Computer Networks 1

Outcomes

- What is a Network
- What is Internet
- Protocols
- RFCs
- Network Addressing
- Devices in the Internet
- Internet Speed
- Layered Architectures
- OSI Model
- TCP/ IP Model

What is Internet

- Can’t imagine life without it.

What is a Network

- Group of interconnected items.
- Eg: Railway network, social network etc.

What is Internet

- Network of computers
- Advantages:
    - Communicate
    - Share Resources
- How into existence:
    - Need to communicate in US Army
    - ARPANet

Protocol

- Imagine a lot of people together not knowing the language of each other.
- No one will be able to understand each other.
- Language is a set of commonly understood rules that people use to communicate.
- Machines need a more precise and concrete set of rules.
- Protocol: Set of rules governing the exchange or transmission of data between devices.
- Eg: TCP, UDP, HTTP

RFCs

- Request for Comments

- Managed by IETF (Internet Engineering Task Force)
- For discussion on proposals on a protocol etc.
- Eg: IP: https://www.rfc-editor.org/pdfrfc/rfc791.txt.pdf
- Find all at: https://www.rfc-editor.org/retrieve/

Network Addressing

- To be able to talk with someone you need to know where they live. If you have to send a letter, you need to know the address of the other person.

IP Addresses

- 32 bit numbers in v4
- Dotted Decimal Notation
- A.b.c.d
- Each a - d can be from 0 to 255

Ports

- More than one person might be living at the same address. We can identify them via a room number.
- Port number. 16 bits. => 65535 ports in a machine.
    - 0-1023 are reserved for well known applications. Like SMTP, HTTP, FTP etc
    - 1024 - 49152 are registered for specific applications. So there might be a conflict with a popular application. But you can still use it.
- Each endpoint is identified via IpAddress:Port
- IP Address + Port creates a socket. Will learn more later.

Devices in the Internet

Edge Systems

- Also known as end systems.
- The devices which use the internet aren't just to relay the traffic (unlike routers). Eg: Mobile, Computer, Server etc.

Edge Routers

- Also known as access networks.
- Connect to end systems
- Eg: Wifi, Satellite, FTTH.

Network Interface Adapter

- Enable computers to attach to a network.
- Have an address => MAC Address
- Also known as physical gateways that allow a machine to connect to the internet.
- Can be many - One for each type of device.

