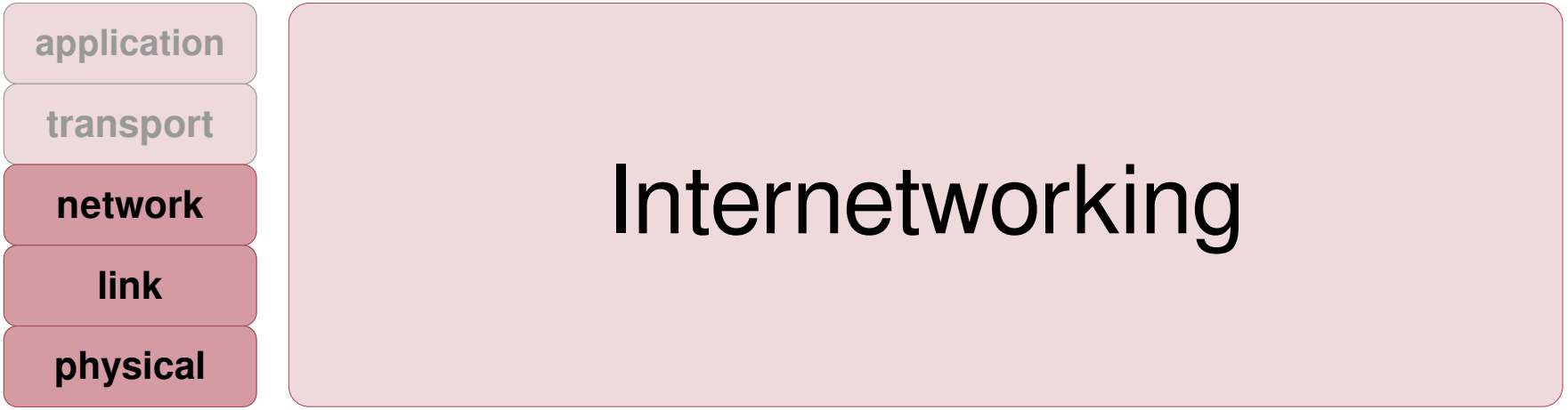
UCLM
UNIVERSIDAD DE CASTILLA-LA MANCHA

Computer Networks I



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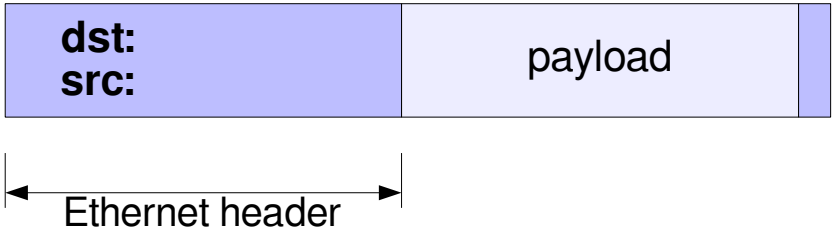
Nomenclature

- **A**: The host '**A**'
- **R1**: The router '**R1**'
- **A.eth0**: The interface **eth0** of the host **A**
- **A.ip**: The **IP** address of the unique external interface of the host **A**
- **A.mac**: The **MAC** address of the unique external interface of the host **A**
- **R2.ppp0**: The interface **ppp0** of the router **R2**
- **R2.eth1.mac**: The **MAC** address of the interface **eth1** in router **R2**
- **R2.eth2.ip**: The **IP** address of the interface **eth2** in router **R2**

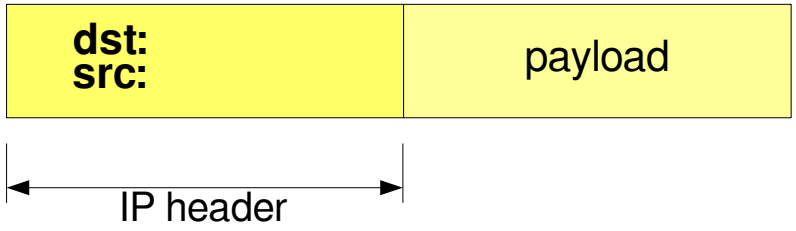
Nomenclature

- Ethernet frame:
  - **dst:** target MAC
  - **src:** source MAC

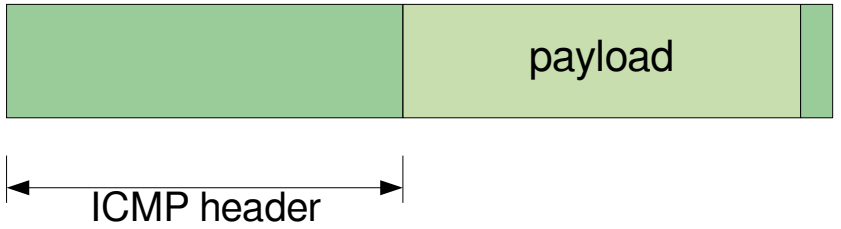


- ARP message:
  - **dst.[ip o mac]:** target IP/MAC
  - **src.[ip o mac]:** source IP/MAC

- IP packet:
  - **dst:** target IP
  - **src:** source IP

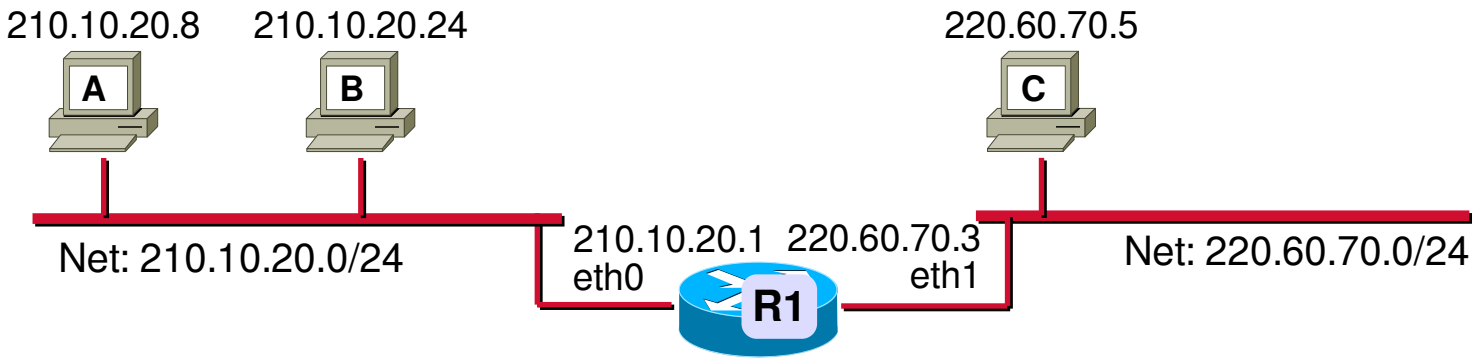


- ICMP message:



