Lesson 1: Foundation

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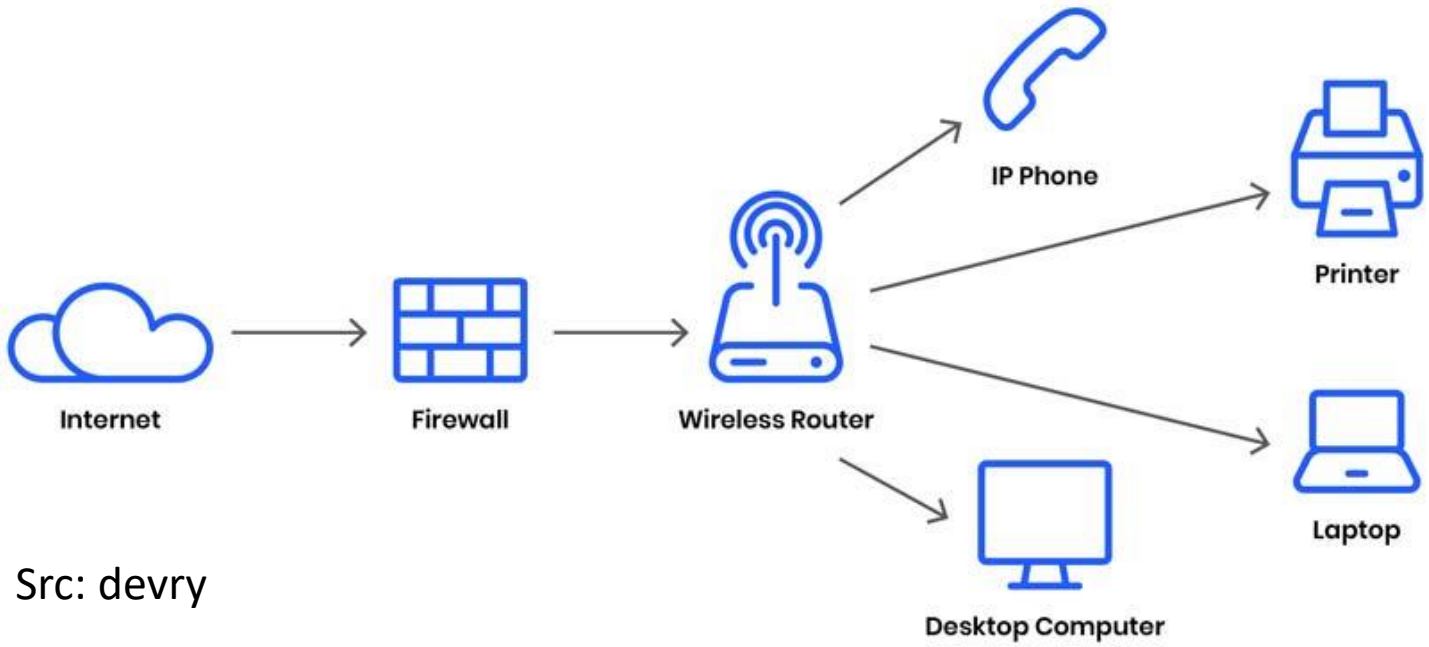
Outline

- What is a computer network?

- Basic terminology
  1. Node, Host
  2. Router, Switch, Gateway
  3. Circuit Switch, Packet Switch
- Network/Internet architecture
- OSI model

Computer network

- **Definition**: a system that connects two or more computing devices for transmitting and sharing information



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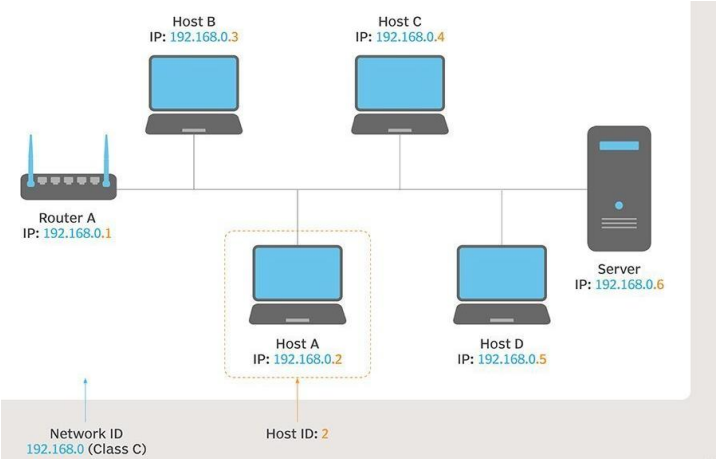
Host vs node

- **Host**: a computer or other device that communicates with other hosts on a network
- **Node**: any physical device within a network of other tools that's able to send, receive, or forward information
- A node is a broader term that includes anything connected to a network, while a host requires an IP address



