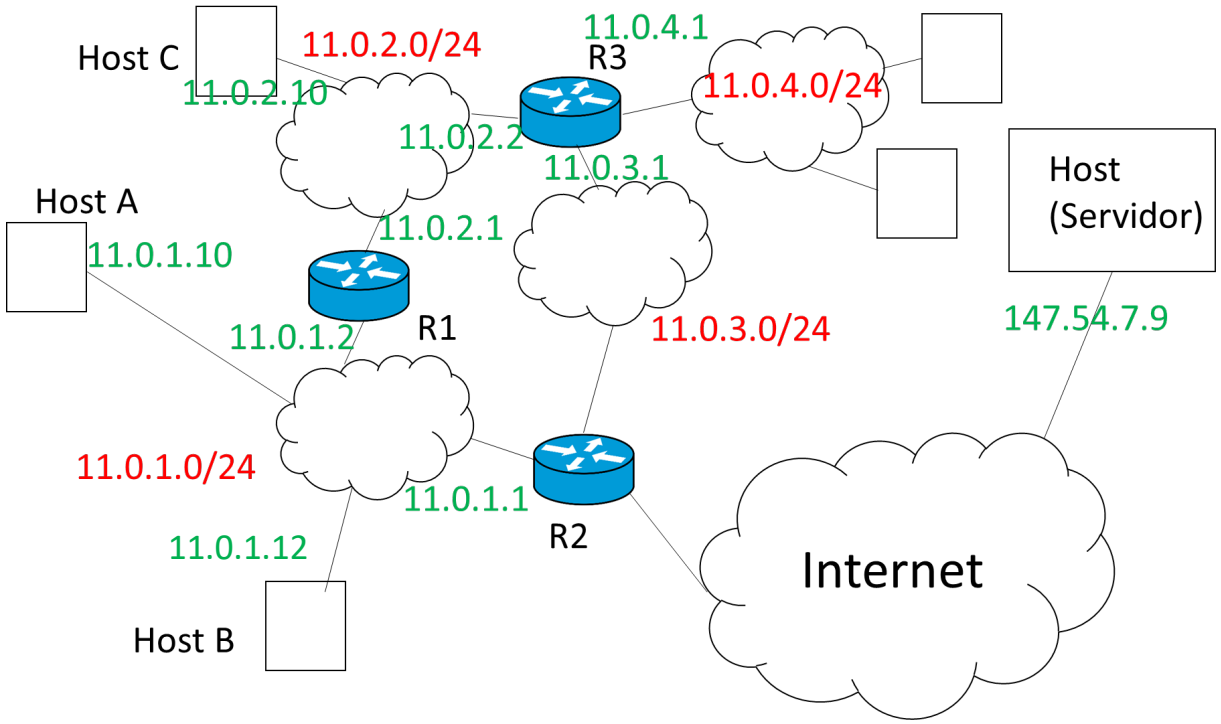
@dst: 11.0.2.10

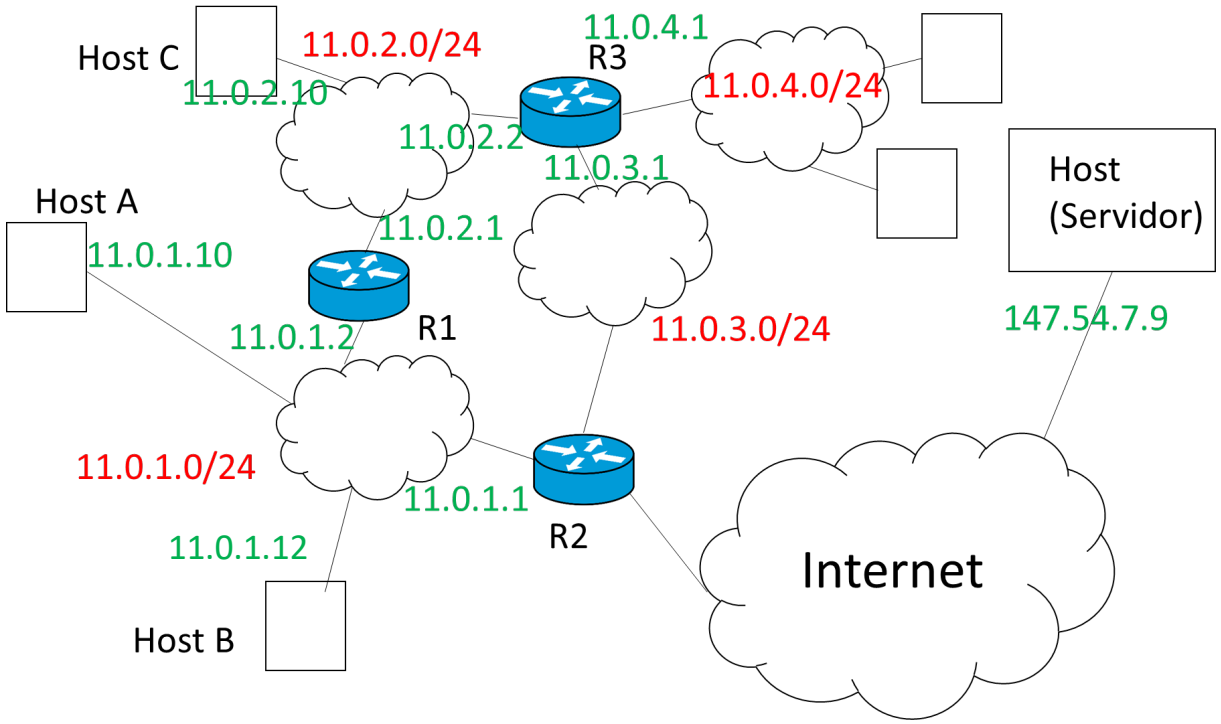
ICMP echo request

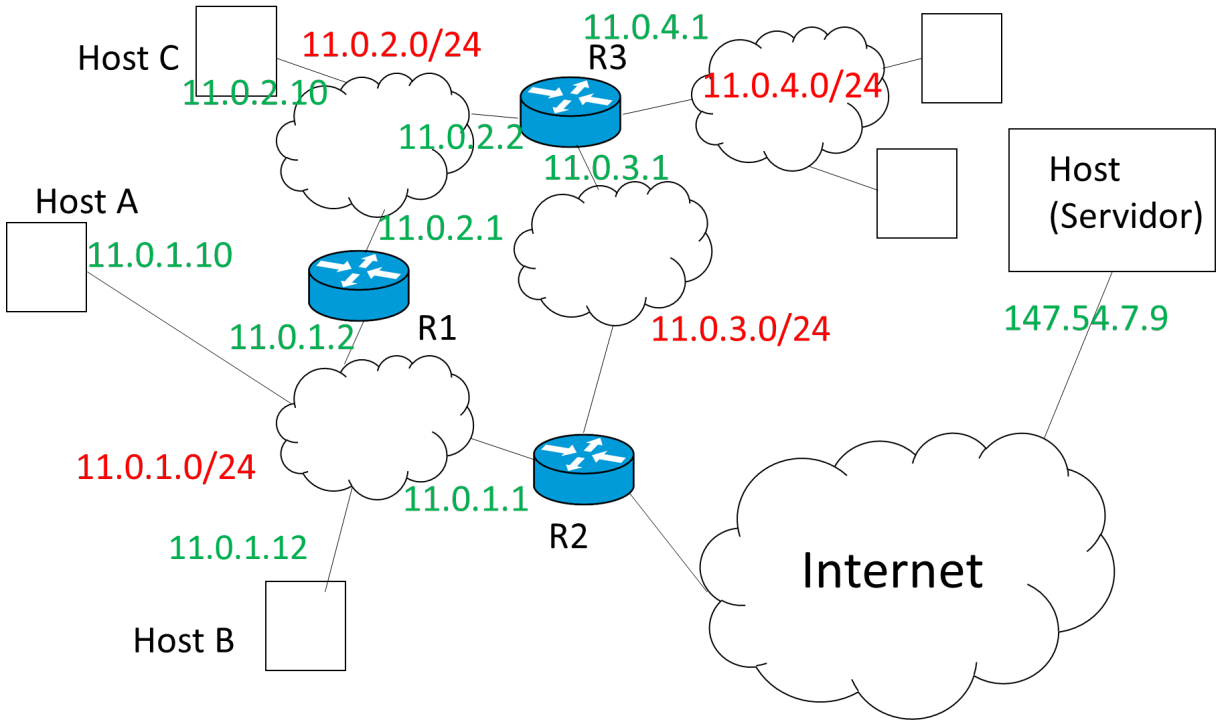


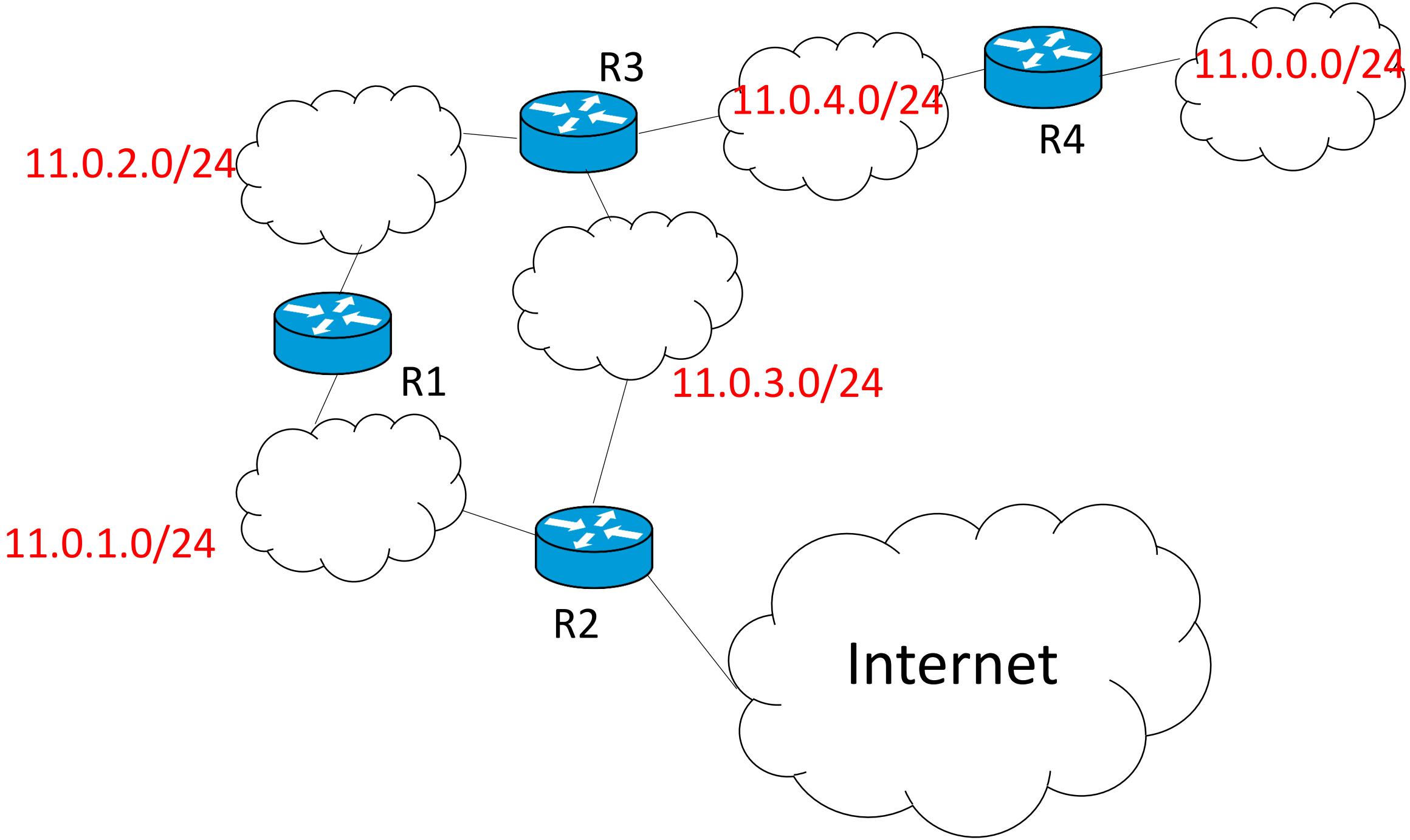
Host A

destination	genmask	gateway	interface
127.0.0.0	255.0.0.0 (/8)	0.0.0.0 (directa)	loopback
11.0.1.0	255.255.255.0 (/24)	0.0.0.0 (directa)	eth0
11.0.2.0	255.255.255.0 (/24)	11.0.1.2 (R1)	eth0
0.0.0.0	0.0.0.0 (/0)	11.0.1.1 (R2)	eth0


Host C
11.0.2.0/24
11.0.4.1
R3
11.0.2.10
11.0.4.0/24
11.0.2.2
11.0.3.1
Host A
Host
(Servidor)
11.0.2.1
11.0.1.10
R1
11.0.1.2
11.0.3.0/24
147.54.7.9
11.0.1.0/24
11.0.1.1
R2
11.0.1.12
Internet
Host B


Host C
11.0.2.0/24
11.0.4.1
R3
11.0.2.10
11.0.4.0/24
11.0.2.2
11.0.3.1
Host A
Host
(Servidor)
11.0.2.1
