

HOMEWORK 1

1)

NOME LAN	PREFISSO	INDIRIZZO BROADCAST	# INDIRIZZI INUTILIZZATI
LAN A	198.10.99.0/24	198.10.99.255/24	54
LAN B	198.10.98.64/26	198.10.98.127/26	12
LAN C	198.10.98.128/25	198.10.98.255/25	16
LAN G	198.10.98.32/27	198.10.98.63/27	10
LAN D	198.10.96.0/24	198.10.96.255/24	125
LAN E	198.10.97.0/27	198.10.97.31/27	10
LAN F	198.10.97.32/28	198.10.97.47/28	4
LAN H	198.10.98.0/30	198.10.98.3/30	0
LAN I	198.10.97.48/30	198.10.97.51/30	0
LAN L	198.10.98.4/30	198.10.98.7/30	0

Dato il blocco 198.10.96.0/22, ho 2 bit di subnetting e quindi 2^2 blocchi di classe C. Essendo già assegnato un indirizzo del blocco .98 alla sottorete collegata alla eth0 di r1, do il blocco .98 al ramo sinistro di r1, insieme al .99, essendo necessari 2 blocchi di classe C ed essendo il .99 l'unico blocco aggregabile al .98. Assegno gli indirizzi a partire dalle lan più grandi.

LAN A richiede 8 bit di host_id e quindi un intero blocco di classe C; gli assegno quindi il .99, poiché del .98 ho già utilizzato un indirizzo per la LAN H.

LAN C vuole 7 bit di host_id, quindi gli assegno gli indirizzi della metà superiore del blocco .98 sempre a causa dell'indirizzo 198.10.98.0 già assegnato.

LAN B ha 6 bit di host_id e gli continuo ad assegnare indirizzi della parte superiore del blocco rimasto; lo stesso con la LAN G, con 5 bit di host_id.

Assegno poi uno degli indirizzi rimasti alla LAN L per cui, non avendo dispositivi collegati all'infuori dei 2 router, basta una maschera di rete /30.

Per quanto riguarda il ramo destro collegato al router r1 (quello collegato tramite eth1), ho ancora a disposizione il blocco .96 ed il .97.

Il blocco .96 lo assegno interamente alla LAN D, avendo questo 129 host per cui 2^7 indirizzi non sono sufficienti.

LAN E richiede 5 bit di host_id e quindi gli assegno i primi 32 indirizzi del blocco .97, mentre i 16 successivi li do alla LAN F avendo questa 4 bit di host_id.

Infine, do i successivi indirizzi all'ultima lan rimasta, la LAN I, per cui bastano 4 indirizzi.

Dunque a questo punto, R1 vede tutta la parte collegata alla sua eth0 come un unico blocco con indirizzo 198.10.98.0/23, mentre quella collegata alla eth1 come il blocco 198.10.96.0/23.

(Routing table r1 al punto successivo)

2)

root@r0: /

```

--- Startup Commands Log
++ ifconfig eth0 198.10.98.5 netmask 255.255.255.252
++ ifconfig eth1 198.10.100.1/0
++ route add -net 198.10.96.0 netmask 255.255.252.0 gw 198.10.98.6
--- End Startup Commands Log

root@r0:/# route
Kernel IP routing table
Destination      Gateway         Genmask        Flags Metric Ref    Use Iface
198.10.96.0      198.10.98.6    255.255.252.0  UG      0      0      0 eth0
198.10.98.4      0.0.0.0        255.255.255.252 U      0      0      0 eth0
root@r0:/#

```

root@r1: /

```

--- Startup Commands Log
++ ifconfig eth0 198.10.98.1 netmask 255.255.255.252
++ ifconfig eth1 198.10.97.49 netmask 255.255.255.252
++ ifconfig eth2 198.10.98.6 netmask 255.255.255.252
++ route add -net 198.10.98.0 netmask 255.255.254.0 gw 198.10.98.2
++ route add -net 198.10.96.0 netmask 255.255.254.0 gw 198.10.97.50
++ route add default gw 198.10.98.5
--- End Startup Commands Log

root@r1:/# route
Kernel IP routing table
Destination      Gateway         Genmask        Flags Metric Ref    Use Iface
default          198.10.98.5    0.0.0.0        UG      0      0      0 eth2
198.10.96.0      198.10.97.50  255.255.254.0  UG      0      0      0 eth1
198.10.97.48     0.0.0.0        255.255.255.252 U      0      0      0 eth1
198.10.98.0      0.0.0.0        255.255.255.252 U      0      0      0 eth0
198.10.98.0      198.10.98.2    255.255.254.0  UG      0      0      0 eth0
198.10.98.4      0.0.0.0        255.255.255.252 U      0      0      0 eth2
root@r1:/#

