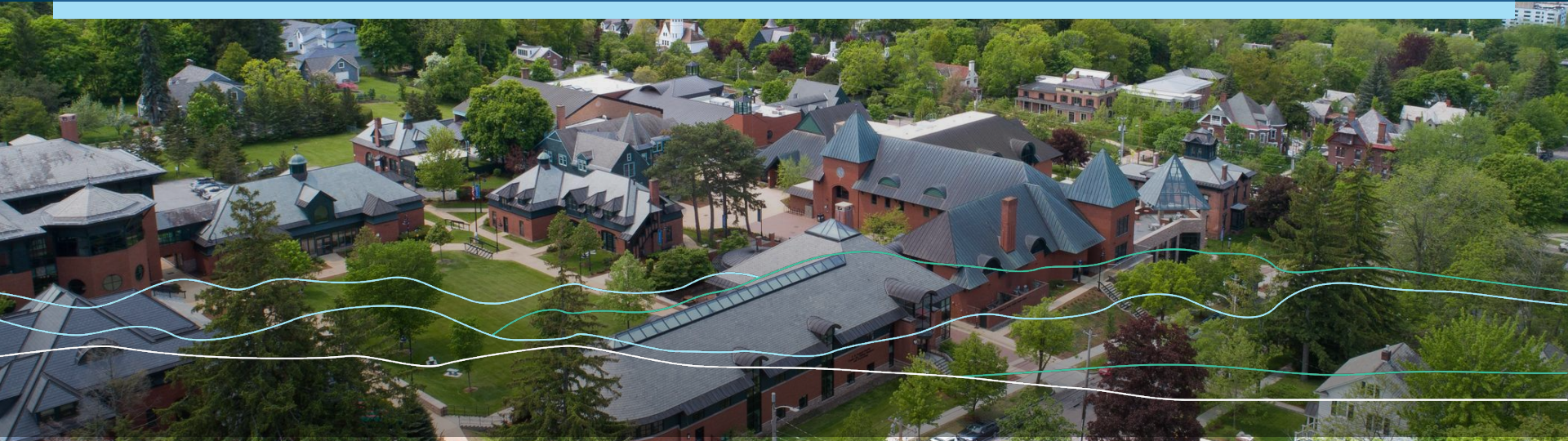


CHAMPLAIN COLLEGE



Mod 9 – Networking Basics

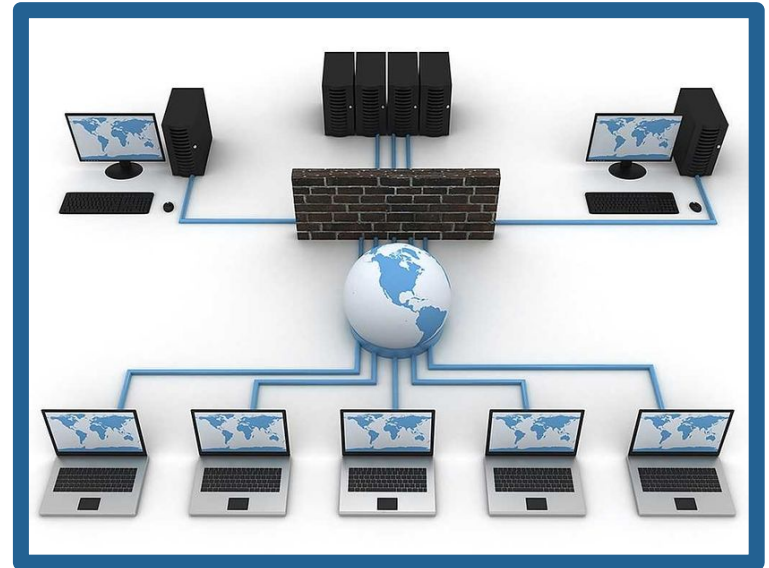
SEC-110



What is a Network?

A network is a group of interconnected devices that communicate and exchange data.

- Networks can have different topologies, devices, and sizes/types.