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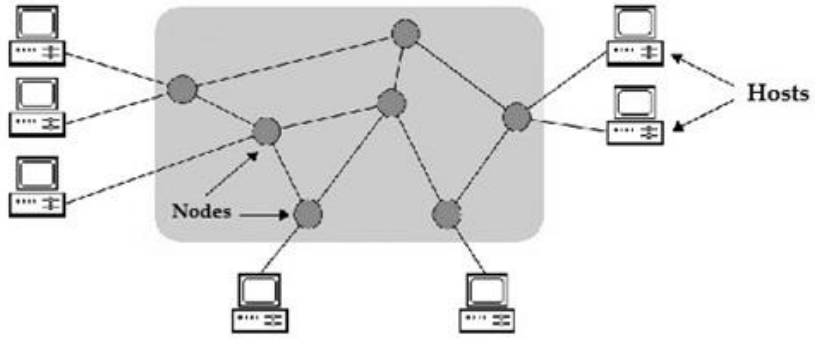
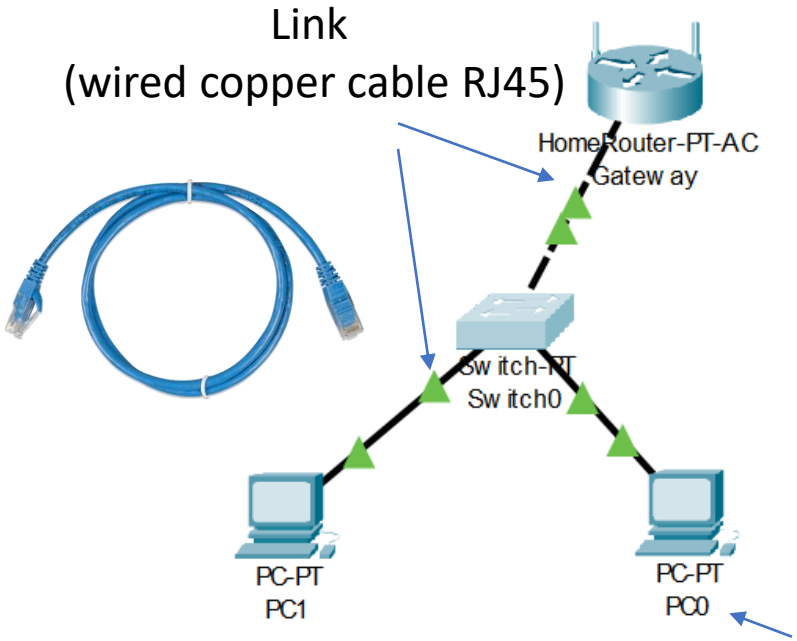
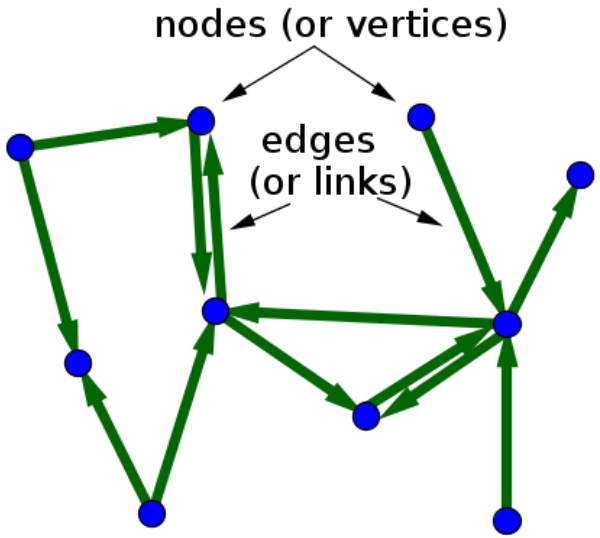
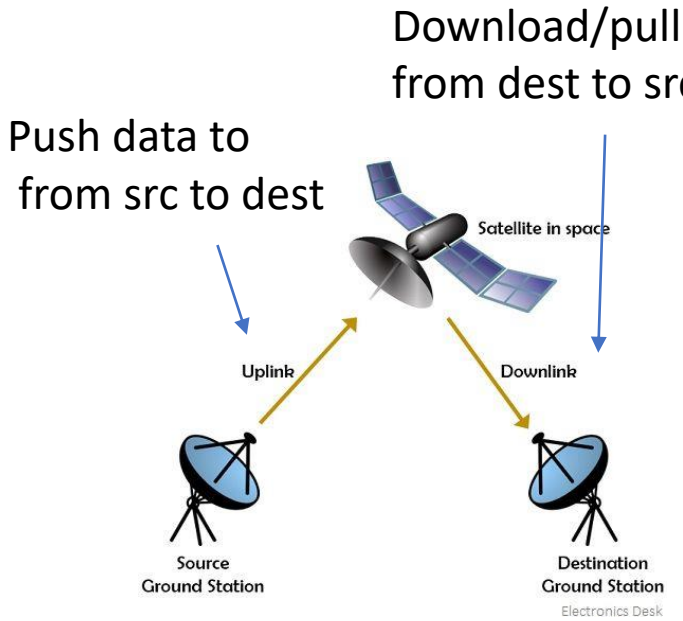