Topology

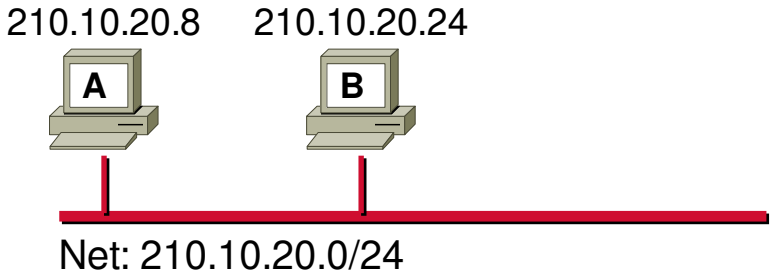
Use case 1



Use case 2

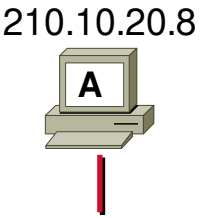
Ping between local hosts

- Use case 1:
  - Hosts connected through an Ethernet LAN
- Ping A → B
  - ping → ICMP request
  - Local delivery

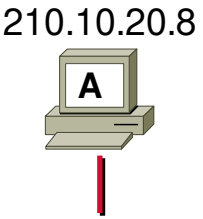


Ping between local hosts

Step 1: The user issues the command



Ping between local hosts



Step 2: O.S. rc

Destination IP

Network mask

Network address

210.10.20.24	00001010.00010100.00011000
& 255.255.255.0	& 11111111.11111111.11111111.00000000
210.10.20.00	11010010.00001010.00010100.00000000

application

transport

network

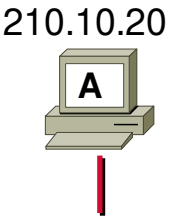
link

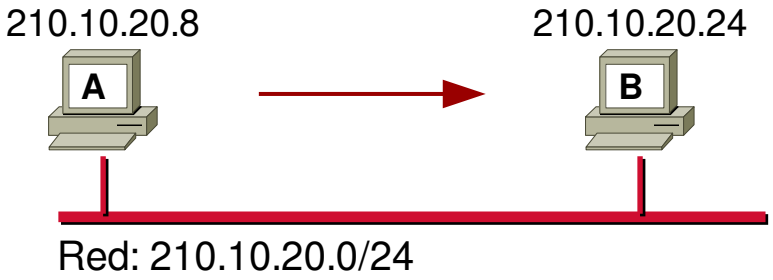
physical

destino	máscara	next hop	iface
210.10.20.0	255.255.255.0	direct	eth0
default	-	210.10.20.1	eth0

Ping between local hosts

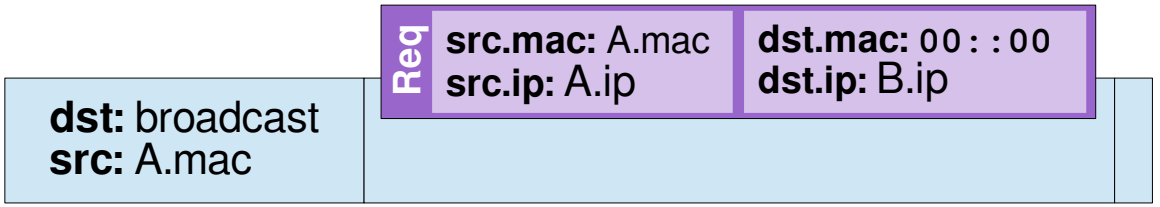
Step 3: Get B physical address (MAC)





application
transport
network
Link
physical

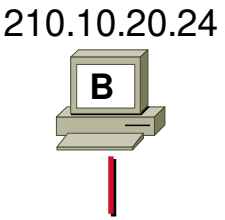
ARP message

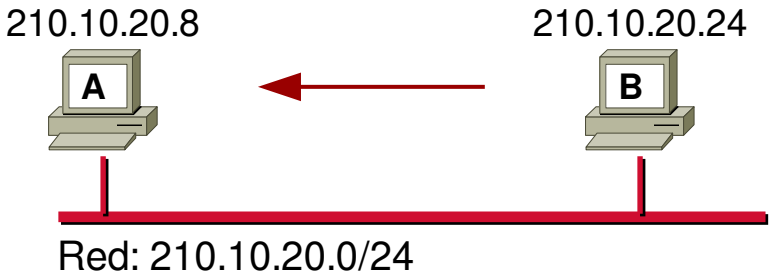


Ethernet frame

Ping between local hosts

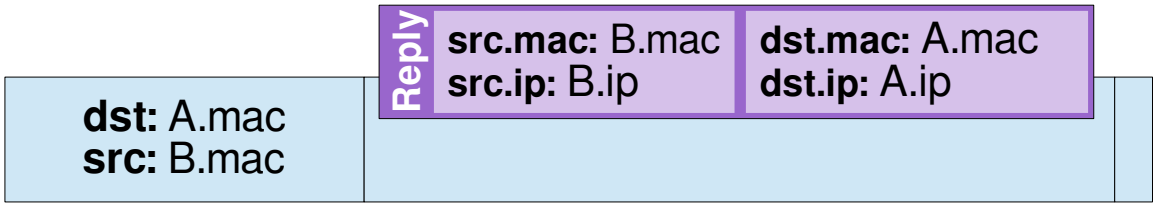
Step 3: Get B physical address (MAC)