11.0.1.10
R1
11.0.1.2
11.0.3.0/24
147.54.7.9
11.0.1.0/24
11.0.1.1
R2
11.0.1.12
Internet
Host B


Host C
11.0.2.0/24
11.0.4.1
R3
11.0.2.10
11.0.4.0/24
11.0.2.2
11.0.3.1
Host A
Host
(Servidor)
11.0.2.1
11.0.1.10
R1
11.0.1.2
11.0.3.0/24
147.54.7.9
11.0.1.0/24
11.0.1.1
R2
11.0.1.12
Internet
Host B


R3
11.0.4.0/24
R4
11.0.0.0/24
11.0.2.0/24
R1
11.0.3.0/24
11.0.1.0/24
R2
Internet

Updated by: 4822 INTERNET STANDARD
Errata Exist

Network Working Group G. Malkin
Request for Comments: 2453 Bay Networks
Obsoletes: 1723, 1388 November 1998
STD: 56
Category: Standards Track

RIP Version 2

Status of this Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

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Abstract

This document specifies an extension of the Routing Information Protocol (RIP), as defined in [1], to expand the amount of useful information carried in RIP messages and to add a measure of security.

A companion document will define the SNMP MIB objects for RIP-2 [2]. An additional document will define cryptographic security improvements for RIP-2 [3].

Acknowledgements

I would like to thank the IETF RIP Working Group for their help in improving the RIP-2 protocol. Much of the text for the background discussions about distance vector protocols and some of the descriptions of the operation of RIP were taken from "Routing Information Protocol" by C. Hedrick [1]. Some of the final editing on the document was done by Scott Bradner.

PROPOSED STANDARD

Network Working Group R. Atkinson
Request for Comments: 4822 Extreme Networks
Obsoletes: 2082 M. Fanto
Updates: 2453 NIST
Category: Standards Track February 2007

RIPv2 Cryptographic Authentication

Status of This Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

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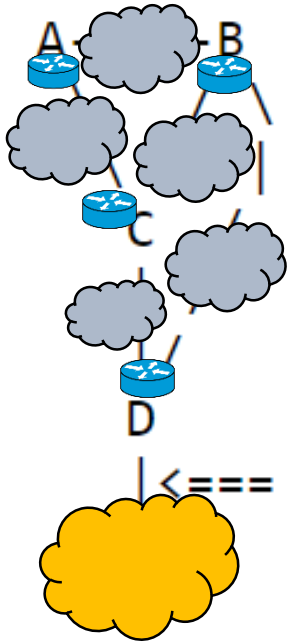
IESG Note

In the interests of encouraging rapid migration away from Keyed-MD5 and its known weakness, the IESG has approved this document even though it does not meet the guidelines in BCP 107 (RFC 4107). However, the IESG stresses that automated key management should be used to establish session keys and urges that the future work on key management described in Section 5.6 of this document should be