Link

- **Definition**: a communication pathway that transfers data from one device to another
- If we address directions, link has uplink/downlink







Router vs Switch

- **Router**: a networking device that forwards data packets between computer networks

- **Switch**: a networking device that connects devices on a computer network by using packet switching to receive and forward data

- A switch has many Ethernet ports while a router has several serial + Ethernet ports only

WiFi Router

Cisco Core Router

D-Link switch

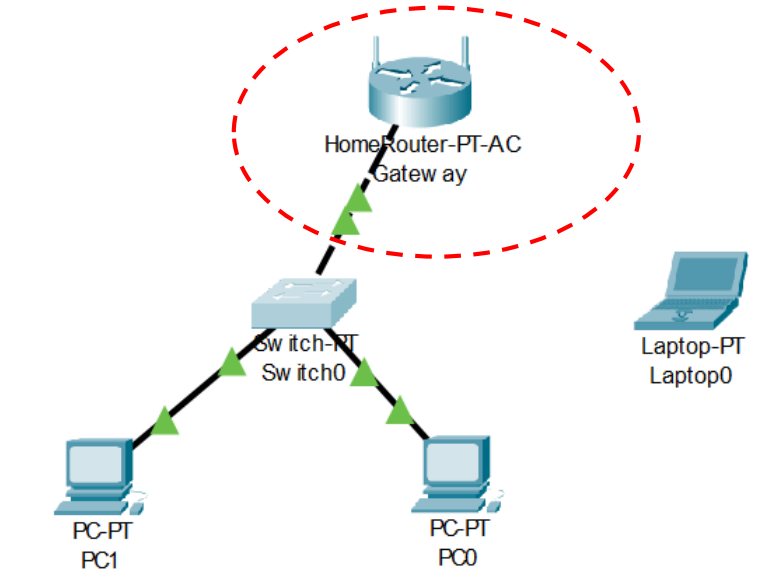
Asus switch

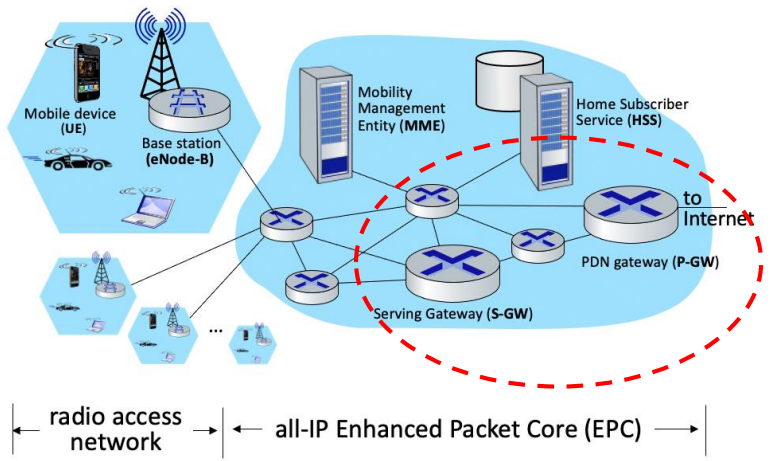
Cisco switch

Gateway

- **Definition**: a piece of networking hardware or software used in telecommunications networks that allows data to flow from one discrete network to another

- **Other definition**: a network node used in telecommunications that connects two networks with different transmission protocols together.





