FIT9137
Introduction to Computer Architecture and Networks

Week 8: Workshop on Network Layer

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Today

How long?	What ?	Why ?
20 mins	Network Layer Addressing & Resolution	Recap from pre-class activities and recorded videos
	Flux Q&A	Recap
30 mins	**Activity 1**: Address Resolution	- Examine Network Addressing, Network & Subnets. - Domain Name Resolution (**DNS**) - Address Resolution Protocol (**arp**)
5 mins	Take-home message	Conclusion
15 mins	Overview of DHCP and Flux Q&A	Recap on DHCP
35 mins	**Activity 2: DHCP**	- Apply your knowledge in Network Layer - DHCP Dynamic Host Configuration Protocol
5 mins	Take-home message	Conclusion

Network Layer:

Addressing

Networks & Subnets

Address Resolution

Dynamic IP addressing

DHCP

Layers

Application layer

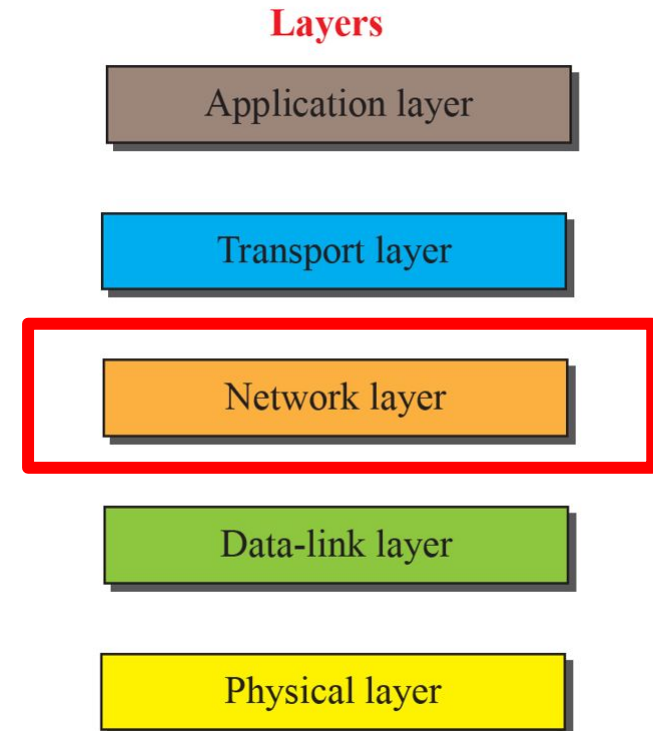| Transport layer |
|---|

Network layer

Data-link layer

Physical layer

Network Layer

Network Layer:

- **addressing** and **routing** of packets

- connecting different networks

Layers

| Application layer |
| Transport layer |
| **Network layer** |
| Data-link layer |
| Physical layer |

Addressing

Addressing applications

Why does the HTTP response arrive in this browser window and not the other one?