Coste = 10



all networks have cost 1, except
for the direct link from C to D, which
has cost 10

<=== target network

Rutas a D

D: directly connected, metric 1

Entrada en la tabla de encamiento del router D que señala a la target network

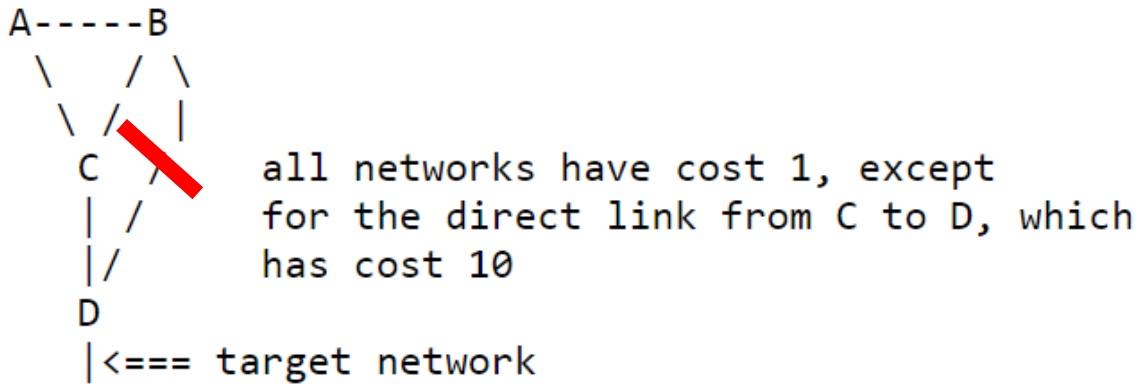
B: route via D, metric 2

C: route via B, metric 3

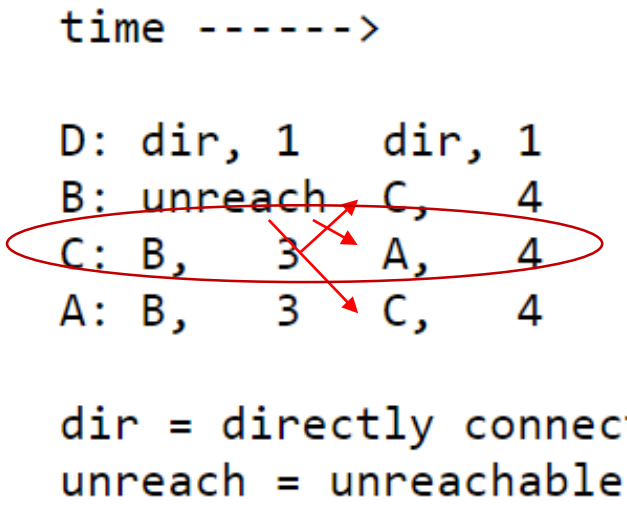
Entrada en la tabla de encamiento del router C que señala a la target network

A: route via B, metric 3

Etc..

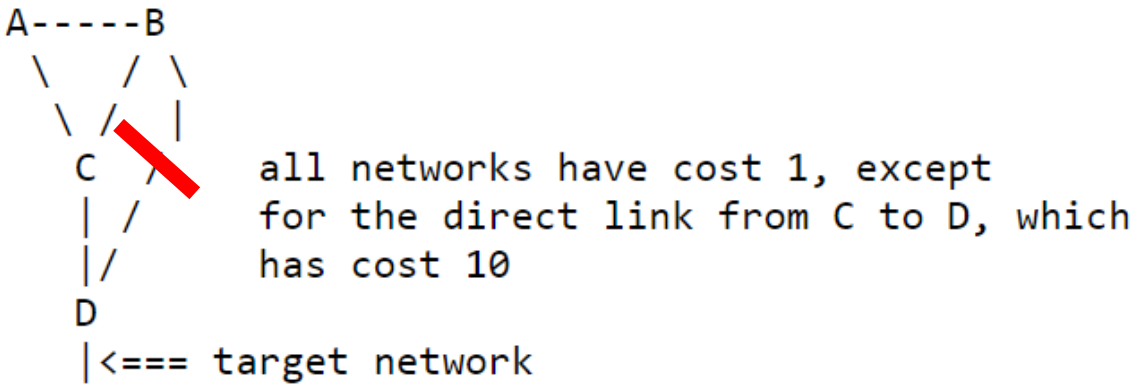


Ruta de B a D se rompe (180 sec, 6 updates perdidos, timeout)