Network Topologies

A **network topology** describes how devices in a network are arranged. Common network topologies include:

Bus

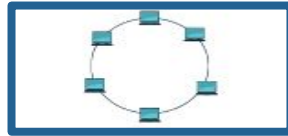
- Devices are connected via a single cable



- Simple and cost effective, but insecure and may have performance issues

Ring

- Devices are connected on a loop where data travels one direction



- Simple, but not scalable
- Reduced data collisions, but still prone to performance issues

Star

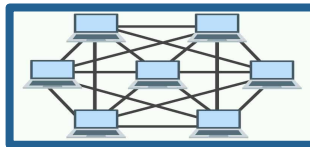
- Devices all connect to a central hub



- Scalable, simple troubleshooting
- Central device is a point of failure

Mesh

- Devices each connect to multiple other devices, creating a web or “mesh”



- Expensive + complex setup, not scalable
- Very reliable, fault tolerant, good bandwidth

Topology Question

What topology do you think is most used today?

Why?

Devices

A network is often made up of multiple types of devices, which each have their own purpose and role.



- **Servers:** provide resources, data, programs, or services to other devices



- **Hubs:** a simple network device that sends incoming data to all attached devices



- **Switches:** connects multiple devices and direct packets to their destination device

- **Routers:** connect networks to each other and direct packets to their destination network

- **Bridges:** connect network segments to make them act as a singular network

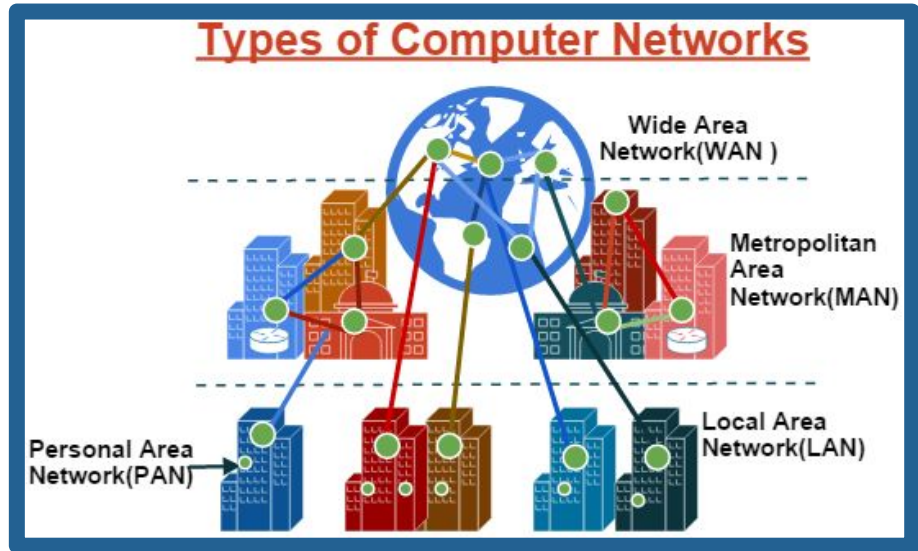
- **Access Points:** allow wireless devices to connect to a wired network



Types of Networks

Networks are categorized based on geographic range, number of devices, and how they connect

- **LAN (Local Area Network):** covers a small area such as a home or school
- **WLAN (Wireless Local Area Network):** LAN that uses WiFi instead of cables
- **WAN (Wide Area Network):** covers large geographical areas such as cities or countries, connecting multiple LANs
- **MAN (Metropolitan Area Network):** covers a city or small campus (in-between LAN and WAN)
- **PAN (Personal Area Network):** a very small network consisting of connections between one person's devices



How Do Networks Work?

The simple story
and the postal mail
analogy:



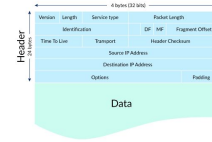
Sending a Letter vs. Sending a Packet

Letter



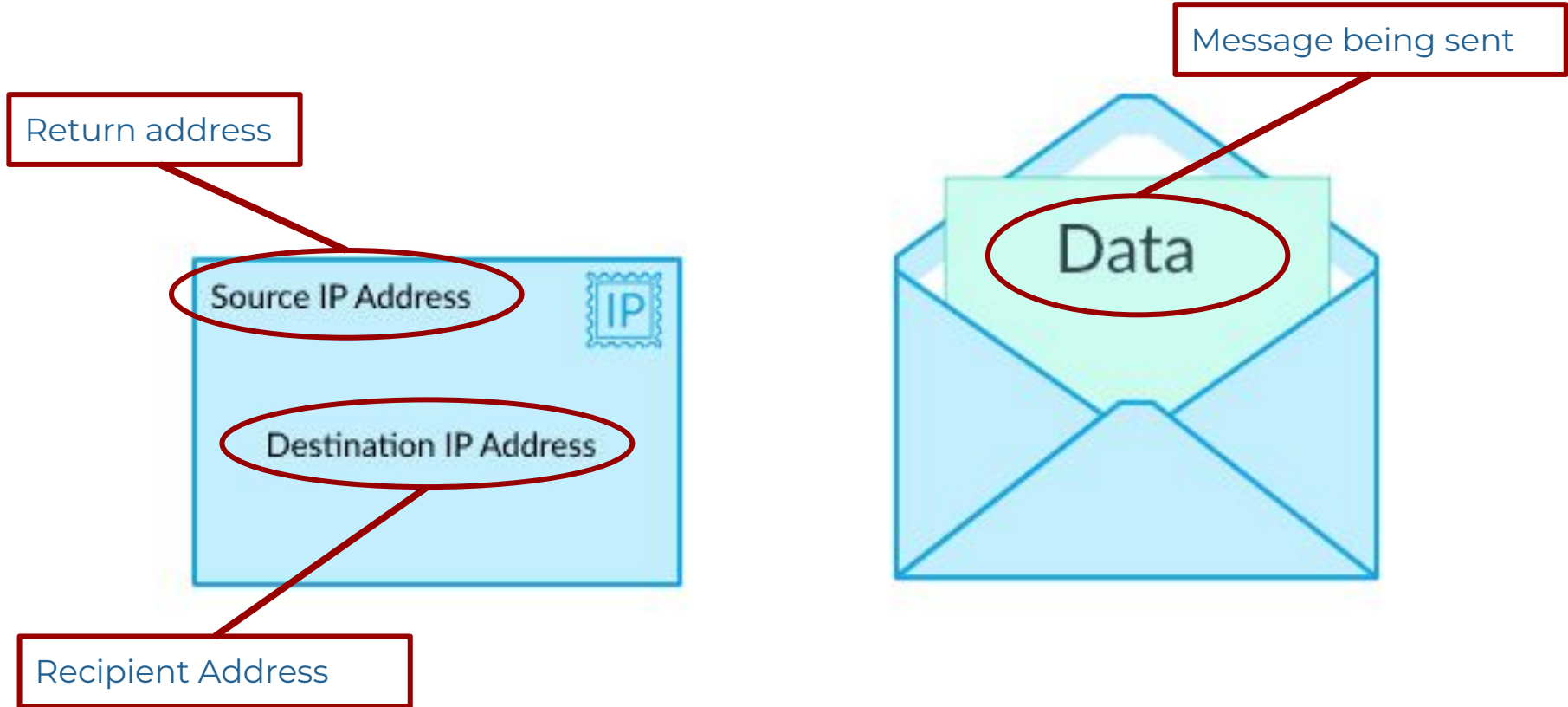
1. Look up **Recipient Address**
2. Put Letter in **Addressed Envelope**
 - Write recipient and return addresses.
3. Put Letter in **Mailbox**
4. Mail Carrier **Picks up** Letter
 - Letter is taken to post office