Addressing applications
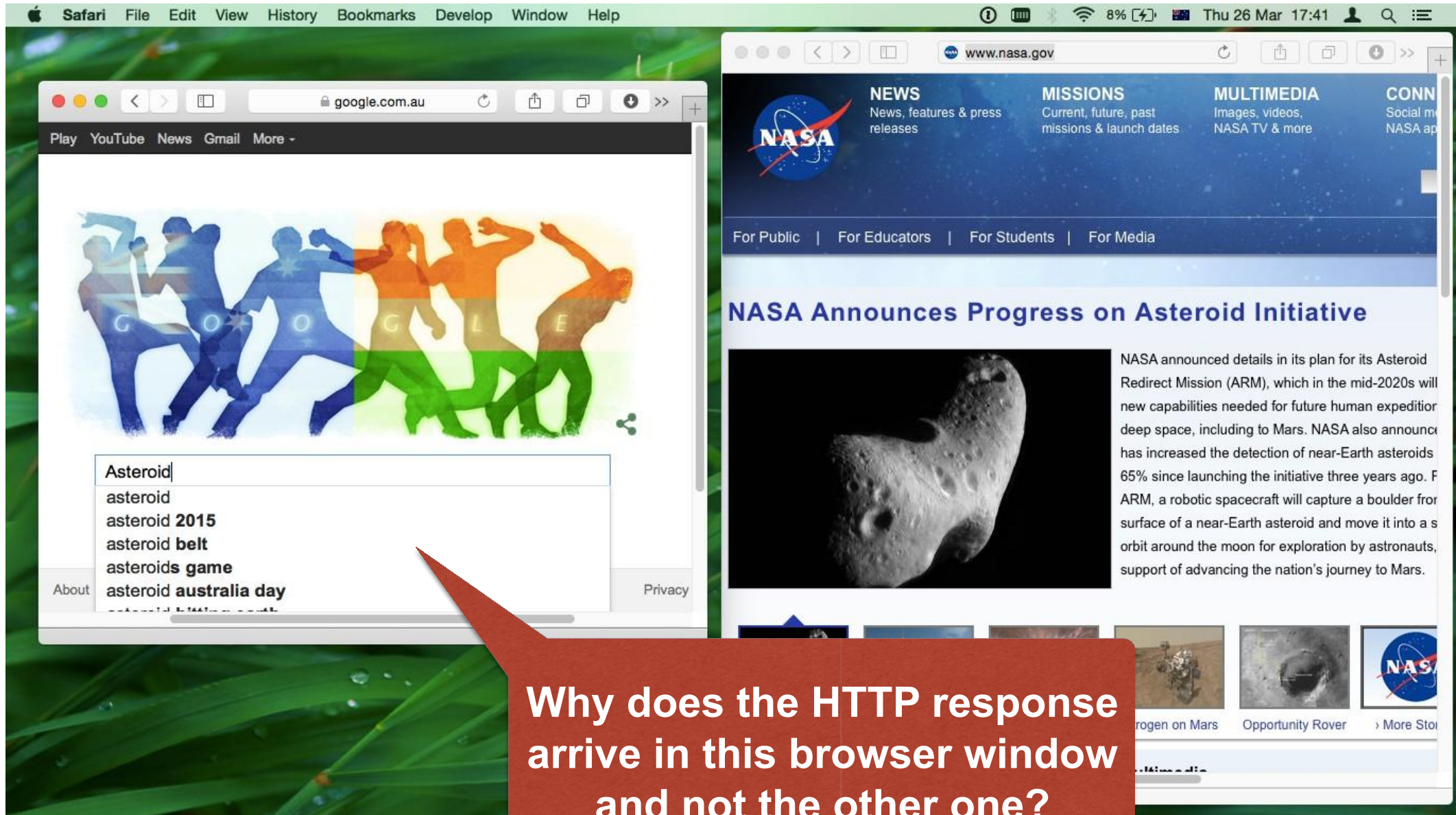
http://www.google.com.au
216.58.220.99:80

Random client port, one per connection

Fixed server port (80 = HTTP)

130.194.77.37:57017
130.194.77.37:57018
130.194.77.37:57019

130.194.11.146:25
smtp.monash.edu

Fixed server port (25 = SMTP)

111.119.8.38:80

http://www.nasa.gov

One address per

Application Layer
- URL (e.g. http://www.csse.monash.edu)

Transport Layer (TCP)
- Port number (e.g. 80 for HTTP)
- identifies the application that handles a message

Network Layer (IP)
- IP address (e.g. 130.194.66.43)
- used for identifying devices across networks

Data Link Layer (Ethernet)
- MAC address (e.g. 00:23:ae:e7:52:85)
- used for sending frames in a LAN

Layers

Application layer

Transport layer

Network layer

Data-link layer

Physical layer

Where to get an address?