In Between

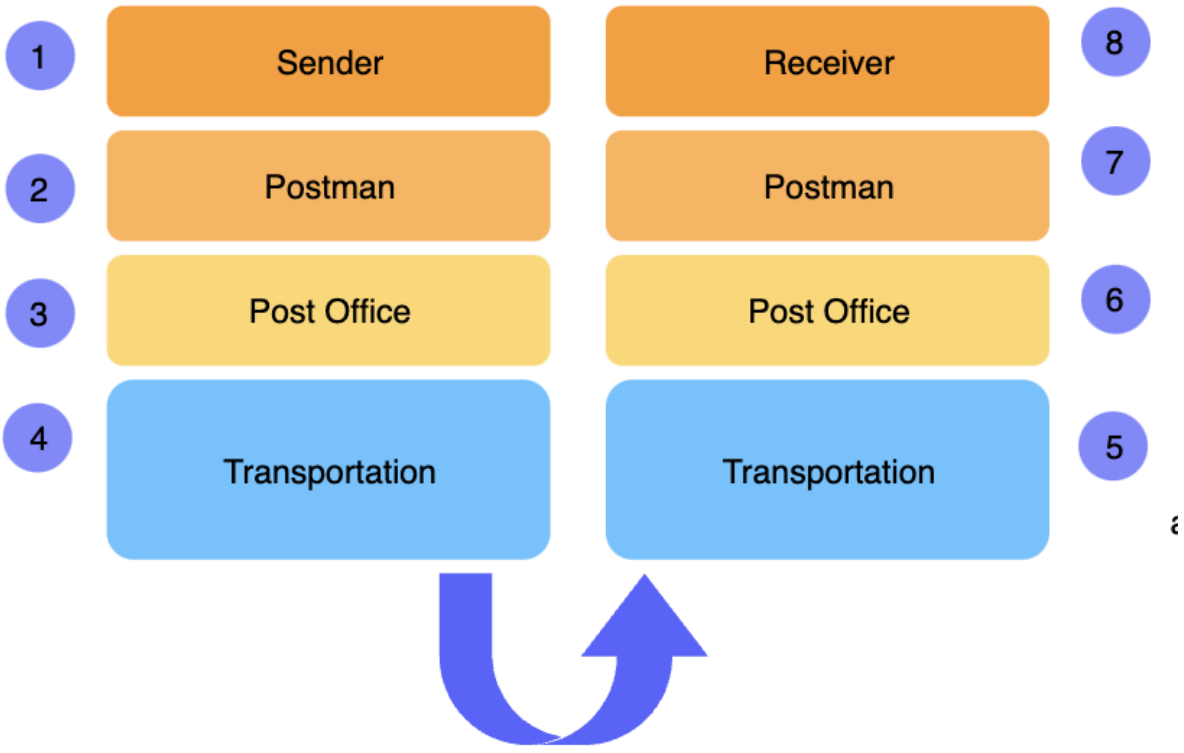
- https://www.submarinecablemap.com/

Internet Speed

- Rate at which data is transferred.
- Data is bits.
- => Measured in bits/ sec
- 1 kilobit => 1000 bits
- 1 megabit => 1000 kilobits
- 1 gigabit => 1000 megabits
- Upload Speed: Speed of receiving data
- Download Speed: Speed of sending data
- Often networks have asymmetric transmission rates as mostly upload requests (requesting a website) is smaller than the response (getting the video)

Internet Layered Architecture

- Layers of abstraction are helpful in a complex system. Eg: For humans, care is just a steering wheel. For mechanics, it may be just an engine. For an engine maker, it is a lot of internal engine stuff.
- Compose a system into layers, each with a well defined task.
- A lot of examples of the internet can be understood via post.
- Eg:



Purpose of Layers

Vertical

- Layers below provide services to the layer above.
- Layers above don't care about how the below layers performs its service. It choose the layer based upon the guarantees that the below layer gives and the needs of itself and then doesn't care about its working. Eg: Post Office might decide to send via Spicejet based on requirements like speed, insurance etc. Then they don't care about how Spicejet will do its work.

Horizontal

- Corresponding layer on the other side knows how to interpret what the layer at the other side meant.
- Eg: Receiver knows what sender meant, Spicejet receiver knows what Spicejet specific details meant etc.

Independence

- Each layer can evolve independently. Upper layers use them based on its guarantees. Eg: Spicejet may change how it sends packages to a particular place. If the upper layer isn't fine with it, they can change Spicejet.

How Layering Architectures Work

- Each layer adds its own information before passing it to the layer below. Eg Post office adds its stamp, spicejet adds its stamp etc.
- Corresponding layer at the other end removes this information after interpreting it before sending it to the layer above.
- If added at start => header
- If added at end => trailer

Internet Layering Models

- OSI model
- TCP/ IP model
- Implemented in software, hardware and combination of both.

OSI Model

- Open Systems Interconnection Model
- Developed in 70s by ISO
- 7 Layers:
    - Application
    - Presentation
    - Session
    - Transport
    - Network
    - Data Link
    - Physical

Application Layer

- Software Layer
- Used by End Users to Interact
- Web Browser, Emails
- Creates data for other layers

Presentation Layer

- Presents data that can be understood by application layer
- Encoding
- Encryption
- Compression

Session Layer

- Manages user sessions
- Session is nothing but a set of activities a user performs on a website.

Transport Layer

- Divides data into chunks called **datagrams (UDP)** or **segments (TCP)**.
- Checksum for correctness
- Maintains order of delivery etc.

Network Layer

- Messages are called Packets.
- Facilitate transport from one machine to another.
- Routing
- Routing protocols run on this layer
- Transport in a way that is load balanced

Data Link Layer

- Communication between 2 directly connected hosts. Transmission in a single link.
- Flow Control
- Error Detection/ Correction
- Transmission conflicts
- Addressing in broadcast

Physical layer

- Hardware
- Medium to transmit data

TCP/ IP Model

- Developed in 1989
- https://tools.ietf.org/html/rfc1122
- Developed as each layer matured.
- Clearly defined protocols in each layer.
- 5 Layers:
    - Application

        - Transport
        - Network
        - Data Link
        - Physical
- Used practically. While OSI is more theoretical.

Vision behind how Internet Works

- Intelligent end devices. Dumb but fast core.
- Route per hop.