```

root@r2: /

```

--- Startup Commands Log
++ ifconfig eth0 198.10.99.1 netmask 255.255.255.0
++ ifconfig eth1 198.10.98.33 netmask 255.255.255.224
++ ifconfig eth2 198.10.98.2 netmask 255.255.255.252
++ route add -net 198.10.99.0 netmask 255.255.255.0 gw 198.10.99.2
++ route add -net 198.10.98.32 netmask 255.255.255.224 gw 198.10.98.34
++ route add -net 198.10.98.64 netmask 255.255.255.192 gw 198.10.98.34
++ route add default gw 198.10.98.1
--- End Startup Commands Log

root@r2:/# route
Kernel IP routing table
Destination      Gateway         Genmask        Flags Metric Ref    Use Iface
default          198.10.98.1    0.0.0.0        UG      0      0      0 eth2
198.10.98.0      0.0.0.0        255.255.255.252 U      0      0      0 eth2
198.10.98.32     198.10.98.34  255.255.255.224 U      0      0      0 eth1
198.10.98.32     0.0.0.0        255.255.255.224 U      0      0      0 eth1
198.10.98.64     198.10.98.34  255.255.255.192 U      0      0      0 eth1
198.10.99.0      198.10.99.2    255.255.255.0  UG      0      0      0 eth0
198.10.99.0      0.0.0.0        255.255.255.0  U      0      0      0 eth0
root@r2:/#

```

root@r3: /

```

--- Startup Commands Log
++ ifconfig eth0 198.10.97.33 netmask 255.255.255.240
++ ifconfig eth1 198.10.97.1 netmask 255.255.255.224
++ ifconfig eth2 198.10.97.50 netmask 255.255.255.252
++ route add -net 198.10.97.32 netmask 255.255.255.240 gw 198.10.97.34
++ route add -net 198.10.97.0 netmask 255.255.255.224 gw 198.10.97.2
++ route add default gw 198.10.97.49
--- End Startup Commands Log

root@r3:/# route
Kernel IP routing table
Destination      Gateway         Genmask        Flags Metric Ref    Use Iface
default          198.10.97.49  0.0.0.0        UG      0      0      0 eth2
198.10.97.0      198.10.97.2    255.255.255.224 UG      0      0      0 eth1
198.10.97.0      0.0.0.0        255.255.255.224 U      0      0      0 eth1
198.10.97.32     198.10.97.34  255.255.255.240 UG      0      0      0 eth0
198.10.97.32     0.0.0.0        255.255.255.240 U      0      0      0 eth0
198.10.97.48     0.0.0.0        255.255.255.252 U      0      0      0 eth2
root@r3:/#

```

root@r4: /

```

--- Startup Commands Log
++ ifconfig eth0 198.10.98.65 netmask 255.255.255.192
++ ifconfig eth1 198.10.98.129 netmask 255.255.255.128
++ ifconfig eth2 198.10.98.34 netmask 255.255.255.224
++ route add -net 198.10.98.64 netmask 255.255.255.192 gw 198.10.98.66
++ route add default gw 198.10.98.33
--- End Startup Commands Log

root@r4:/# route
Kernel IP routing table
Destination      Gateway         Genmask        Flags Metric Ref    Use Iface
default          198.10.98.33  0.0.0.0        UG      0      0      0 eth2
198.10.98.32     0.0.0.0        255.255.255.224 U      0      0      0 eth2
198.10.98.64     198.10.98.66  255.255.255.192 UG      0      0      0 eth0
198.10.98.64     0.0.0.0        255.255.255.192 U      0      0      0 eth0
198.10.98.128    0.0.0.0        255.255.255.128 U      0      0      0 eth1
root@r4:/#