DNS entries

- ICANN/Registrars manage top-level and second-level domains

- Network admins manage DNS for their assigned domains

Port numbers
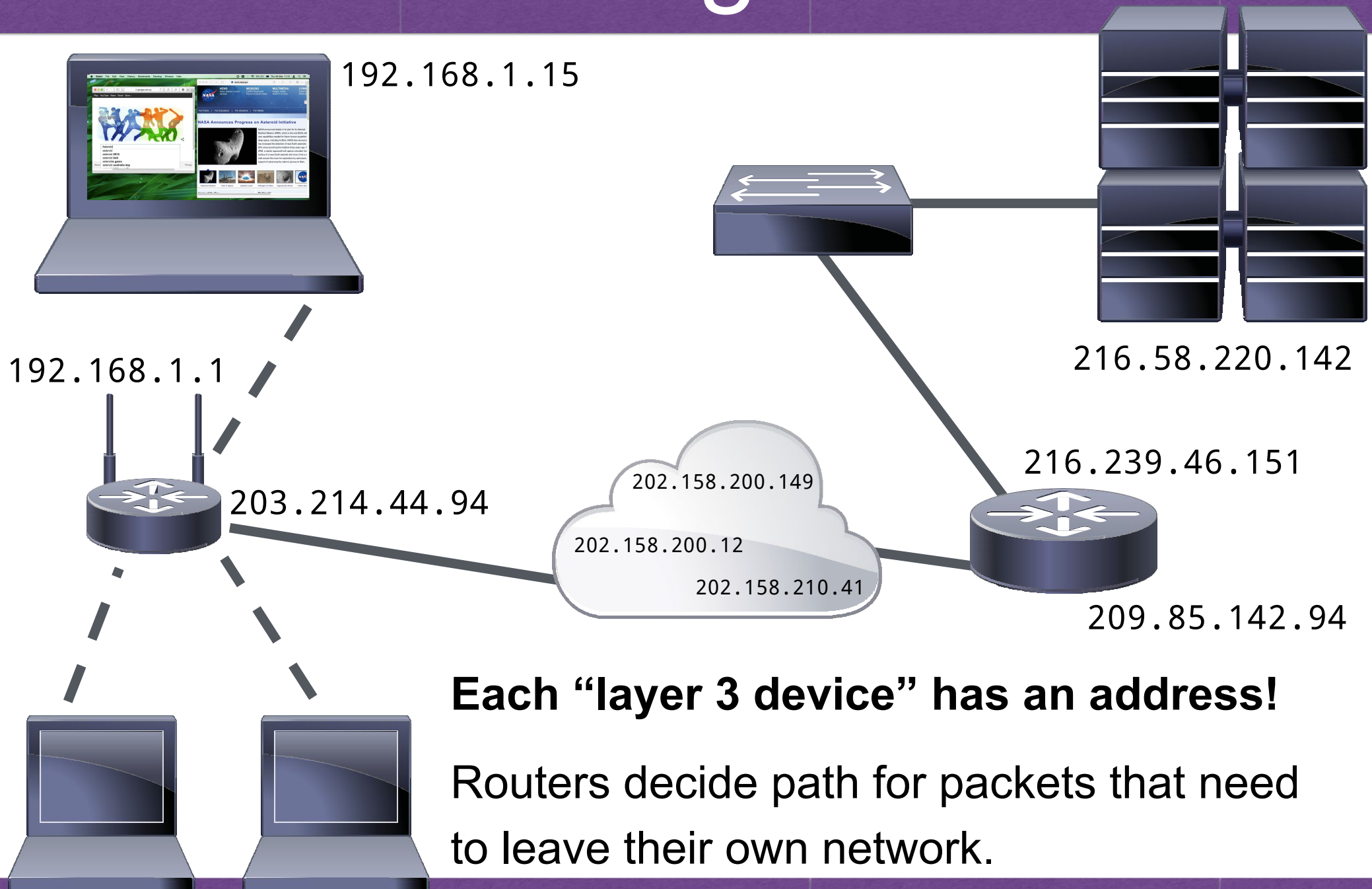
- IANA maintains official <u>list of port numbers</u>

IP addresses

- IANA and 5 RIRs allocate blocks of addresses, local registries re-distribute to customers