application
transport
network
Link
physical

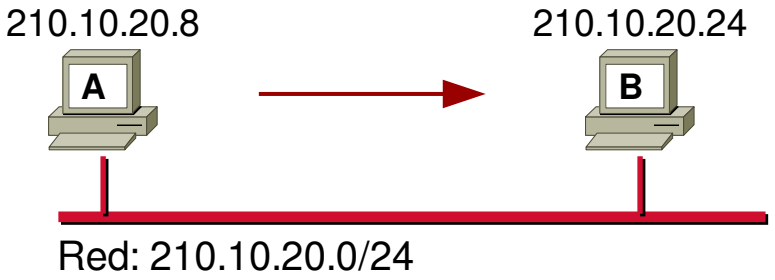
ARP message

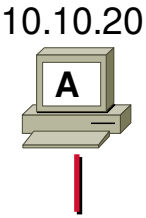


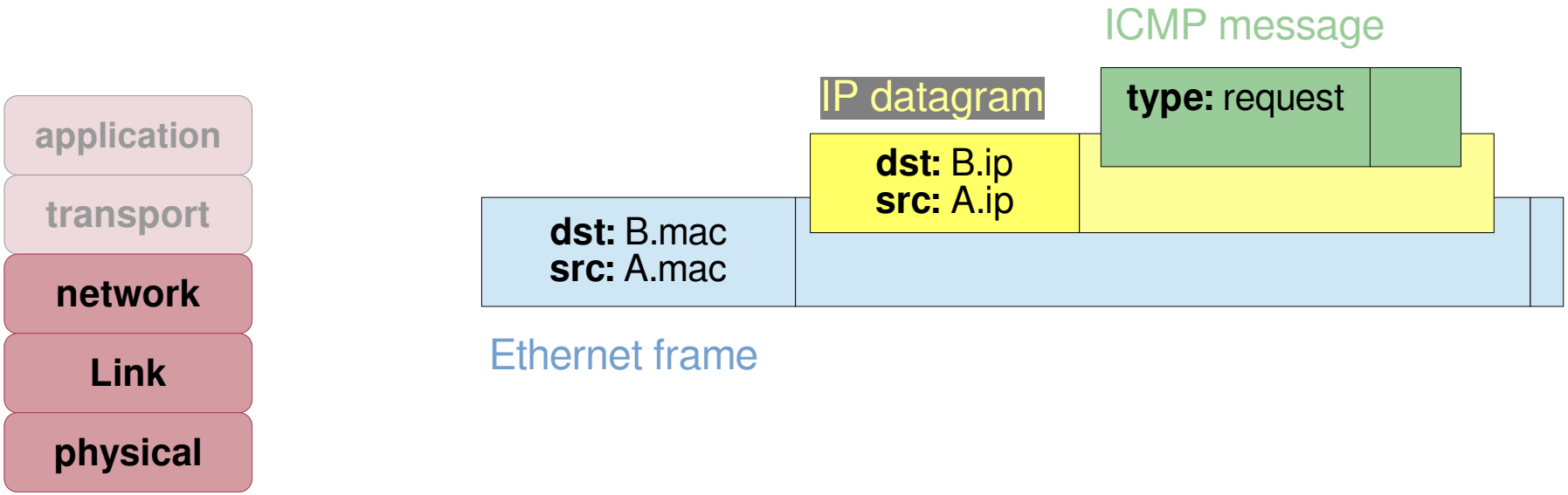
Ethernet frame

Ping between local hosts

Step 4: Echo request

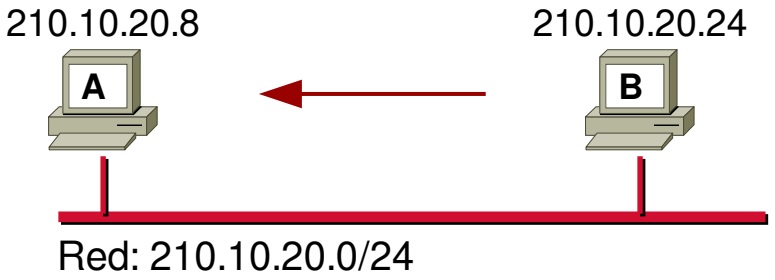


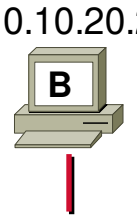


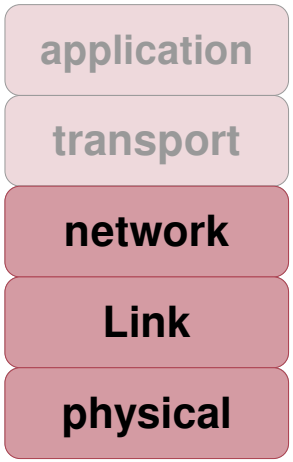


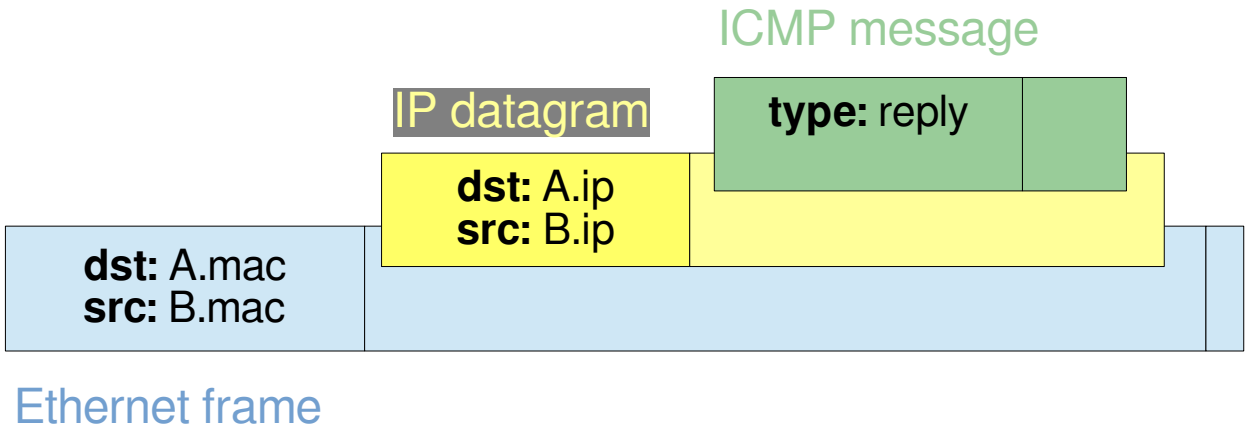
Ping between local hosts

Step 4: Echo reply



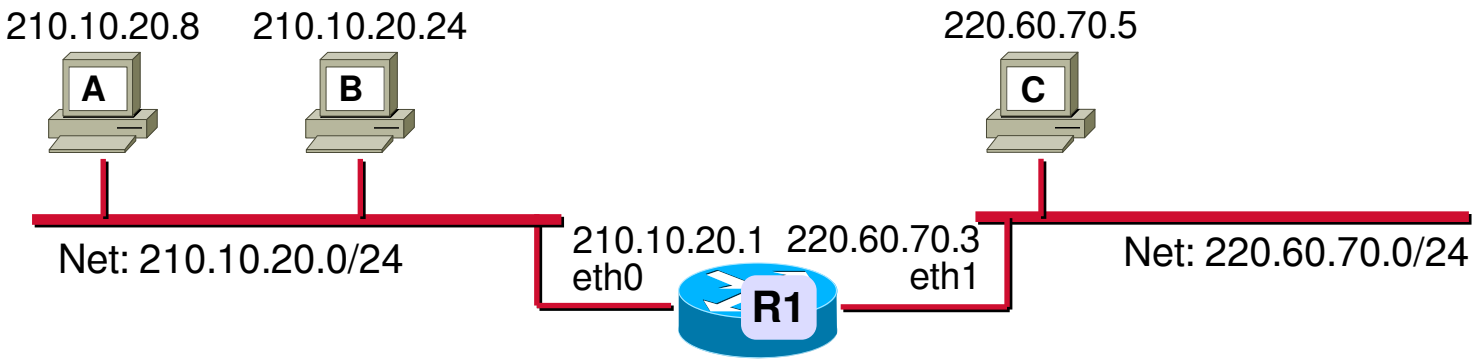






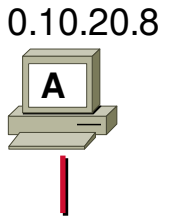
Ping between remote hosts

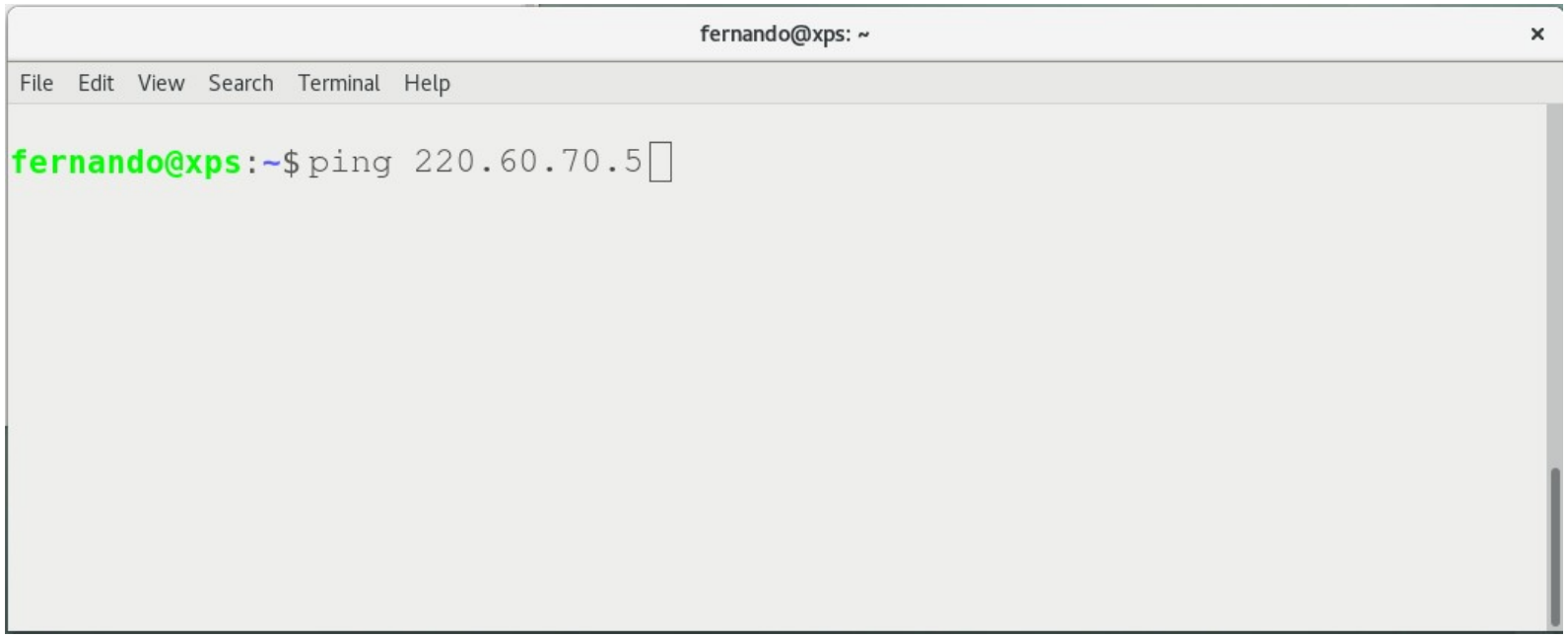
- Use Case 2:
  - Hosts belonging to different networks