```

root@r5: /

```

--- Startup Commands Log
++ ifconfig eth0 198.10.96.1 netmask 255.255.255.0
++ ifconfig eth1 198.10.97.34 netmask 255.255.255.240
++ ifconfig eth2 198.10.97.2 netmask 255.255.255.224
++ route add -net 198.10.98.0 netmask 255.255.254.0 gw 198.10.97.33 dev eth1
++ route add default gw 198.10.97.1
--- End Startup Commands Log

root@r5:/# route
Kernel IP routing table
Destination      Gateway         Genmask        Flags Metric Ref    Use Iface
default          198.10.97.1    0.0.0.0        UG      0      0      0 eth2
198.10.96.0      0.0.0.0        255.255.255.0  U      0      0      0 eth0
198.10.97.0      0.0.0.0        255.255.255.224 U      0      0      0 eth2
198.10.97.32     0.0.0.0        255.255.255.240 U      0      0      0 eth1
198.10.98.0      198.10.97.33  255.255.254.0  UG      0      0      0 eth1
root@r5:/#

```

3)

```

Terminal - root@r5: /
File Edit View Terminal Tabs Help
root@r5:/# traceroute 198.10.100.1
traceroute to 198.10.100.1 (198.10.100.1), 64 hops max
 1  198.10.97.1  0.003ms  0.003ms  0.002ms
 2  198.10.97.49 0.003ms  0.002ms  0.001ms
 3  198.10.100.1 0.002ms  0.003ms  0.002ms
root@r5:/# traceroute 198.10.99.2
traceroute to 198.10.99.2 (198.10.99.2), 64 hops max
 1  198.10.97.33 0.005ms  0.004ms  0.001ms
 2  198.10.97.49 0.001ms  0.001ms  0.001ms
 3  198.10.98.2  0.002ms  0.001ms  0.002ms
 4  198.10.99.2  0.002ms  0.001ms  0.001ms
root@r5:/# traceroute 198.10.98.66
traceroute to 198.10.98.66 (198.10.98.66), 64 hops max
 1  198.10.97.33 0.004ms  0.003ms  0.004ms
 2  198.10.97.49 0.004ms  0.004ms  0.005ms
 3  198.10.98.2  0.003ms  0.003ms  0.003ms
 4  198.10.98.34 0.004ms  0.003ms  0.003ms
 5  198.10.98.66 0.004ms  0.003ms  0.003ms
root@r5:/#

```

A partire da R5, il percorso verso i due host h1 e h2 passa per la Lan F (198.10.97.33 è l'indirizzo della scheda eth0 di r3 collegata alla Lan F), mentre il traffico verso internet passa per la Lan E (198.10.97.1)

4)

r2_eth0.pcap

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

Apply a display filter ... <Ctrl-/>

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	f6:5c:bb:ee:37:87	Broadcast	ARP	42	Who has 198.10.99.1? Tell 198.10.99.2
2	0.000019	16:53:74:74:a2:86	f6:5c:bb:ee:37:87	ARP	42	198.10.99.1 is at 16:53:74:74:a2:86
3	0.000040	198.10.99.2	198.10.99.1	ICMP	98	Echo (ping) request id=0x002e, seq=1/256, ttl=64 (reply in 4)
4	0.000056	198.10.99.1	198.10.99.2	ICMP	98	Echo (ping) reply id=0x002e, seq=1/256, ttl=64 (request in 3)
5	5.200695	16:53:74:74:a2:86	f6:5c:bb:ee:37:87	ARP	42	Who has 198.10.99.2? Tell 198.10.99.1
6	5.200824	f6:5c:bb:ee:37:87	16:53:74:74:a2:86	ARP	42	198.10.99.2 is at f6:5c:bb:ee:37:87

▶ Frame 1: 42 bytes on wire (336 bits), 42 bytes captured (336 bits)

▶ Ethernet II, Src: f6:5c:bb:ee:37:87 (f6:5c:bb:ee:37:87), Dst: Broadcast (ff:ff:ff:ff:ff:ff)

▼ Address Resolution Protocol (request)

- Hardware type: Ethernet (1)
- Protocol type: IPv4 (0x0800)
- Hardware size: 6
- Protocol size: 4
- Opcode: request (1)
- Sender MAC address: f6:5c:bb:ee:37:87 (f6:5c:bb:ee:37:87)
- Sender IP address: 198.10.99.2
- Target MAC address: 00:00:00_00:00:00 (00:00:00:00:00:00)
- Target IP address: 198.10.99.1

```

0000  ff ff ff ff ff f6 5c bb ee 37 87 08 06 00 01  ....\...7....
0010  08 00 06 04 00 01 f6 5c bb ee 37 87 c6 0a 63 02  ....\...7...c.
0020  00 00 00 00 00 00 c6 0a 63 01  ....c.