- Network admins configure (static or dynamic) addresses in their assigned block

MAC addresses

- Unique addresses allocated by hardware manufacturers

Addressing devices

192.168.1.15

192.168.1.1

203.214.44.94

202.158.200.149

202.158.200.12

202.158.210.41

216.58.220.142

216.239.46.151

209.85.142.94

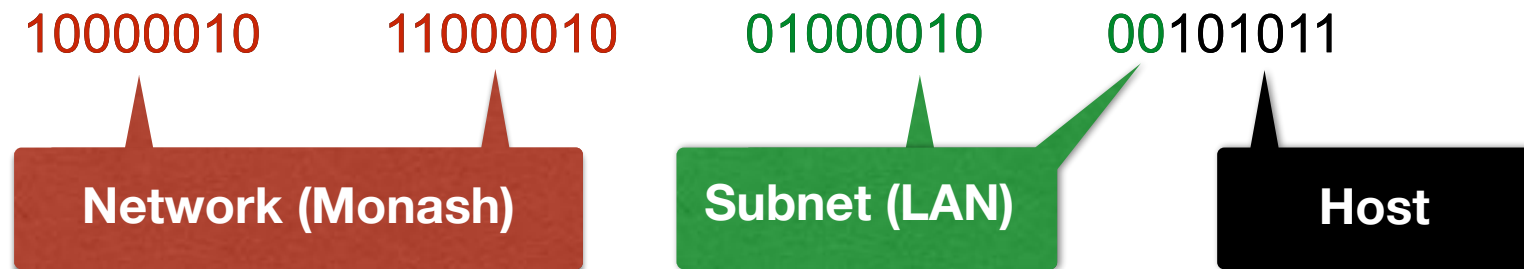**Each "layer 3 device" has an address!**

Routers decide path for packets that need to leave their own network.