Message vs Packet

- **Message**: data or piece of information which is to be communicated

- **Packet**: a small segment of a larger message

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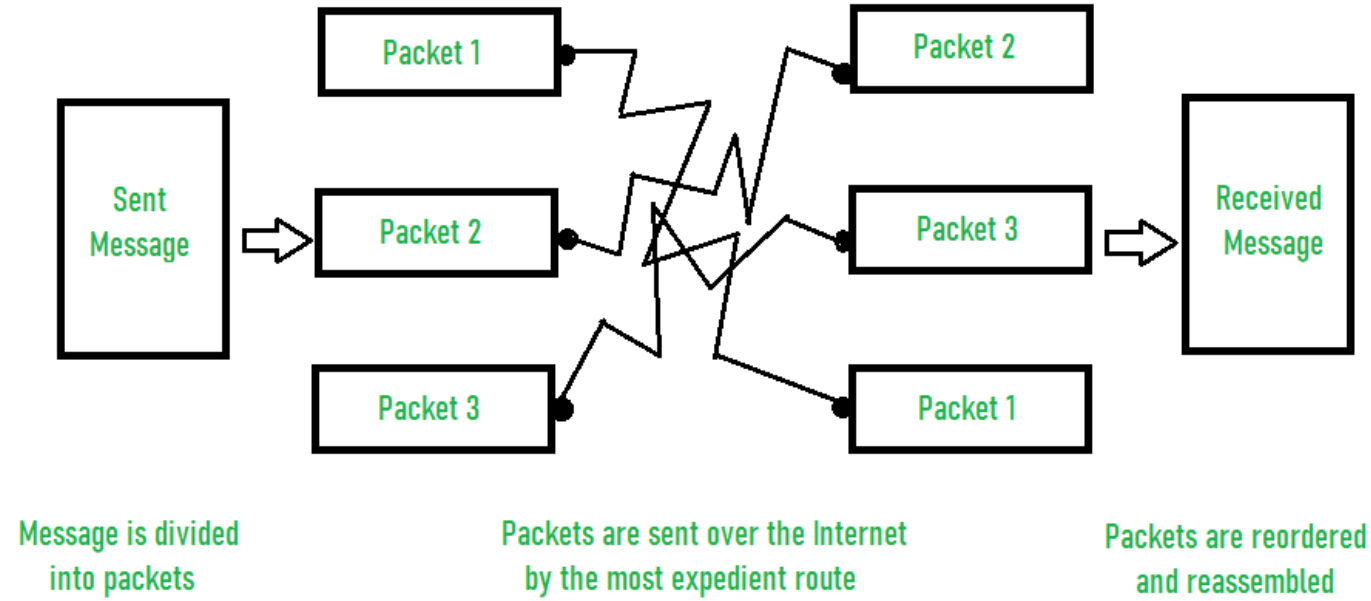
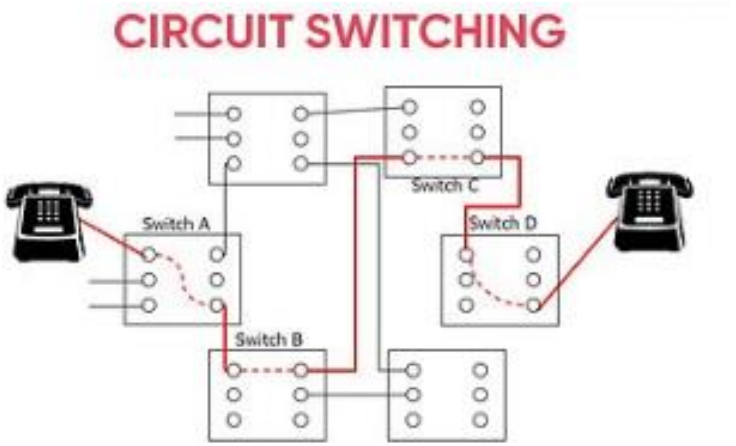
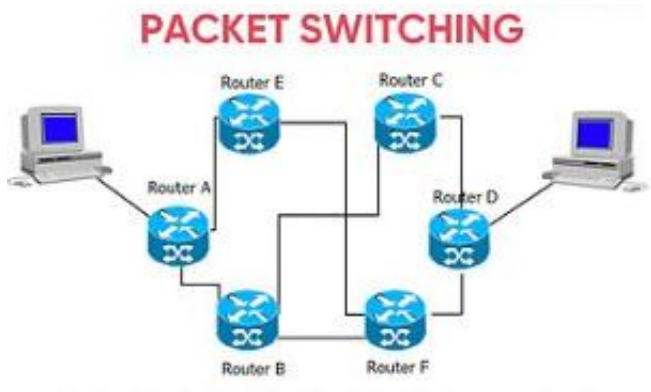


Circuit switch vs Packet Switch

- **Circuit switch**: Before a communication starts, a dedicated path must be established between the sender and the receiver



- **Packet Switch**: No identified path is identified before, the sender only needs to know the receiver's address



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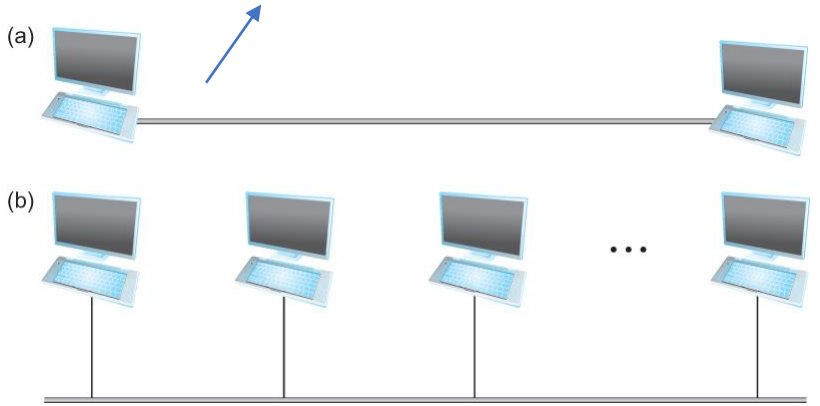
Point-to-point vs Multiple Access