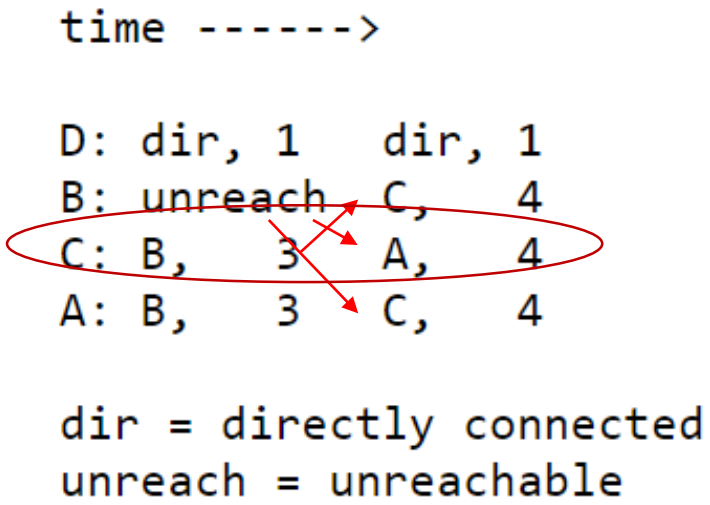


Mensajes RIPv2 recibidos por C:

De B: target network unreachable (coste=16)
De A: target network con coste 3
De D: target network con coste 1



Ruta de B a D se rompe (180 sec, 6 updates perdidos, timeout)



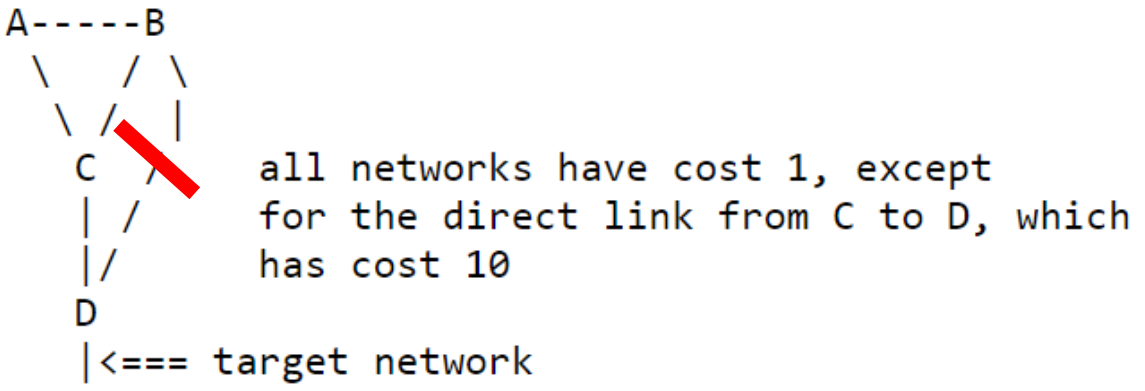
Actualizacion de la tabla de C

De B: target network unreachable (coste=16)

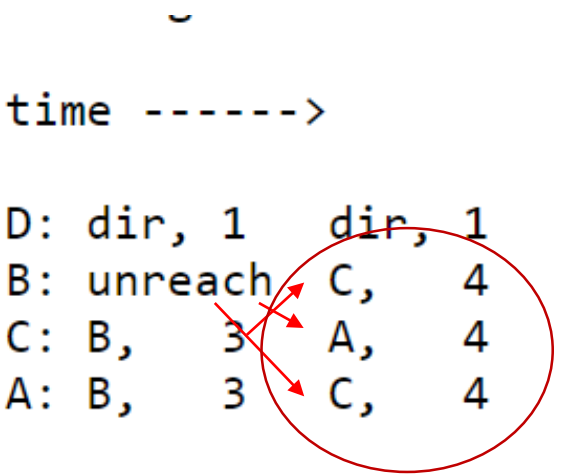
De A: target network con coste 3 (coste de C a A es 1) => coste 4