IP version 4

32 bit addresses

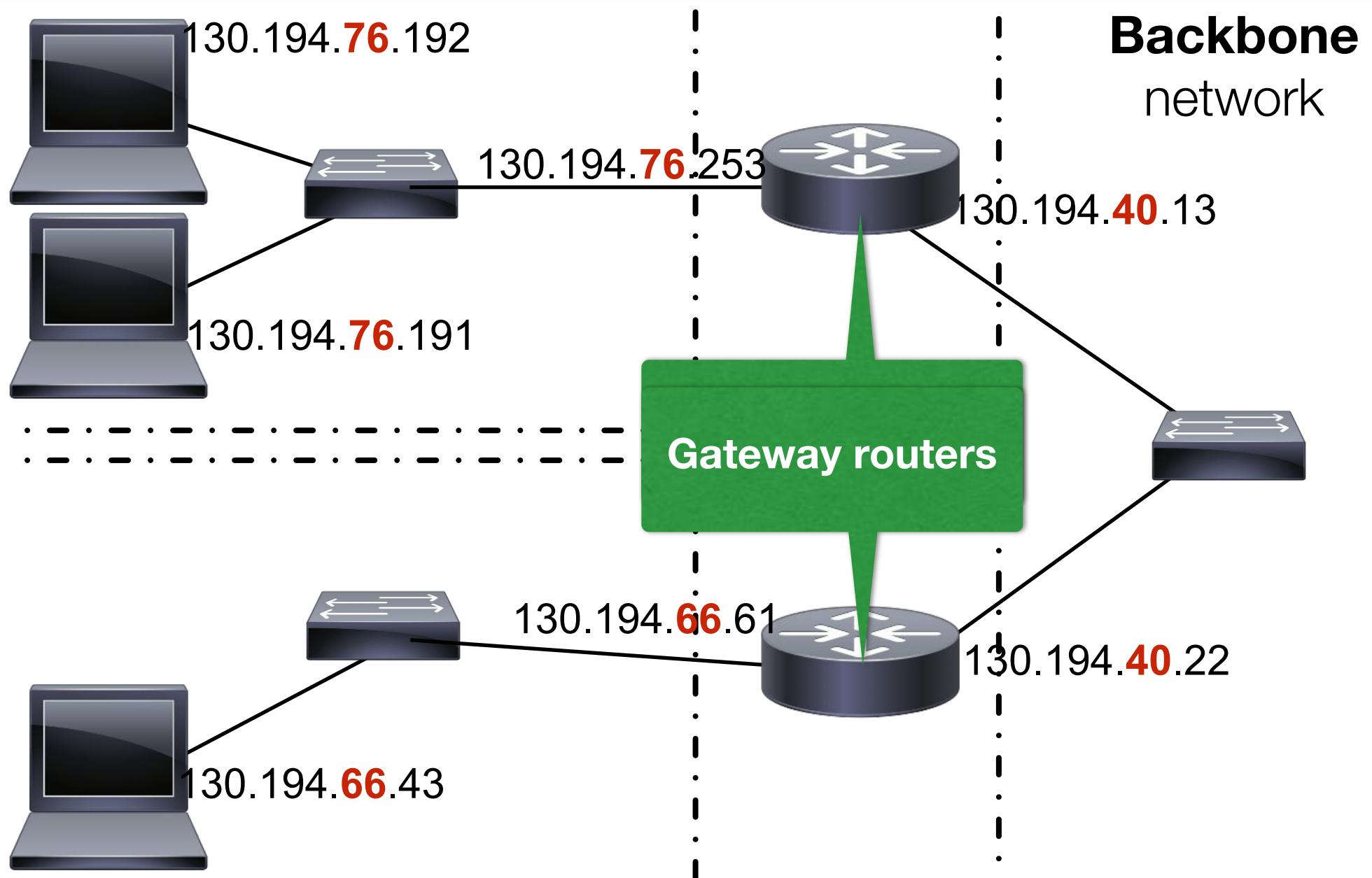Written using "dotted decimal" notation

Example: 130.194.66.43

10000010   11000010   01000010   00101011

Network (Monash)   **Subnet (LAN)**   **Host**

Hierarchy used for routing

You can immediately see if a destination address is in the same subnet!

no. of bits in network + subnet

Subnet **mask**: **255.255.255.192 or /26**

Subnets

130.194.**76**.192

130.194.**76**.253

Backbone
network

130.194.**40**.13

130.194.**76**.191

Gateway routers

130.194.**66**.61

130.194.**40**.22

130.194.**66**.43

Address resolution

Assume we browse to http://www.google.com.au

- We know client use random tcp port & server uses destination port 80 for http

- We have to translate www.google.com.au into an IP address: 216.58.220.99 (domain name resolution)

- We send a request through the Internet to that IP address

- The router in the destination LAN of 216.58.220.99 needs to know the MAC address for 216.58.220.99 to deliver the frame (MAC address resolution)

This is known as Name resolution or address resolution.