```

H1 manda una arp request in broadcast(indirizzo MAC ff:ff:ff:ff:ff:ff, come segnalato in foto),e chiede a tutti i dispositivi sulla rete chi ha l'indirizzo ip cercato, in questo caso 198.10.99.1,indirizzo del gateway.

The screenshot shows a Wireshark capture of network traffic on the r2_eth0.pcap interface. The packet list shows six packets:

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	f6:5c:bb:ee:37:87	Broadcast	ARP	42	Who has 198.10.99.1? Tell 198.10.99.2
2	0.000019	16:53:74:74:a2:86	f6:5c:bb:ee:37:87	ARP	42	198.10.99.1 is at 16:53:74:74:a2:86
3	0.000040	198.10.99.2	198.10.99.1	ICMP	98	Echo (ping) request id=0x002e, seq=1/256, ttl=64 (reply in 4)
4	0.000056	198.10.99.1	198.10.99.2	ICMP	98	Echo (ping) reply id=0x002e, seq=1/256, ttl=64 (request in 3)
5	5.200695	16:53:74:74:a2:86	f6:5c:bb:ee:37:87	ARP	42	Who has 198.10.99.2? Tell 198.10.99.1
6	5.200824	f6:5c:bb:ee:37:87	16:53:74:74:a2:86	ARP	42	198.10.99.2 is at f6:5c:bb:ee:37:87

The packet details for Frame 2 (ARP reply) are expanded, showing:

- Hardware type: Ethernet (1)
- Protocol type: IPv4 (0x0800)
- Hardware size: 6
- Protocol size: 4
- Opcode: reply (2)
- Sender MAC address: 16:53:74:74:a2:86 (16:53:74:74:a2:86)
- Sender IP address: 198.10.99.1
- Target MAC address: f6:5c:bb:ee:37:87 (f6:5c:bb:ee:37:87)
- Target IP address: 198.10.99.2

A blue arrow points from the text box "R2 invia il suo mac ad h1" to the Sender MAC address field.

The packet bytes section shows the raw data for the ARP reply:

```
0000 f6 5c bb ee 37 87 16 53 74 74 a2 86 08 06 00 01  \..7..S tt.....
0010 08 00 06 04 00 02 16 53 74 74 a2 86 c6 0a 63 01  .....S tt....c.
0020 f6 5c bb ee 37 87 c6 0a 63 02  \..7..c.
```

A questa arp request, risponde solo il dispositivo che ha l'indirizzo ip segnalato, con una arp reply in unicast contenente il proprio indirizzo MAC.

The screenshot shows a Wireshark capture of network traffic on the r2_eth0.pcap interface. The packet list shows six packets:

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	f6:5c:bb:ee:37:87	Broadcast	ARP	42	Who has 198.10.99.1? Tell 198.10.99.2
2	0.000019	16:53:74:74:a2:86	f6:5c:bb:ee:37:87	ARP	42	198.10.99.1 is at 16:53:74:74:a2:86
3	0.000040	198.10.99.2	198.10.99.1	ICMP	98	Echo (ping) request id=0x002e, seq=1/256, ttl=64 (reply in 4)
4	0.000056	198.10.99.1	198.10.99.2	ICMP	98	Echo (ping) reply id=0x002e, seq=1/256, ttl=64 (request in 3)
5	5.200695	16:53:74:74:a2:86	f6:5c:bb:ee:37:87	ARP	42	Who has 198.10.99.2? Tell 198.10.99.1
6	5.200824	f6:5c:bb:ee:37:87	16:53:74:74:a2:86	ARP	42	198.10.99.2 is at f6:5c:bb:ee:37:87

The packet details for Frame 5 (ARP request) are expanded, showing:

- Hardware type: Ethernet (1)
- Protocol type: IPv4 (0x0800)
- Hardware size: 6
- Protocol size: 4
- Opcode: request (1)
- Sender MAC address: 16:53:74:74:a2:86 (16:53:74:74:a2:86)
- Sender IP address: 198.10.99.1
- Target MAC address: 00:00:00_00:00:00 (00:00:00:00:00:00)
- Target IP address: 198.10.99.2

A blue arrow points from the text box "Il router ancora non conosce il MAC di h1" to the Target MAC address field.