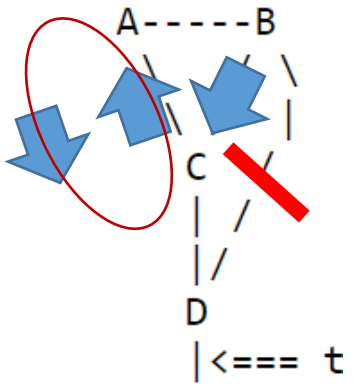
De D: target network con coste 1 (coste de C a D es 10) => coste 11

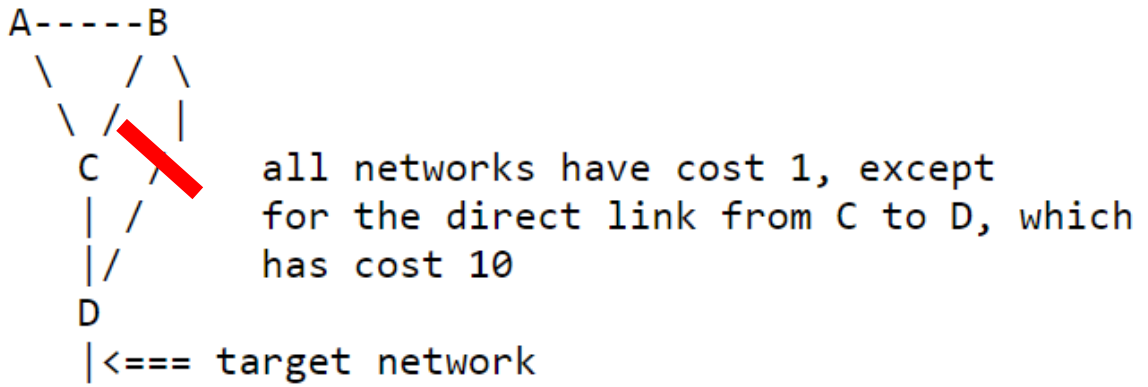
C actualiza la table a target network Router A, coste 4



Ruta de B a D se rompe (180 sec, 6 updates perdidos, timeout)





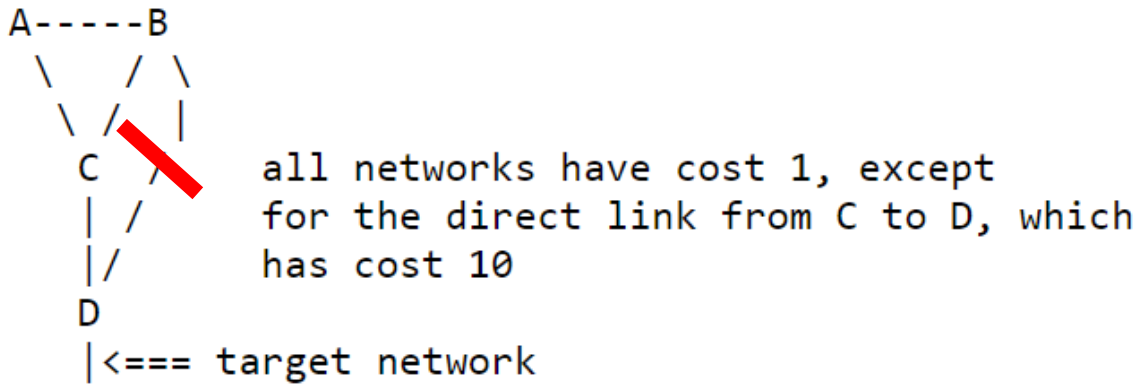


Ruta de B a D se rompe (180 sec, 6 updates perdidos, timeout)

time ------>

D:	dir,	1	dir,	1	dir,	1	dir,	1
B:	unreach,		C,	4	C,	5	C,	6
C:	B,	3	A,	4	A,	5	A,	6
A:	B,	3	C,	4	C,	5	C,	6

dir = directly connected
unreach = unreachable



Ruta de B a D se rompe (180 sec, 6 updates perdidos, timeout)