- Ping A → C
  - Requires forwarding



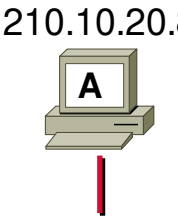
Ping between remote hosts

Step 1: The user issues the command





Ping between remote hosts



Step 2: O.S. rc

Destination IP

Network mask

Network address

220.60.70.5	00111100.01000110.00000101
& 255.255.255.0	& 11111111.11111111.11111111.00000000
220.60.70.00	11011100.00111100.01000110.00000000

application

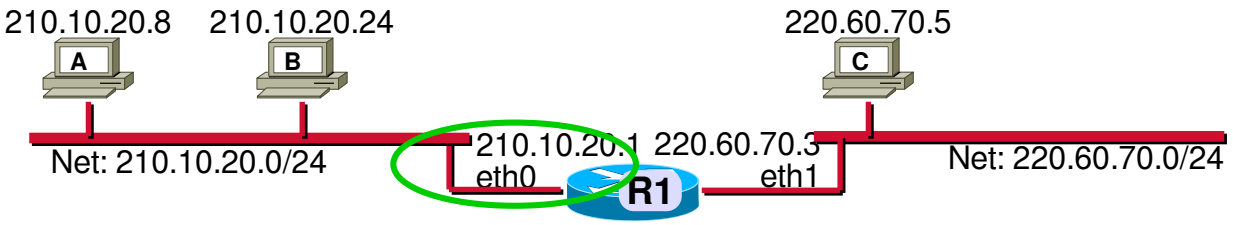
transport

network

link

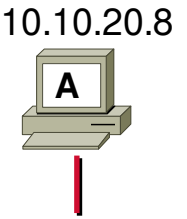
physical

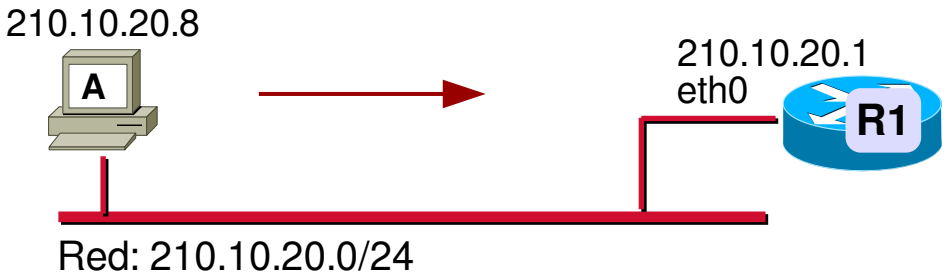
destino	máscara	next hop	iface
210.10.20.0	255.255.255.0	direct	eth0
default	-	210.10.20.1	eth0