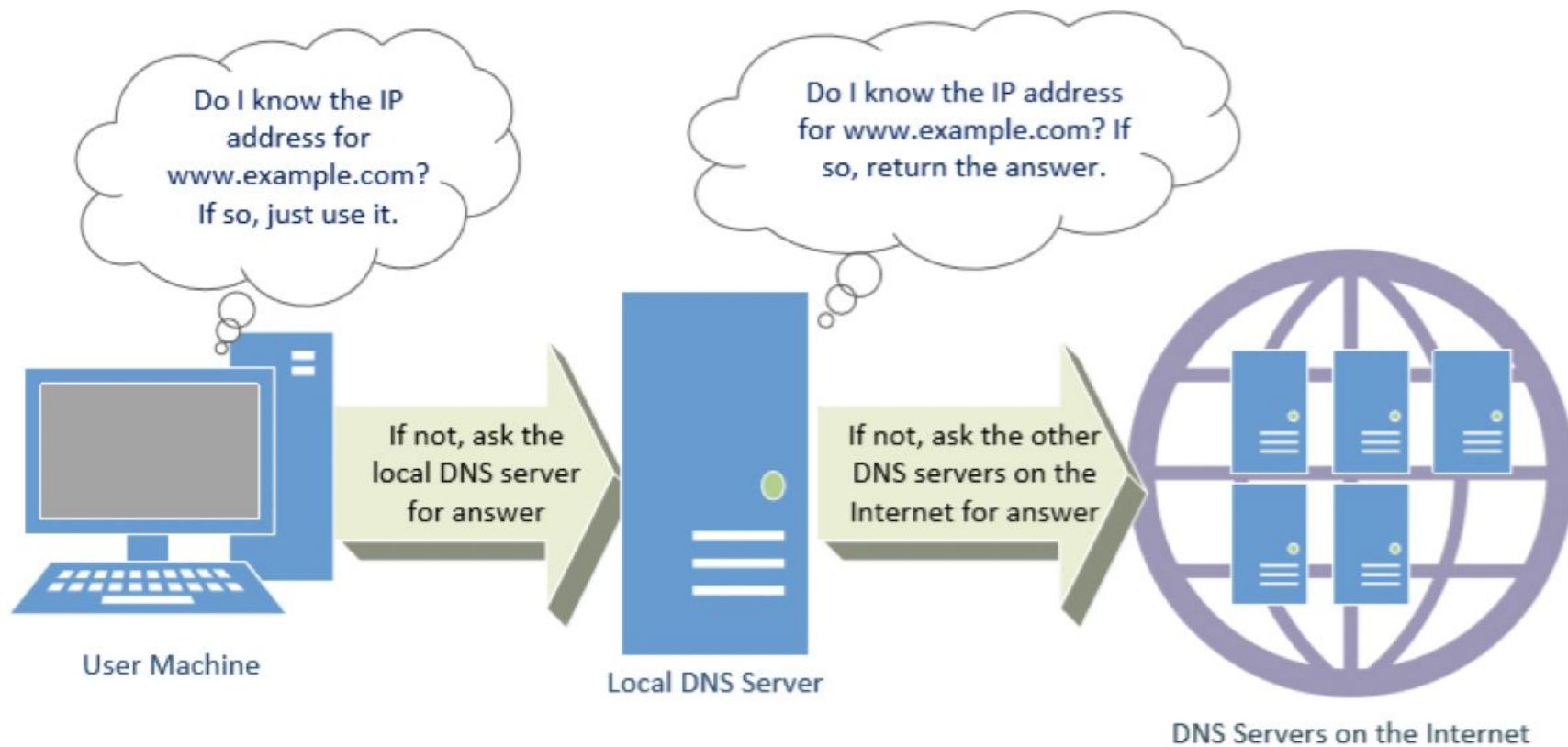# Address resolution: Application Layer

DNS (Domain Name System)

- Application layer protocol for address resolution

- Client sends request to DNS server to get IP address registered for a name
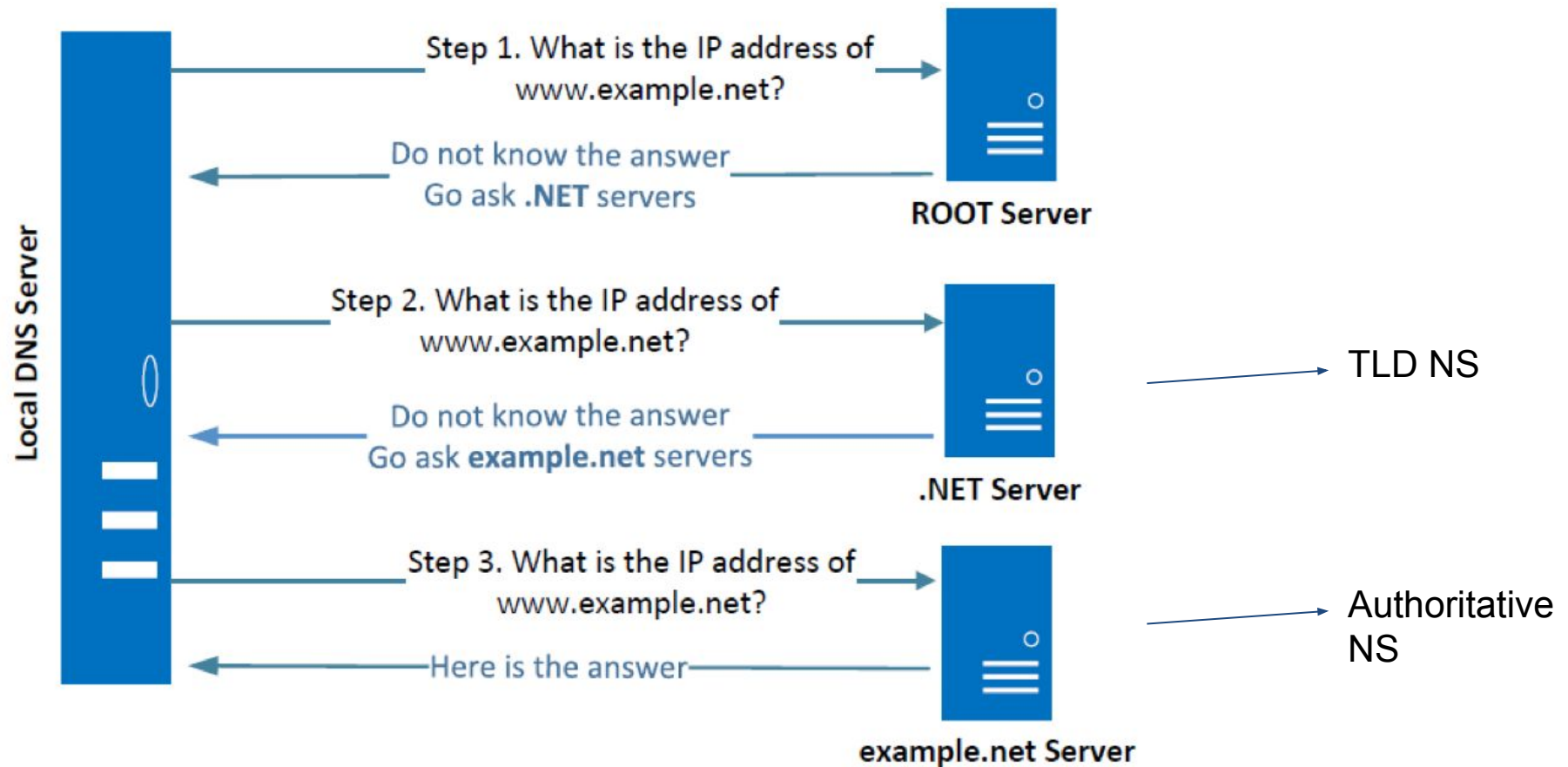
DNS Servers