- **Point-to-point** : a communications connection between two communication nodes

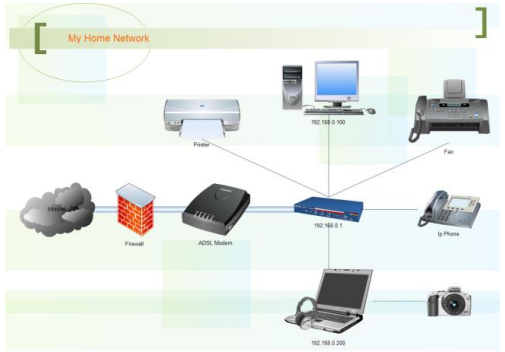
- **Multiple Access**: a network which can have multiple (more than 2) machines participating in the network

Often seen in Internet access between home router and ISP router or inter-connected systems



(a) Point-to-point

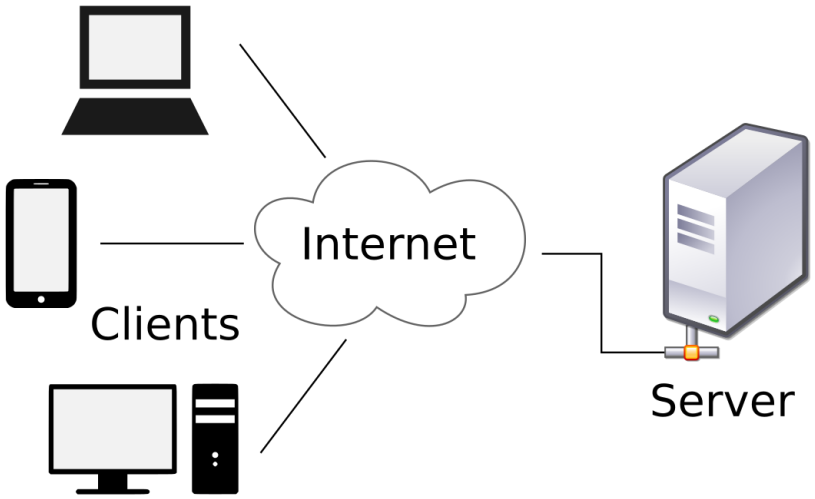
(b) Multiple access

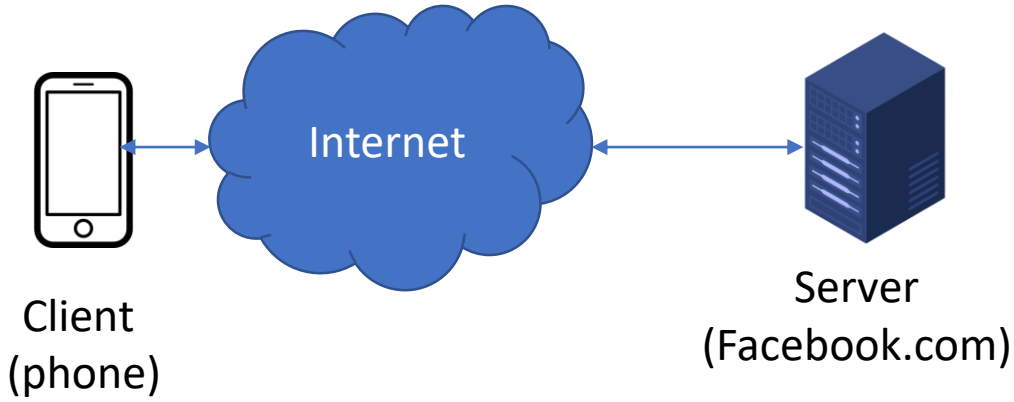


Often see in our home network
With a WiFi router/switch to share network connections for many users

Client/Server

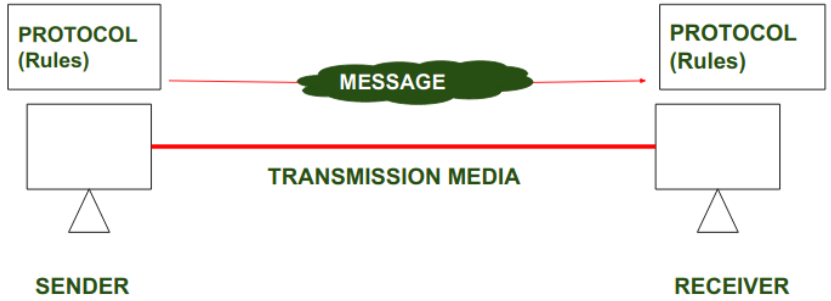
- Definition: a distributed application structure that partitions tasks or workloads between the providers of a resource or service, called servers, and service requesters, called clients