Ping between remote hosts

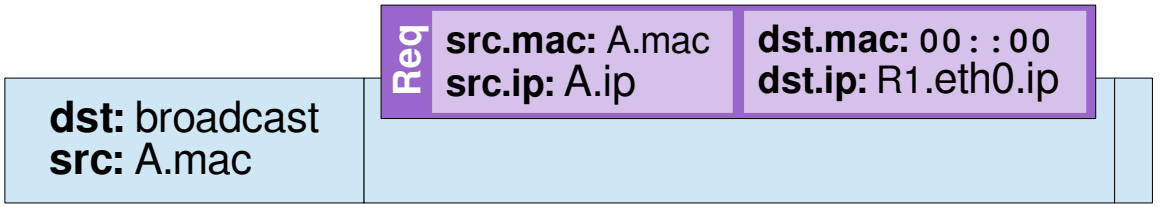
Step 3: Get R1.eth0 physical address (MAC)





application
transport
network
Link
physical

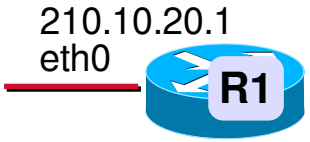
ARP message

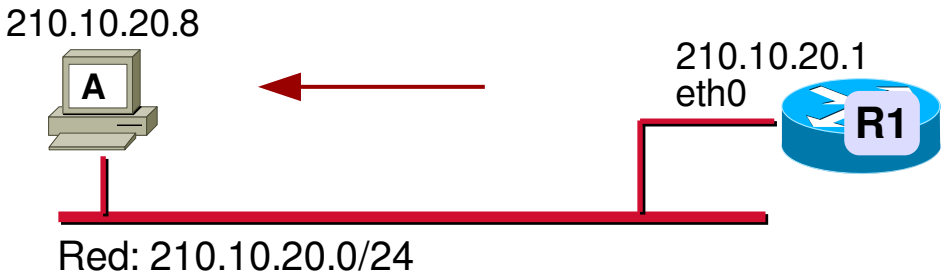


Ethernet frame

Ping between remote hosts

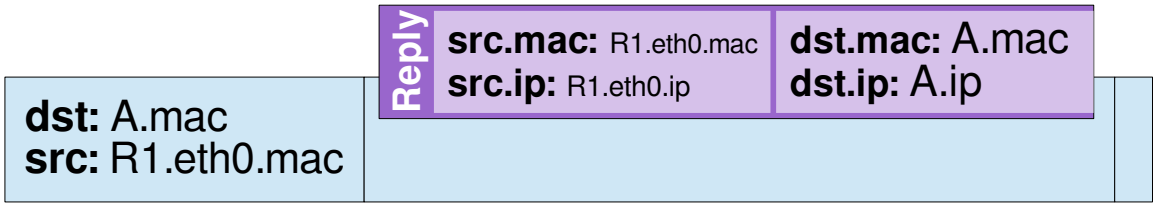
Step 3: Get R1.eth0 physical address (MAC)





application
transport
network
Link
physical

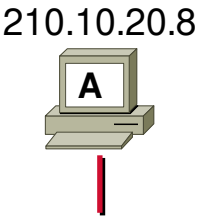
ARP message

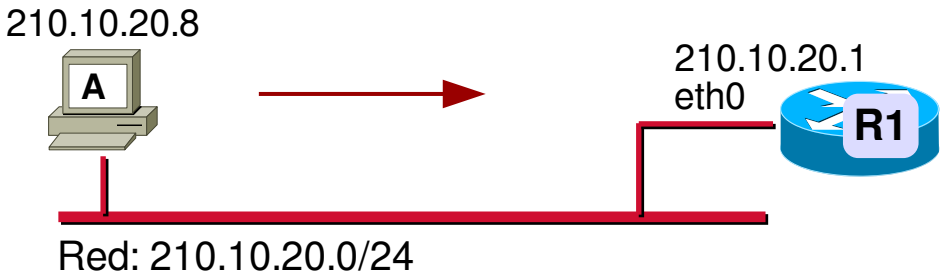


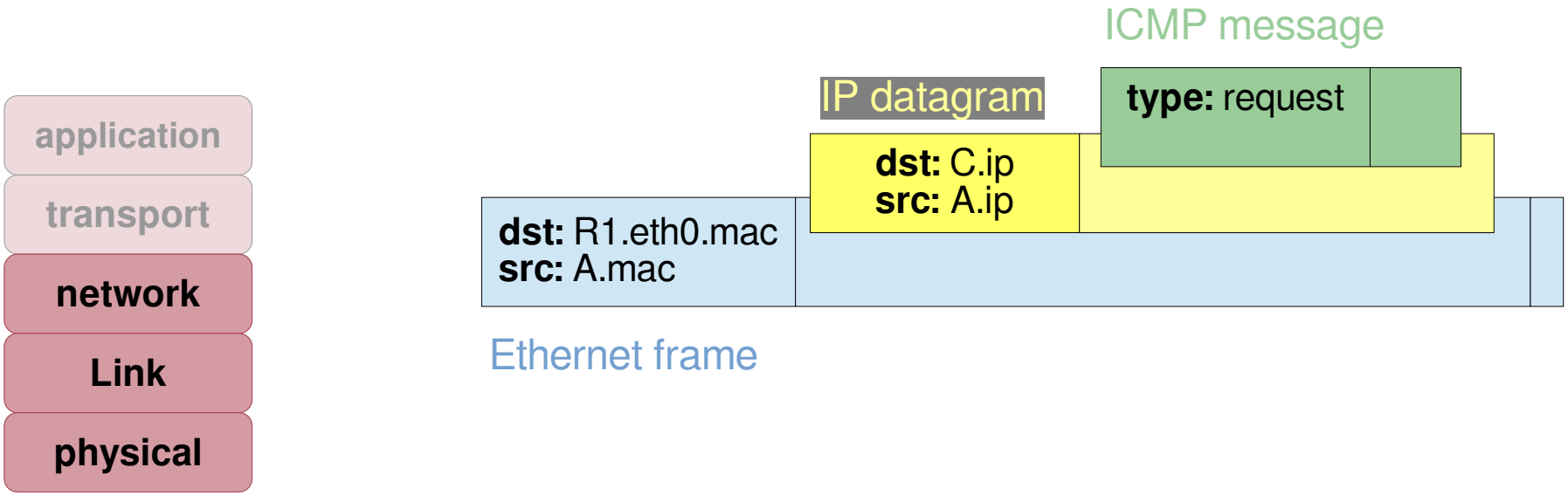
Ethernet frame

Ping between remote hosts

Step 4: Echo request (first hop)