Packet

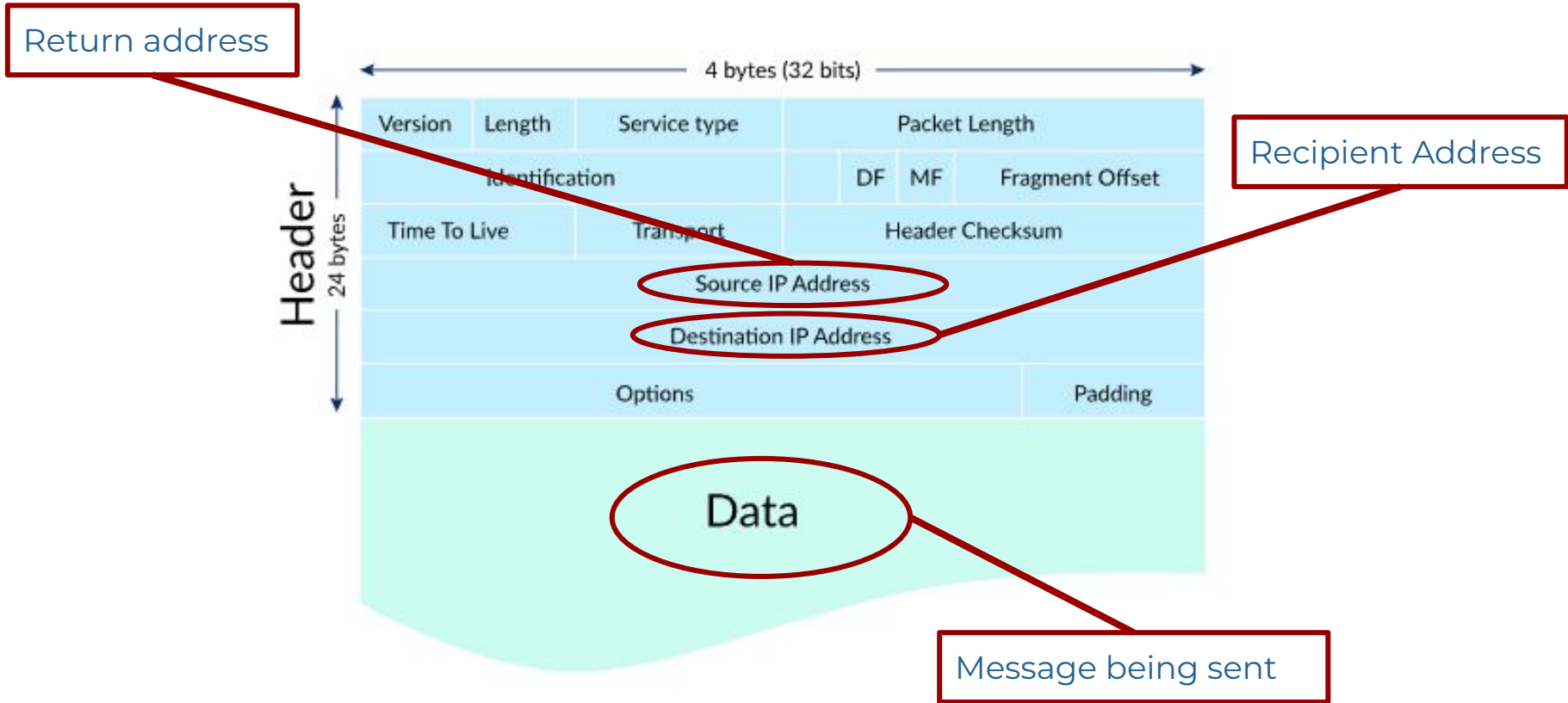


1. Look up **Recipient Address**
 - Domain Name System (DNS)
 - Convert hostname to IP address
2. Add **headers** to data
 - Put bits to header with recipient/sender IP address
3. Send packet to **Network Interface Controller** (NIC)
4. **Transmits** onto network
 - Sent to local router (aka default gateway)

Sending a Letter vs. Sending a Packet



Sending a Letter vs. Sending a Packet



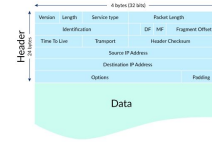
Sending a Letter vs. Sending a Packet

Letter



5. Post Office **sorts** and **sends** to next facility
6. How does the post office know **where** to send the letter next?
 - Postal service has “routing lists.”
7. **Ends** at local post office of recipient
8. Mail carrier **delivers to recipient**

Packet



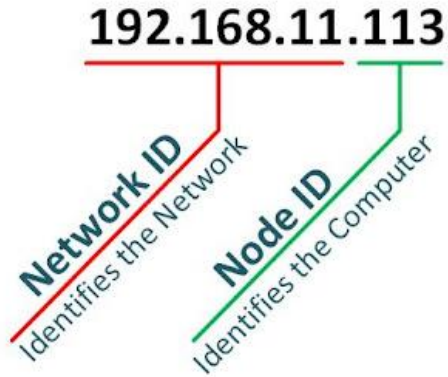
5. **Router** sends packet to next router
6. How does the router know **where** to send the packet next?
 - Routing table of IP networks
7. **Ends** at local router of recipient
8. Router and switches send to recipient
 - Uses Host part of IP address and Mac Address