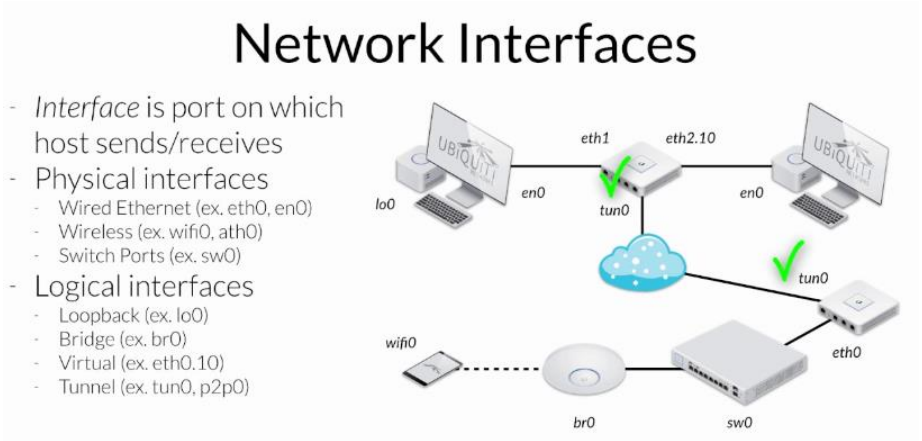
Protocol vs Interfaces

- **Protocol**: a set of rules outlining how connected devices communicate across a network to exchange information easily and safely



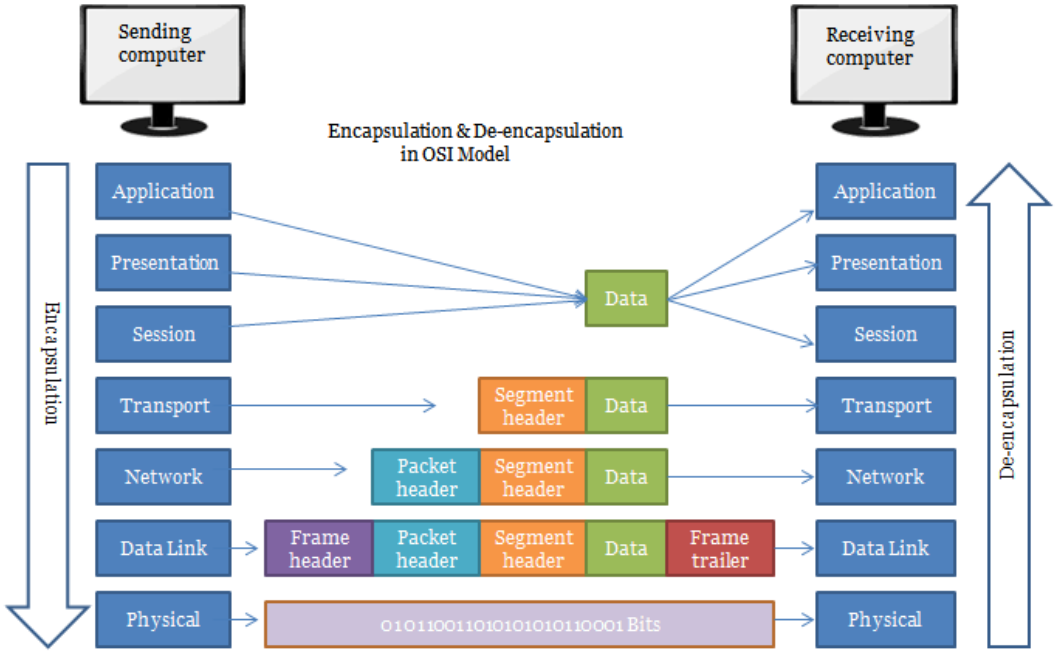
Hypertext Transfer Protocol (HTTP): This Internet Protocol defines how data is transmitted over the internet and determines how web servers and browsers should respond to commands

- Interfaces: the point of interconnection between a computer and a private or public network. A network interface could be a physical network interface card (NIC) or a logical interface (API, bridge, tunnel, virtual)



OSI architecture

- Open Systems Interconnection (OSI) model describes seven layers that computer systems use to communicate over a network



7	Application Layer	Human-computer interaction layer, where applications can access the network services
6	Presentation Layer	Ensures that data is in a usable format and is where data encryption occurs
5	Session Layer	Maintains connections and is responsible for controlling ports and sessions
4	Transport Layer	Transmits data using transmission protocols including TCP and UDP
3	Network Layer	Decides which physical path the data will take
2	Data Link Layer	Defines the format of data on the network
1	Physical Layer	Transmits raw bit stream over the physical medium