- Implement a **distributed database** of names

- Are organised in a **hierarchy** reflecting the **structure** of the domain names
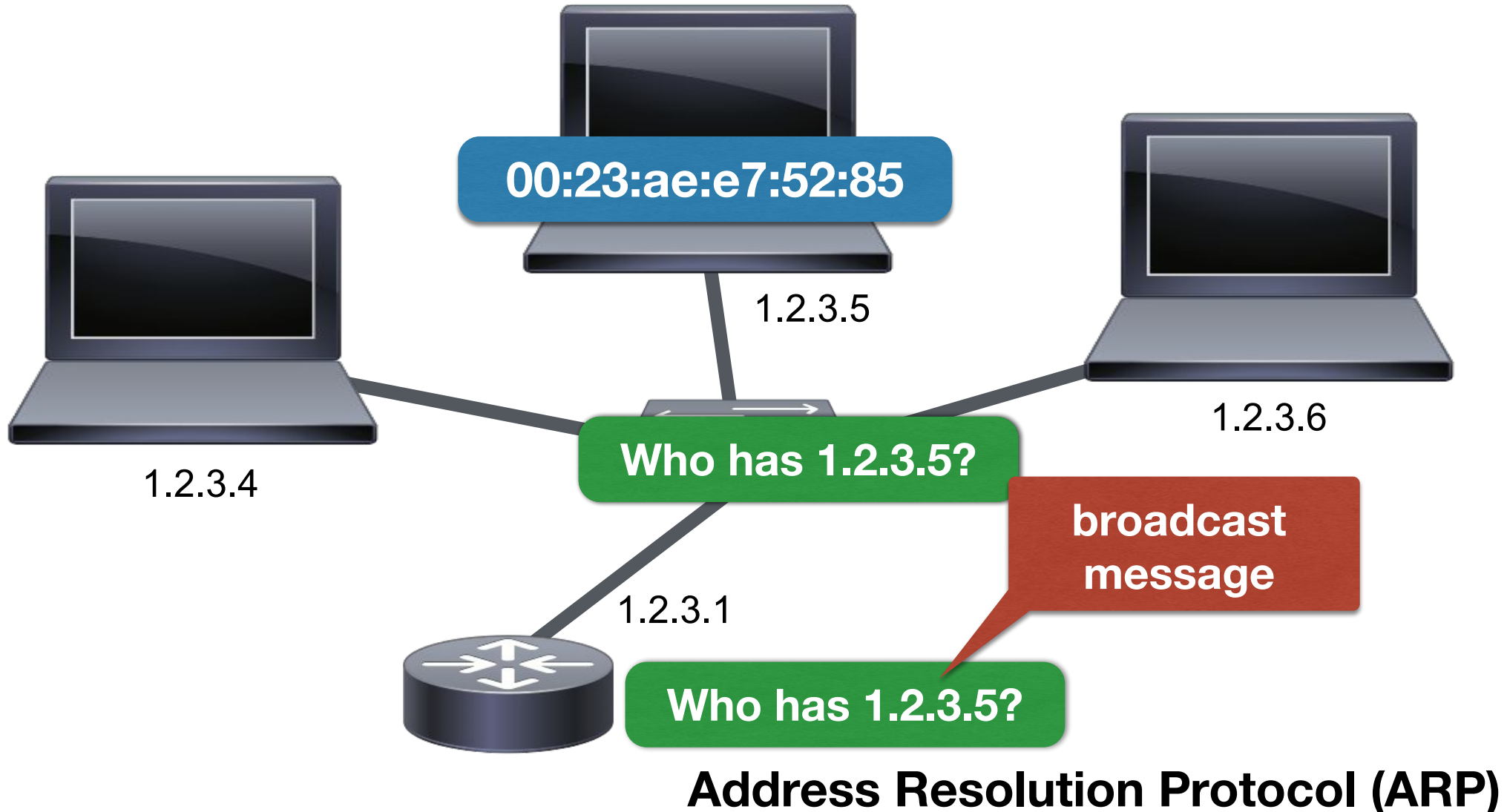
DNS Query