The packet bytes section shows the raw data for the ARP request:

```
0000 f6 5c bb ee 37 87 16 53 74 74 a2 86 08 06 00 01  \..7..S tt.....
0010 08 00 06 04 00 01 16 53 74 74 a2 86 c6 0a 63 01  .....S tt....c.
0020 00 00 00 00 00 00 c6 0a 63 02  .....c.
```

Successivamente, è il router a inviare una arp request ad h1 per conoscere il suo indirizzo MAC, stavolta direttamente in unicast poiché grazie alla precedente comunicazione, il gateway conosce già il suo indirizzo ip. Questo processo è il MAC learning, che permette al gateway di sapere anticipatamente i mac dei

dispositivi a se connessi per consegnare pacchetti provenienti dall'esterno della rete senza dover ricorrere ogni volta all'Address Resolution Protocol.

The screenshot shows a Wireshark capture of network traffic on the interface r2_eth0.pcap. The packet list shows six packets. Packet 6 is an ARP reply from the router (16:53:74:74:a2:86) to the host (f6:5c:bb:ee:37:87). A blue arrow points to the 'Sender MAC address' field in the packet details, which is f6:5c:bb:ee:37:87. The packet bytes pane shows the raw data of the ARP reply.

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	f6:5c:bb:ee:37:87	Broadcast	ARP	42	Who has 198.10.99.1? Tell 198.10.99.2
2	0.000019	16:53:74:74:a2:86	f6:5c:bb:ee:37:87	ARP	42	198.10.99.1 is at 16:53:74:74:a2:86
3	0.000040	198.10.99.2	198.10.99.1	ICMP	98	Echo (ping) request id=0x002e, seq=1/256, ttl=64 (reply in 4)
4	0.000056	198.10.99.1	198.10.99.2	ICMP	98	Echo (ping) reply id=0x002e, seq=1/256, ttl=64 (request in 3)
5	5.200695	16:53:74:74:a2:86	f6:5c:bb:ee:37:87	ARP	42	Who has 198.10.99.2? Tell 198.10.99.1
6	5.200824	f6:5c:bb:ee:37:87	16:53:74:74:a2:86	ARP	42	198.10.99.2 is at f6:5c:bb:ee:37:87

Frame 6: 42 bytes on wire (336 bits), 42 bytes captured (336 bits)
Ethernet II, Src: f6:5c:bb:ee:37:87 (f6:5c:bb:ee:37:87), Dst: 16:53:74:74:a2:86 (16:53:74:74:a2:86)
Address Resolution Protocol (reply)
Hardware type: Ethernet (1)
Protocol type: IPv4 (0x0800)
Hardware size: 6
Protocol size: 4
Opcode: reply (2)
Sender MAC address: f6:5c:bb:ee:37:87 (f6:5c:bb:ee:37:87)
Sender IP address: 198.10.99.2
Target MAC address: 16:53:74:74:a2:86 (16:53:74:74:a2:86)
Target IP address: 198.10.99.1

0000 16 53 74 74 a2 86 f6 5c bb ee 37 87 08 06 00 01 ..Stt... \ ..7....
0010 08 00 06 04 00 02 f6 5c bb ee 37 87 c6 0a 63 02 \ ..7...c.
0020 16 53 74 74 a2 86 c6 0a 63 01 ..Stt... c.

Infine, l'ultimo scambio avviene proprio con h1 che manda una arp reply al router, contenente il suo indirizzo MAC.

5)

The screenshot shows a Wireshark capture of network traffic on the interface r2_eth0.pcap. The packet list shows six packets. Packet 3 is an ARP request from the host (e6:2e:4f:b9:4a:d8) to the router (8e:c2:2b:56:65:8d). The packet details show the Ethernet II frame and the ARP request.

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	198.10.99.2	198.10.98.66	ICMP	98	Echo (ping) request id=0x0039, seq=1/256
2	0.000044	198.10.98.66	198.10.99.2	ICMP	98	Echo (ping) reply id=0x0039, seq=1/256
3	5.021480	e6:2e:4f:b9:4a:d8	8e:c2:2b:56:65:8d	ARP	42	Who has 198.10.99.2? Tell 198.10.99.1
4	5.021678	8e:c2:2b:56:65:8d	e6:2e:4f:b9:4a:d8	ARP	42	Who has 198.10.99.1? Tell 198.10.99.2
5	5.021680	e6:2e:4f:b9:4a:d8	8e:c2:2b:56:65:8d	ARP	42	198.10.99.1 is at e6:2e:4f:b9:4a:d8
6	5.021686	8e:c2:2b:56:65:8d	e6:2e:4f:b9:4a:d8	ARP	42	198.10.99.2 is at 8e:c2:2b:56:65:8d