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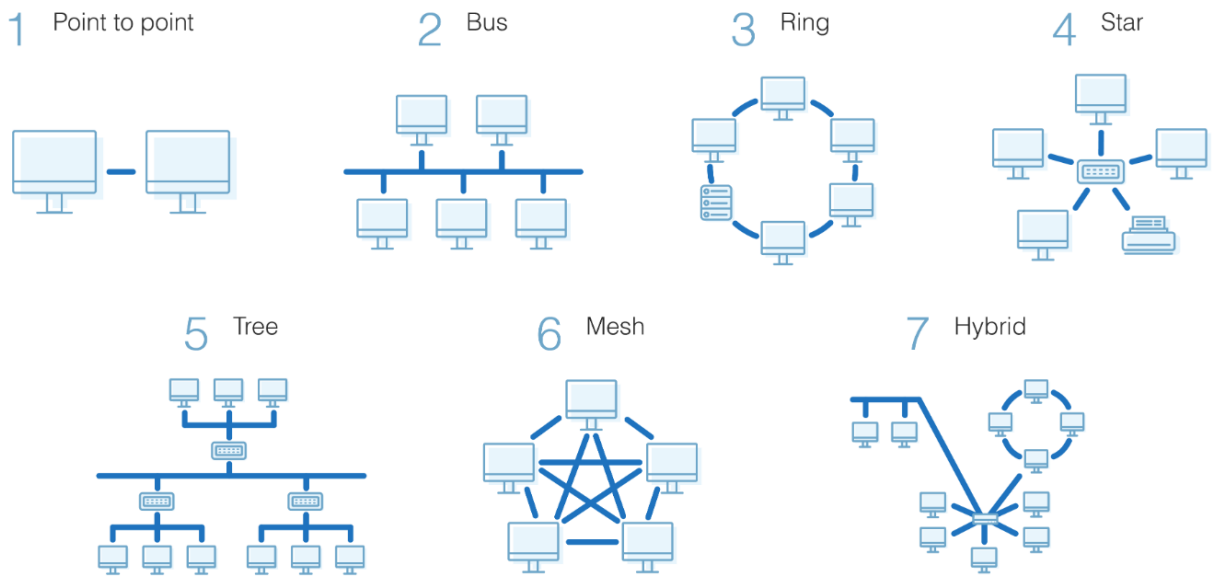
Network architecture

- **Definition**: the way network devices and services (i.e., nodes and nodes) are structured to serve the connectivity needs of client devices



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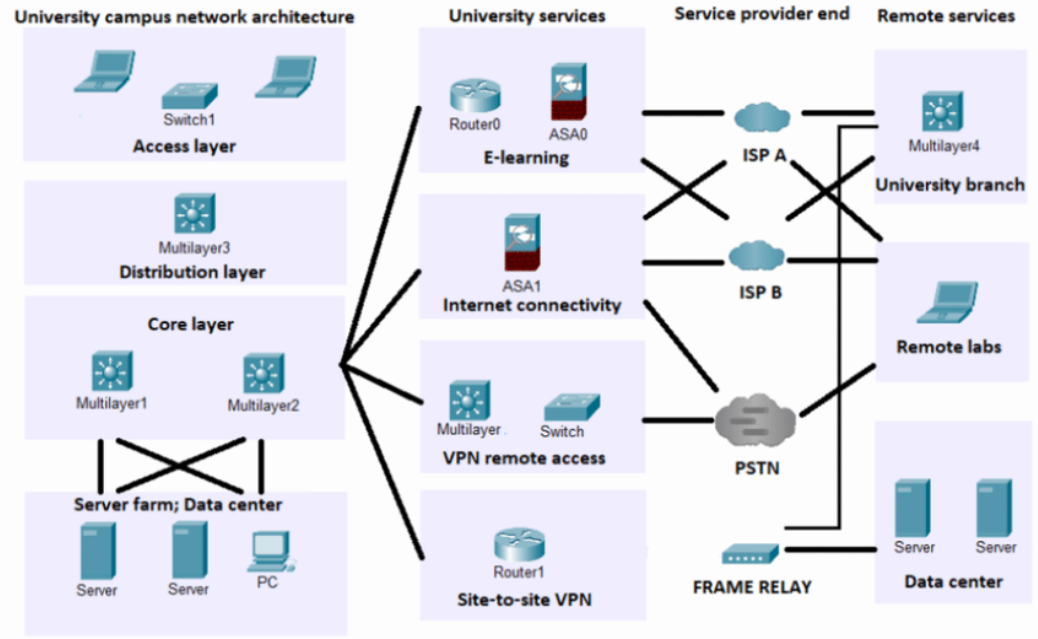
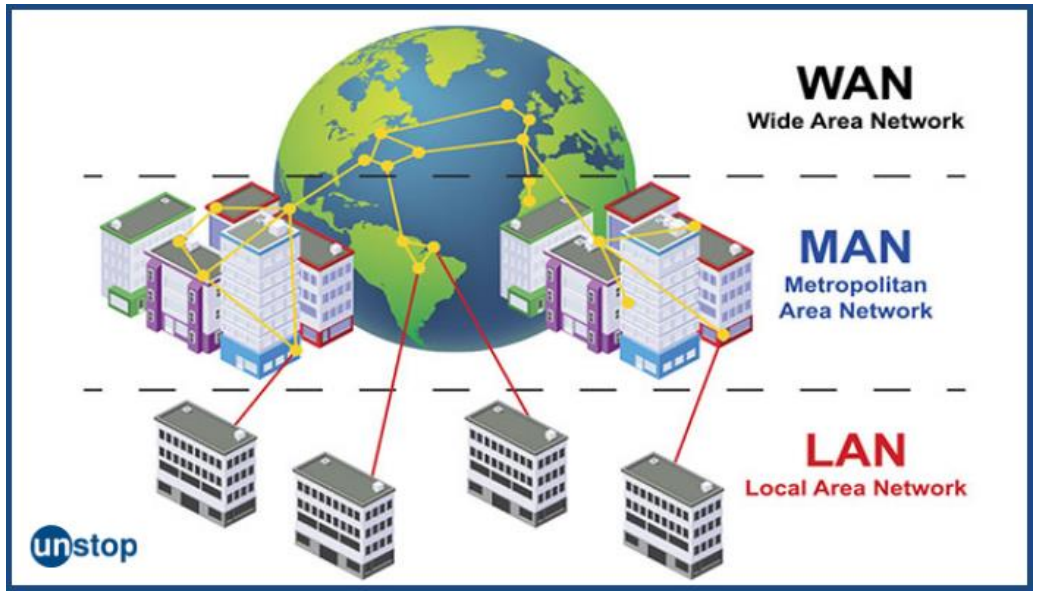