Name Servers

- To resolve a domain name, a resolver queries a distributed hierarchy of DNS servers also called name servers (NS)

Address resolution: Data Link Layer

- How to find the MAC address for an IP address:

00:23:ae:e7:52:85

1.2.3.5

1.2.3.6

Who has 1.2.3.5?

1.2.3.4

broadcast message

1.2.3.1

Who has 1.2.3.5?

Address Resolution Protocol (ARP)

Arp /? command for ARP **MAC address** to **IP_Address** resolution

In Address Resolution Protocol (ARP), the **arp** request message is encapsulated as a:

A. Data Link integer

B. Data Link header

C. Data Link frame check sequence

D. Data Link frame

To participate, go to

flux.qa/JSBJLK

https://flux.qa/JSBJLK

FLUX Question: arp(2)

Address Resolution Protocol (ARP) request is sent as a broadcast message, the reply is:

To participate, go to

flux.qa/JSBJLK

A.   Unicast message

B.   Broadcast message

C.   Multicast message

D.   Generated locally

https://flux.qa/JSBJLK

FLUX Question: Domain Name System

Mapping a name to an address or an address to a name is called:

A. Name-address Generations

B. Name-address Abbreviations

C. Name-address Resolution

D. Name-address Information

To participate, go to

flux.qa/JSBJLK

https://flux.qa/JSBJLK

<u>Download File inside VM (no spaces or new lines):</u>

https://drive.google.com/file/d/1lJcCVJ_p8Yh1vtvSwLQPilC9nx_Zm6wy/view

Activity A

Configuring IP addresses

Every device on the network needs an IP address

- Doesn't change for servers and routers, so configure statically

- Probably doesn't need to change for workstations, but configuring is time consuming

- Infeasible to allocate statically for mobile devices

Dynamic Addressing IPv4

Dynamic Host Configuration Protocol (DHCP)

- Send broadcast to DHCP server to get an address and subnet mask

- Addresses are only *leased* for a limited time

- Makes efficient use of limited IPv4 address space (since only computers currently connected to the network get an address)

- Much easier for admins to manage than static addresses

Activity B: DHCP

Normal DHCP Operation

Client IP: 192.168.1.10/24
Gateway: 192.168.1.1
DNS: 192.168.1.6

DHCPDISCOVER
Broadcast for a DHCP Server

DHCPOFFER
MAC unicast with configuration information

DHCPREQUEST
Broadcast requesting configuration information sent in DHCPOFFER

DHCPACK
Acknowledge configuration information and begins lease

Pool: 192.168.1.0/24
Gateway: 192.168.1.1
DNS Server: 192.168.1.6

The DHCP (Dynamic Host Configuration Protocol) server _____

To participate, go to

flux.qa/JSBJLK

A. Maintains a database of available IP addresses

B. Maintains the information about client configuration parameters

C. Grants an IP address when receives a request from a client

D. All of the above

https://flux.qa/JSBJLK

Activity B

End