Frame 3: 42 bytes on wire (336 bits), 42 bytes captured (336 bits)
Ethernet II, Src: e6:2e:4f:b9:4a:d8 (e6:2e:4f:b9:4a:d8), Dst: 8e:c2:2b:56:65:8d (8e:c2:2b:56:65:8d)
Destination: 8e:c2:2b:56:65:8d (8e:c2:2b:56:65:8d)
Source: e6:2e:4f:b9:4a:d8 (e6:2e:4f:b9:4a:d8)
Type: ARP (0x0806)
Address Resolution Protocol (request)

Per inviare una echo request ad h2, h1 trova l'indirizzo MAC del suo gateway tramite ARP ed invia a questo la echo request, incapsulata in un pacchetto ip, a sua volta incapsulato in un frame ethernet. (protocollo arp come da punto 4).

Nello screen sono visibili le coordinate del frame Ethernet, composte dai mac divenuti noti dopo l'applicazione dell'arp.

r4_eth2.pcap						
No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	198.10.99.2	198.10.98.66	ICMP	98	Echo (ping) request id=0x0039, seq=1/256, ttl=63 (reply in 2)
2	0.000026	198.10.98.66	198.10.99.2	ICMP	98	Echo (ping) reply id=0x0039, seq=1/256, ttl=63 (request in 1)
3	5.021490	22:91:3e:3b:3a:06	06:0a:03:ae:9a:7f	ARP	42	Who has 198.10.98.33? Tell 198.10.98.34
4	5.021660	06:0a:03:ae:9a:7f	22:91:3e:3b:3a:06	ARP	42	Who has 198.10.98.34? Tell 198.10.98.33
5	5.021663	22:91:3e:3b:3a:06	06:0a:03:ae:9a:7f	ARP	42	198.10.98.34 is at 22:91:3e:3b:3a:06
6	5.021677	06:0a:03:ae:9a:7f	22:91:3e:3b:3a:06	ARP	42	198.10.98.33 is at 06:0a:03:ae:9a:7f

```

> Frame 1: 98 bytes on wire (784 bits), 98 bytes captured (784 bits)
> Ethernet II, Src: 06:0a:03:ae:9a:7f (06:0a:03:ae:9a:7f), Dst: 22:91:3e:3b:3a:06 (22:91:3e:3b:3a:06)
  > Destination: 22:91:3e:3b:3a:06 (22:91:3e:3b:3a:06)
  > Source: 06:0a:03:ae:9a:7f (06:0a:03:ae:9a:7f)
  Type: IPv4 (0x0800)
> Internet Protocol Version 4, Src: 198.10.99.2, Dst: 198.10.98.66
> Internet Control Message Protocol

```

R2 va quindi nella sua routing table per vedere come raggiungere la lan a cui è collegato h2, individuando l'ip del router del prossimo salto.

Per mandare a questo router r4 il frame, r2 chiede e riceve tramite arp il MAC di r4 a cui riesce quindi a rigirare il pacchetto, dopo averlo riincapsulato in un nuovo frame ethernet col MAC di r4, poichè aveva aperto il vecchio per leggere che il mac destinatario fosse il suo.

h2_eth0.pcap						
No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	198.10.99.2	198.10.98.66	ICMP	98	Echo (ping) request id=0x0039, seq=1/256,
2	0.000009	198.10.98.66	198.10.99.2	ICMP	98	Echo (ping) reply id=0x0039, seq=1/256,
3	5.021486	ce:11:11:fe:71:43	2a:f5:34:bf:11:7a	ARP	42	Who has 198.10.98.65? Tell 198.10.98.66
4	5.021642	2a:f5:34:bf:11:7a	ce:11:11:fe:71:43	ARP	42	Who has 198.10.98.66? Tell 198.10.98.65
5	5.021647	ce:11:11:fe:71:43	2a:f5:34:bf:11:7a	ARP	42	198.10.98.66 is at ce:11:11:fe:71:43
6	5.021667	2a:f5:34:bf:11:7a	ce:11:11:fe:71:43	ARP	42	198.10.98.65 is at 2a:f5:34:bf:11:7a

```

> Frame 1: 98 bytes on wire (784 bits), 98 bytes captured (784 bits)
> Ethernet II, Src: 2a:f5:34:bf:11:7a (2a:f5:34:bf:11:7a), Dst: ce:11:11:fe:71:43 (ce:11:11:fe:71:43)
  > Destination: ce:11:11:fe:71:43 (ce:11:11:fe:71:43)
  > Source: 2a:f5:34:bf:11:7a (2a:f5:34:bf:11:7a)
  Type: IPv4 (0x0800)
> Internet Protocol Version 4, Src: 198.10.99.2, Dst: 198.10.98.66
> Internet Control Message Protocol