Ping between remote hosts

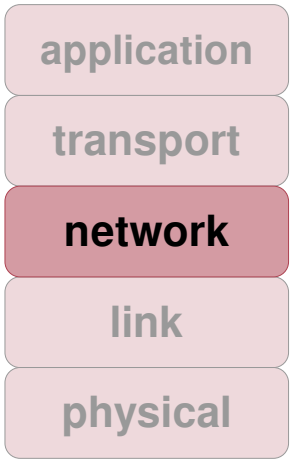
Step 5: R1 rou

Destination IP

Network mask

Network address

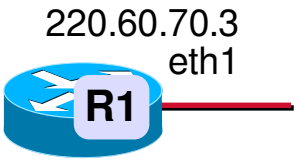
220.60.70.5	00111100.01000110.00000101
& 255.255.255.0	& 11111111.11111111.11111111.00000000
220.60.70.00	11011100.00111100.01000110.00000000

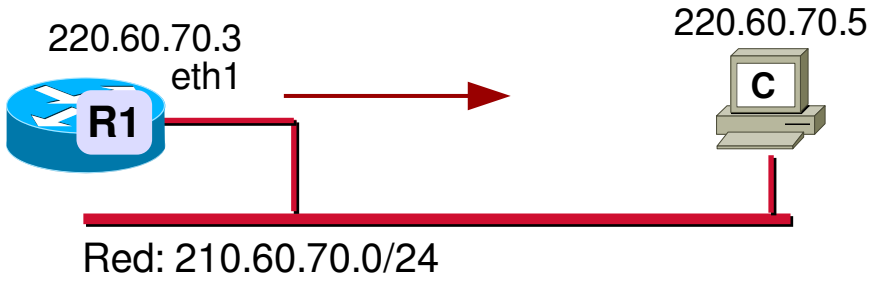


destination	mask	next hop	ifac
210.10.20.0	255.255.255.0	direct	eth
220.60.70.0	255.255.255.0	direct	eth

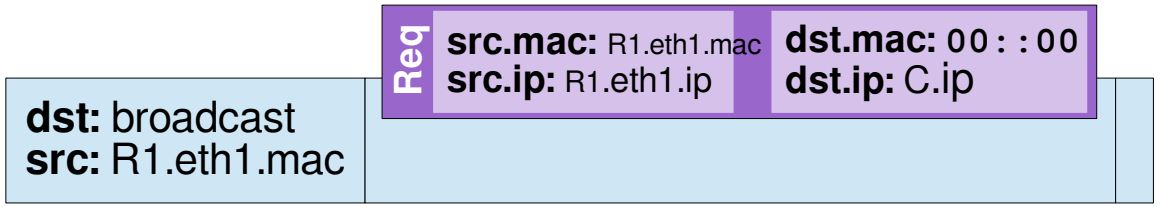
Ping between remote hosts

Step 6: Get C physical address (MAC)





ARP message

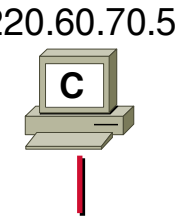


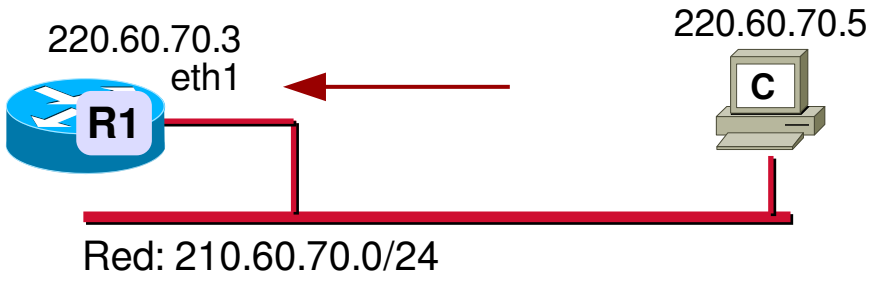
Ethernet frame

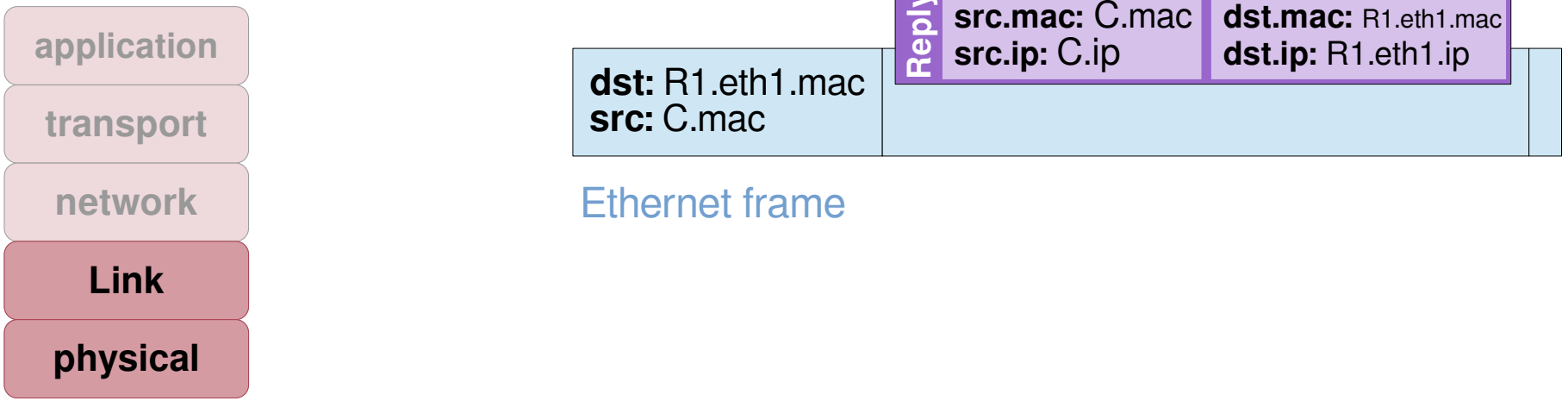
application
transport
network
Link
physical