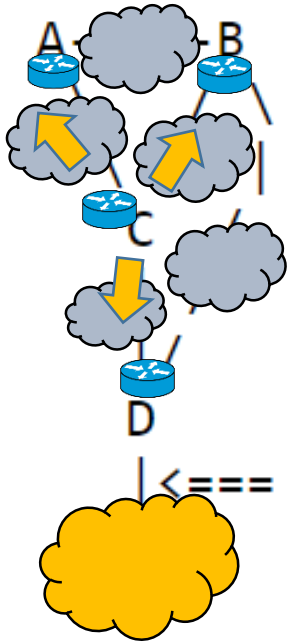
time ------>

D:	dir,	1	dir,	1	dir,	1	dir,	1	...	dir,	1	dir,	1
B:	unreach		C,	4	C,	5	C,	6		C,	11	C,	12
C:	B,	3	A,	4	A,	5	A,	6		A,	11	D,	11
A:	B,	3	C,	4	C,	5	C,	6		C,	11	C,	12

dir = directly connected
unreach = unreachable

Split-Horizon: Si aprendo una ruta a través de un interface de red, no envío esa ruta en los mensajes RIPv2 que envío por dicho interfaz. Si hago un update de la ruta a través de otro interfaz, entonces sí la incluyo. **Poisoned-reverse**: la incluyo con un coste de 16

Coste = 10




```
all networks have cost 1, except
for the direct link from C to D, which
has cost 10

|<=== target network
```

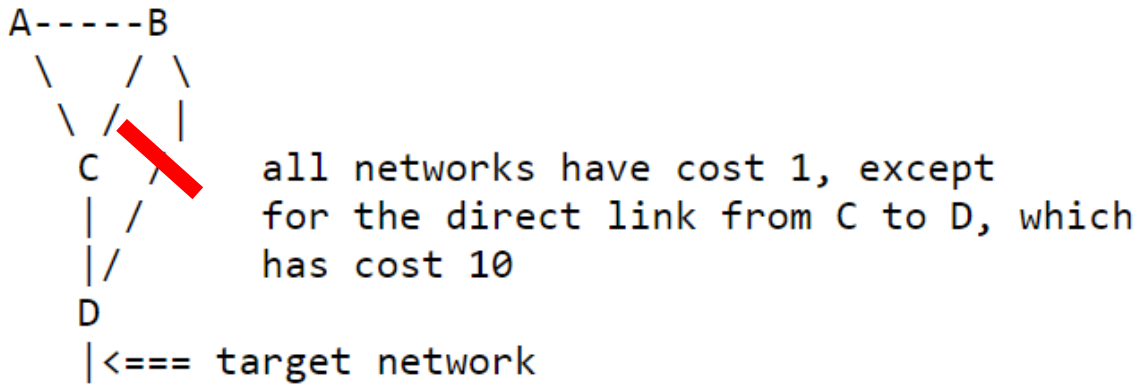
Rutas a D

```
D:  directly connected, metric 1
B:  route via D, metric 2
C:  route via B, metric 3
A:  route via B, metric 3
```

Entrada en la tabla de encamiento del router D que señala a la target network

Entrada en la tabla de encamiento del router C que señala a la target network

Etc..



Ruta de B a D se rompe (180 sec, 6 updates perdidos, timeout)

Triggered updates: no espero 30 sec si hay un cambio en la tabla

30 segundos => pocos segundos

time ------>

D:	dir,	1	dir,	1	dir,	1	dir,	1	...	dir, 1	dir, 1
B:	unreach,		C,	4	C,	5	C,	6		C, 11	C, 12
C:	B,	3	A,	4	A,	5	A,	6		A, 11	D, 11
A:	B,	3	C,	4	C,	5	C,	6		C, 11	C, 12

dir = directly connected
unreach = unreachable