Network Addressing

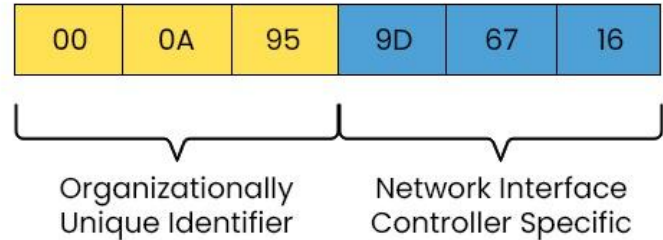
There are 3 components to a computer's network address

- 1. Network ID**
 - Zip code
- 2. Host ID (Node ID)**
 - Street address

- 3. MAC Address**
 - Unique to every network adapter
 - Like a street address

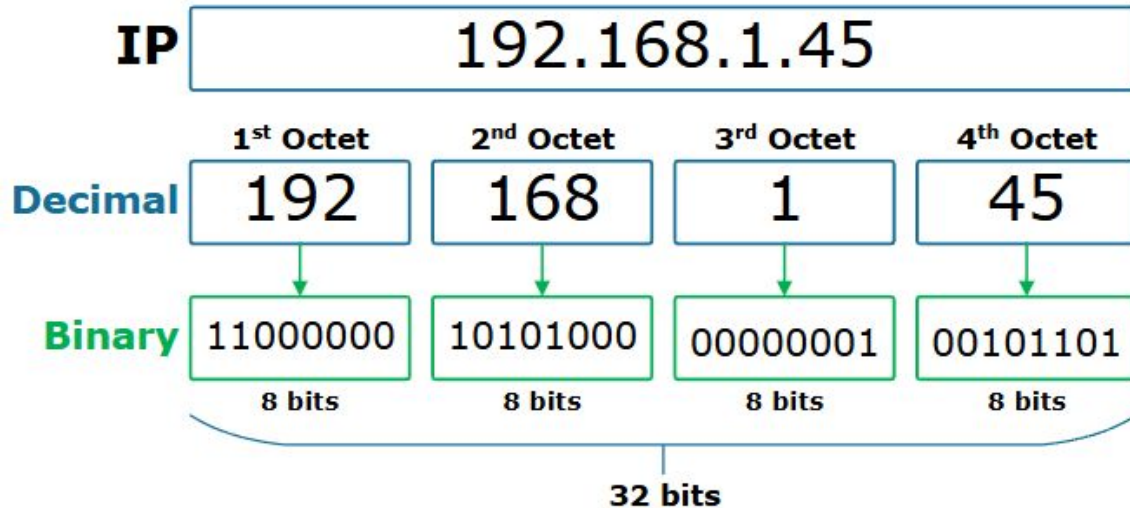


Media Access Control Address



Network Addressing: IP Address

An IP address is a 32-bit long binary number divided into four octets (8 bits each)



Network Addressing: IP Address

Net ID:

- Beginning of address
- Anywhere from 8 to 30 bits

Host ID:

- Whatever is left over from Net ID

Subnet Mask:

- Defines how many bits are in the Net ID

Binary IP address:

- 10000001101010100001001011011100

Translated to dotted decimal:

- 129.170.18.220

Subnet Mask is /24

- First 24 bits are Network ID

Net ID: 129.170.18

Host ID: 220

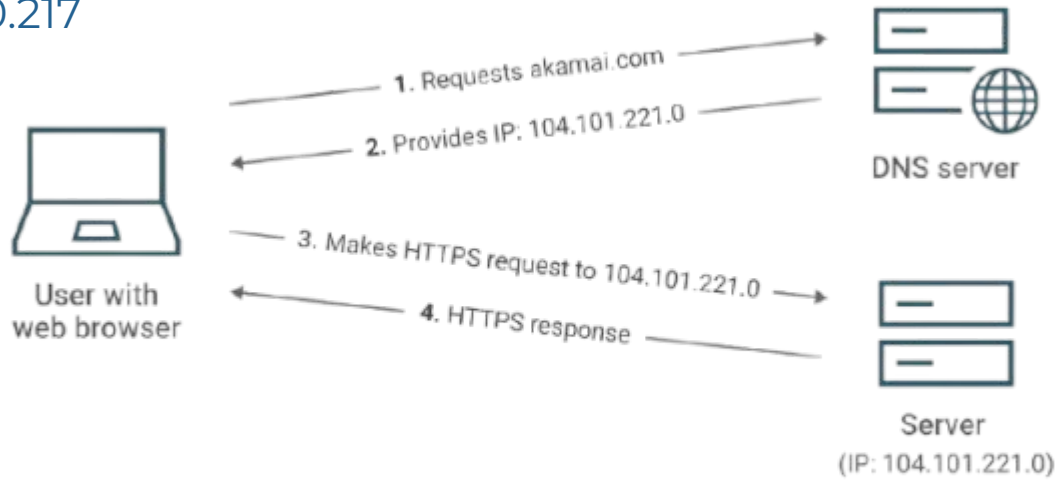
Domain Name System (DNS)