Ping between remote hosts

Step 6: Get C physical address (MAC)

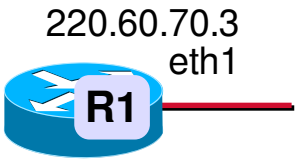


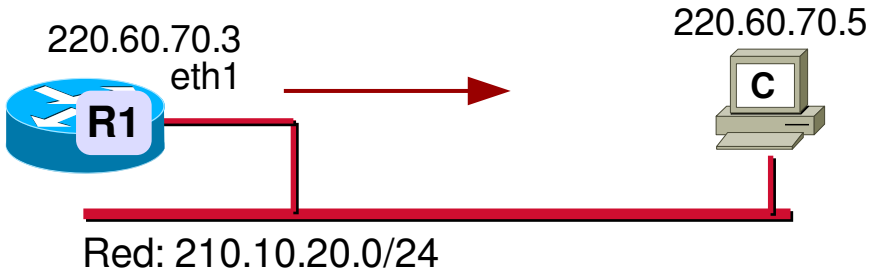


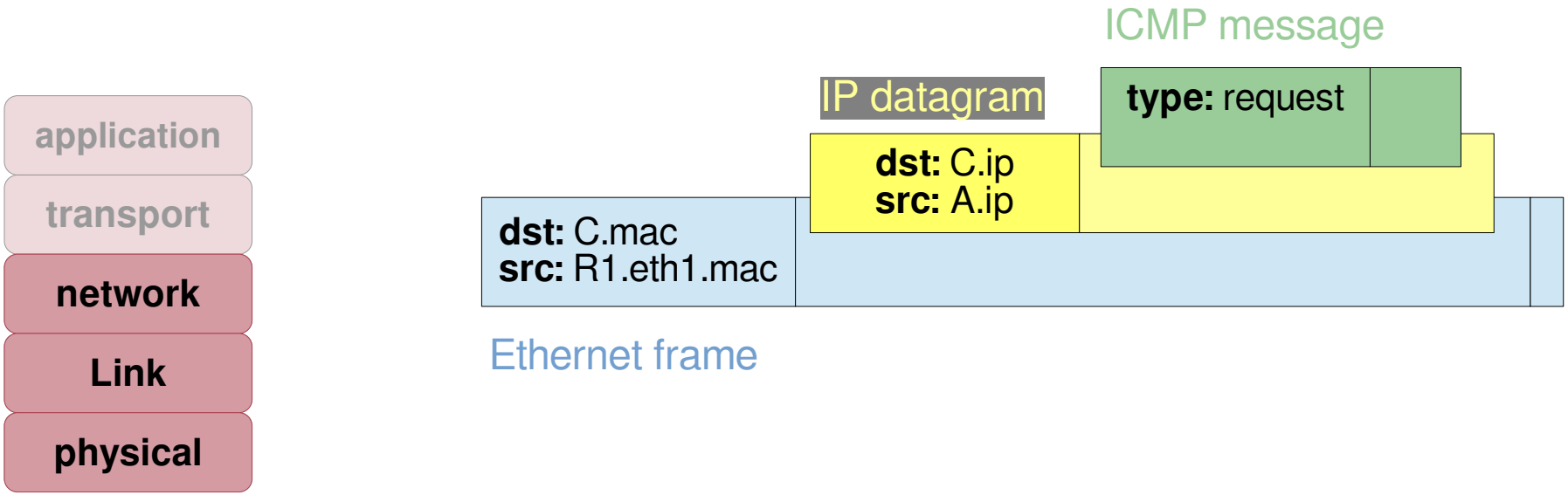


Ping between remote hosts

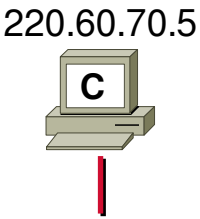
Step 7: Echo request (second hop)







Ping between remote hosts



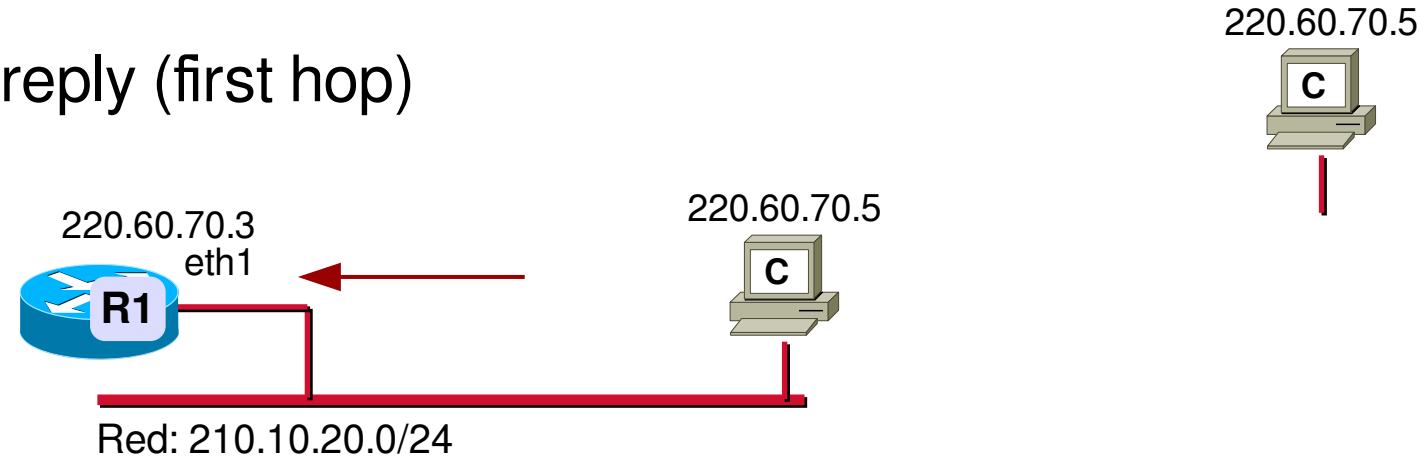
Step 8: O.S. echo request received and replied