```

Infine, r4, che è connesso alla stessa lan di h2, chiede a questo il suo mac ancora una volta tramite arp e gli invia pacchetto ip incapsulato in un frame ethernet recante il suo MAC come destinazione.

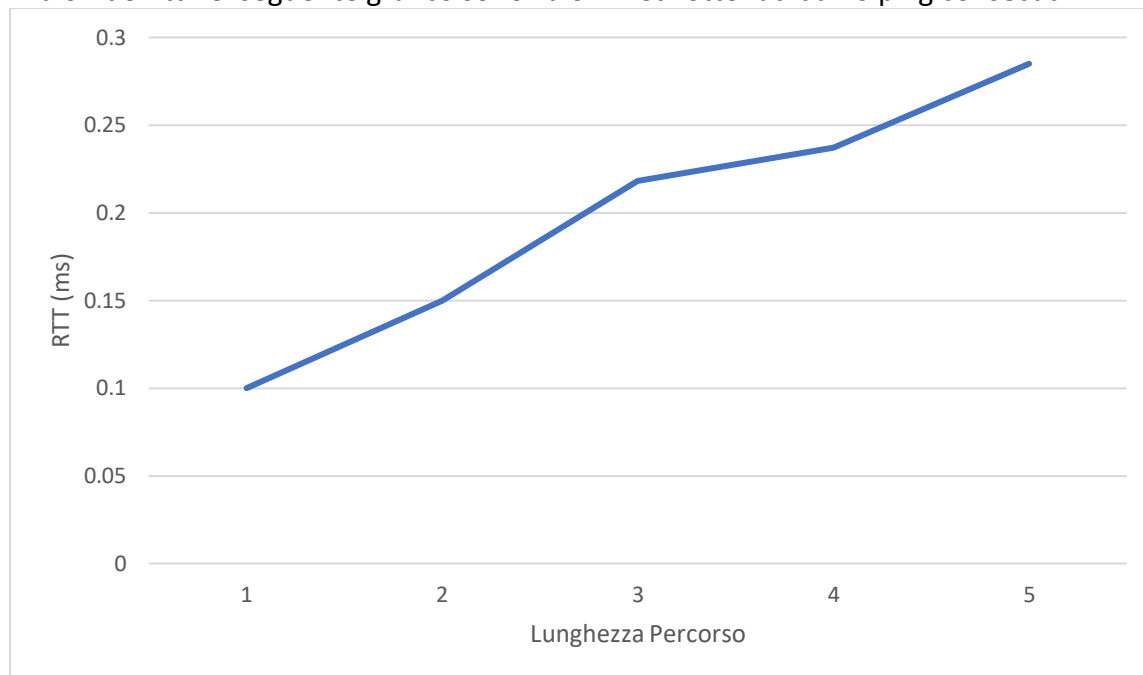
A questo punto, h2 riuscirà ad aprire sia il frame che il pacchetto ip poiché indica il suo indirizzo e a leggere la echo request, alla quale risponderà con una echo reply.

A questo punto, inizia il processo inverso per recapitare a h1 questa echo reply.

6)

In generale, all'aumentare della lunghezza del percorso, e quindi dei dispositivi attraversati, aumenta anche il Round Trip Time; tuttavia a causa dei vari e non costanti ritardi presenti sulla rete, può capitare di rado che il RTT su un percorso più lungo sia più veloce di uno su un percorso più breve, come emerso dopo vari test.

I valori del rtt nel seguente grafico sono valori medi ottenuti da 10 ping consecutivi.



Lunghezza percorso	Rtt(ms)
1	0,1
2	0,15
3	0,218
4	0,237
5	0,285

È quindi evidente una correlazione similr-lineare tra rtt e lunghezza percorso, la quale viene in media rispettata, nonostante possano presentarsi singoli casi anomali, a sottolineare la bassa frequenza con cui accadono.