A hierarchical, distributed system that **translates website names into IP addresses**, like a phonebook for the internet.

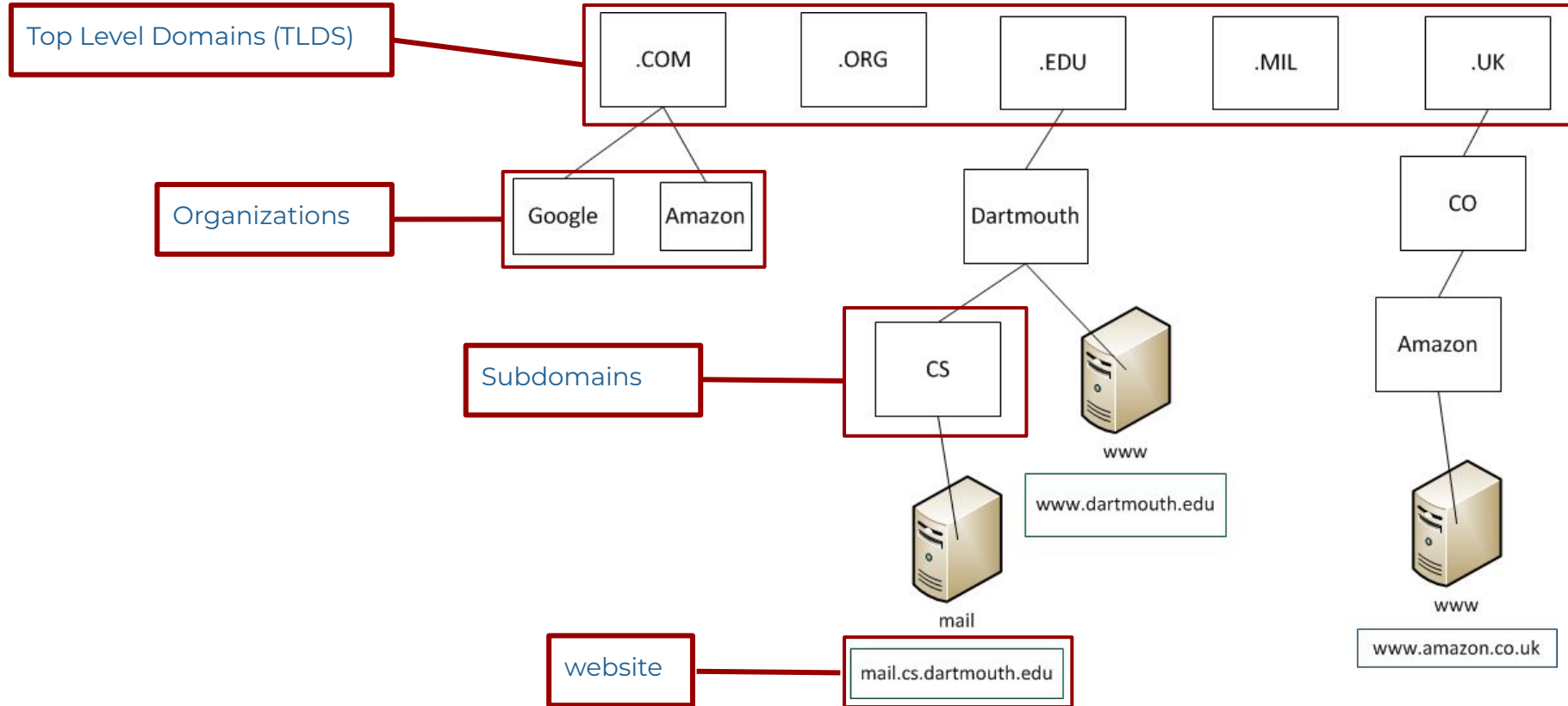
Example:

my.champlain.edu is 216.93.150.217

google.com is 8.8.8.8



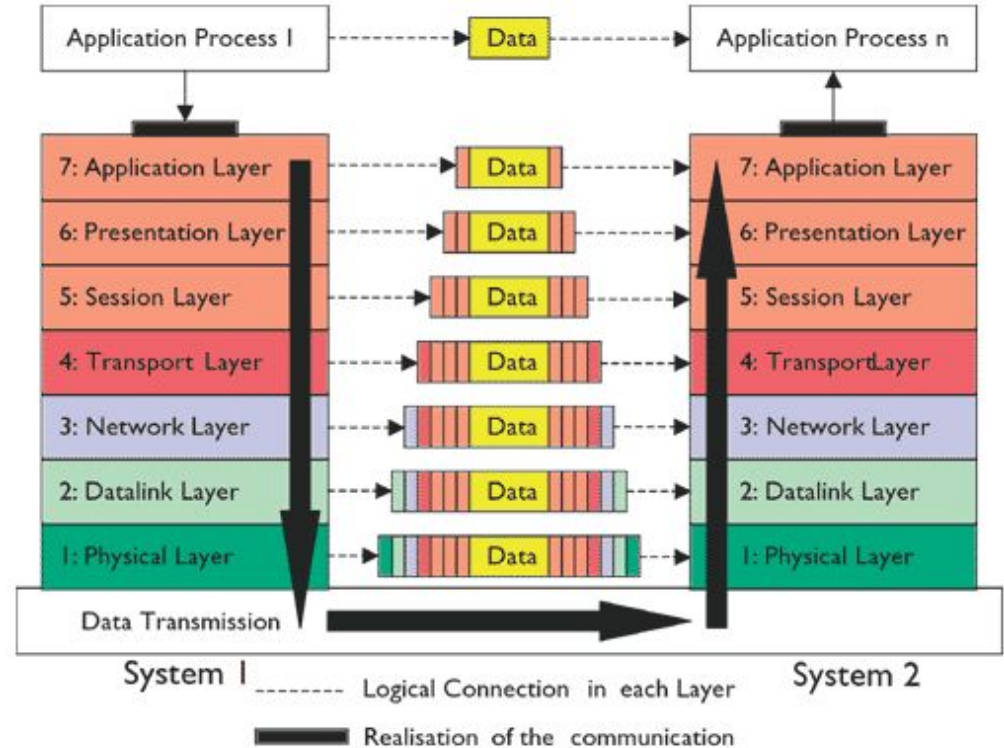
DNS Hierarchy



OSI Model

Open Systems Interconnection (OSI) Model

- Network protocol framework that uses **7 layers**
- The layers define the different stages that **data** goes through to travel from one device to another over a **network**



OSI Model

Physical Layer (1)

- Wires and signals
 - carries data



Data Link Layer (2)

- Getting data across the wires
 - MAC addresses



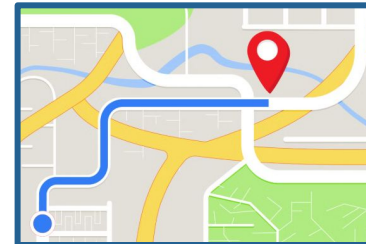
MAC

Media Access Control Address



Network Layer (3)

- Finding the best route
 - IP addresses and routers



OSI Model – Letter Analogy

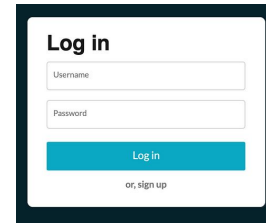
Transport Layer (4)

- Keeping data in order
 - TCP and UDP



Session Layer (5)

- Managing connections
 - Keeping you connected



Presentation Layer (6)

- Translation Data
 - convert data into a format your device understands



OSI Model

Application Layer (7)

- What you see and use



Network Security Toolkit: Wireshark

Wireshark: A popular tool for “capturing” network traffic. (also called sniffing)

- Captures all traffic to and from local host
- Will parse packet “headers” and display the info in an organized way
- Can filter results to show specific sessions, protocols, hosts, etc.