- Just copies the content back to A
- Same procedure than step 2

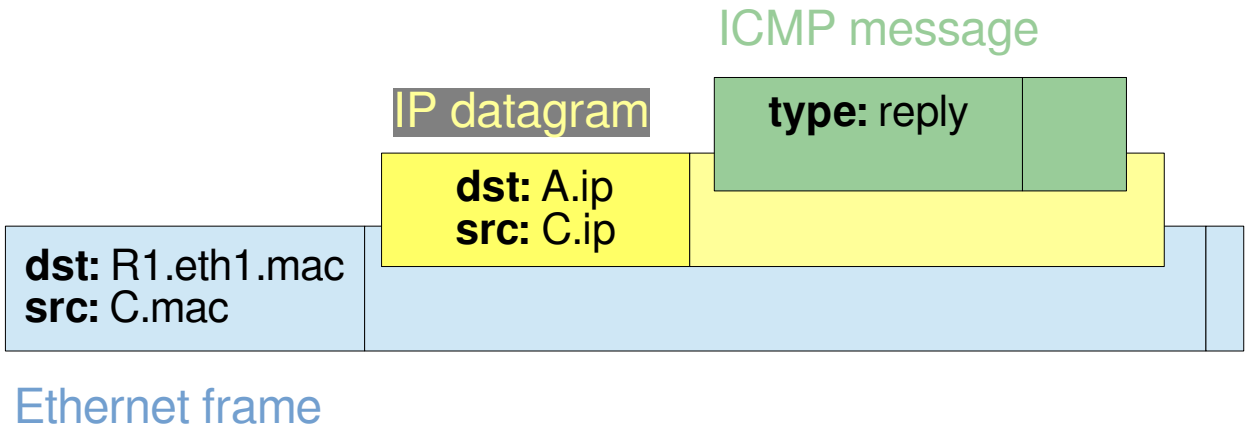
application
transport
network
link
physical

Ping between local hosts

Step 9: Echo reply (first hop)



application
transport
network
Link
physical

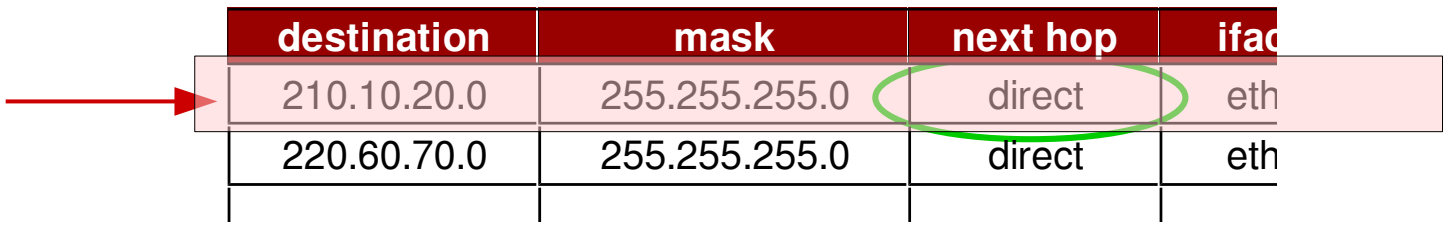


Ping between remote hosts

Step 10: R1 routing

- Same procedure than step 5
- This time opposite direction

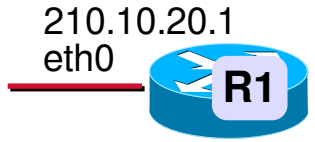
application
transport
network
link
physical

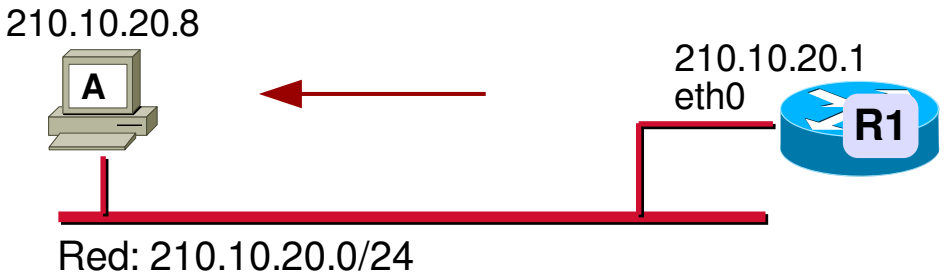


destination	mask	next hop	ifac
210.10.20.0	255.255.255.0	direct	eth
220.60.70.0	255.255.255.0	direct	eth

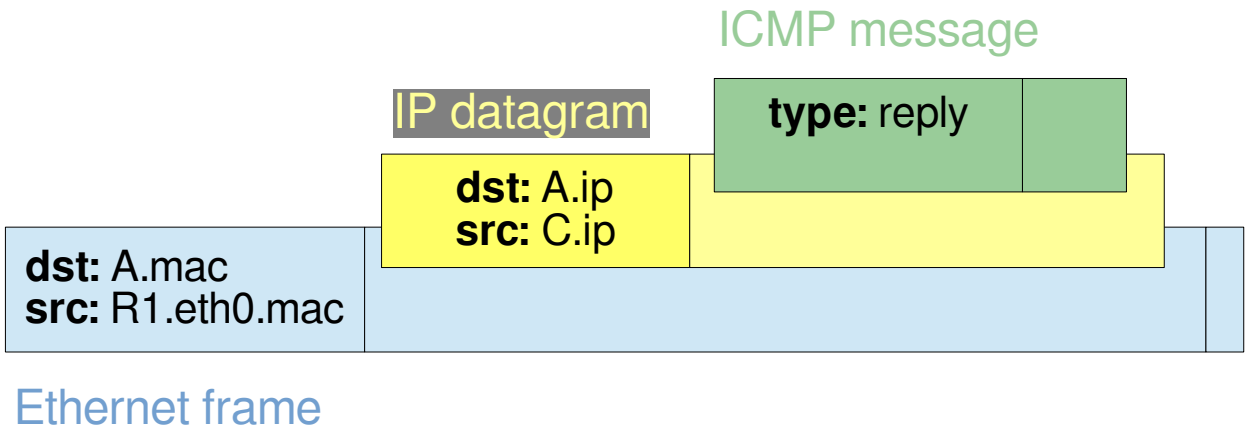
Ping between local hosts

Step 11: Echo reply (second hop)





application
transport
network
Link
physical



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Final remarks

- MACs are used for local delivery
- IPs are used for internetworking
- IPs don’t vary from hop to hop. MACs do.
- And remember that we normally use names not numbers
  - Previous DNS requests for the translation