Network architecture of a university campus

Src: ResearchGate

LAN, MAN, WAN

- **LAN:** Local Area Network is a private network indicates the connection between personal computers in local areas such as schools, business offices, and office buildings
- **MAN**: Metropolitan Area network covers a larger geographical area in comparison to LAN (up to 100 km) and can span an entire city.
- **WAN**: stands for the Wide Area Network and the network size can span up to 1,000 km of area
- Network size: WAN > MAN > LAN
- WAN is often used as a term of Internet networks



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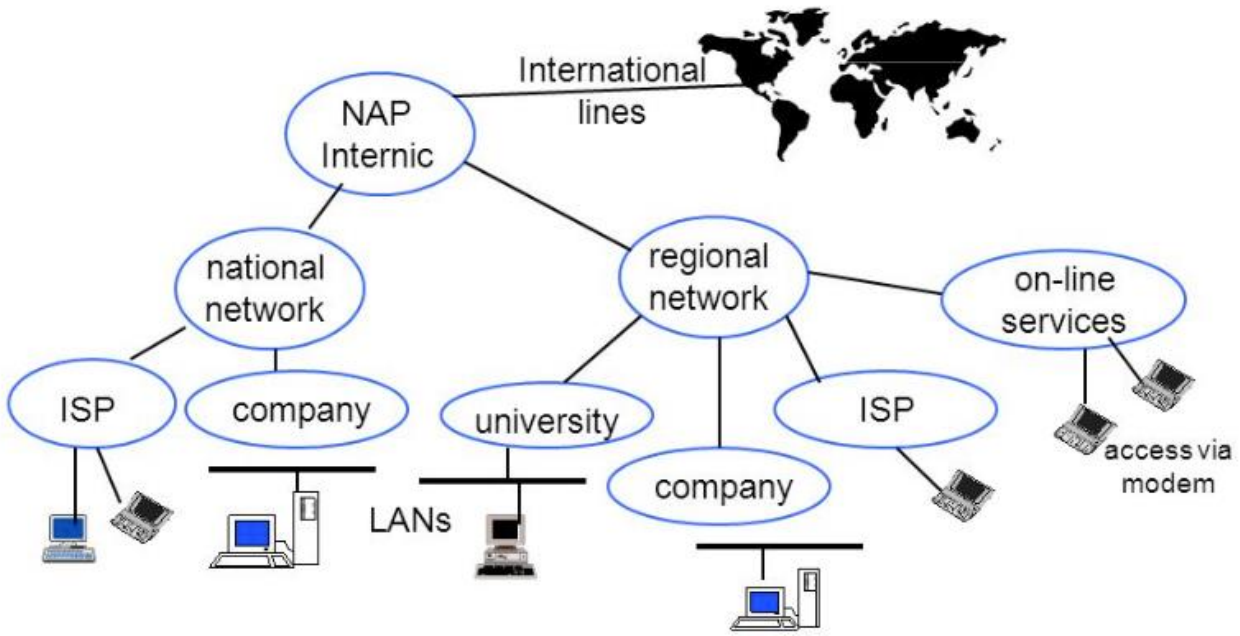
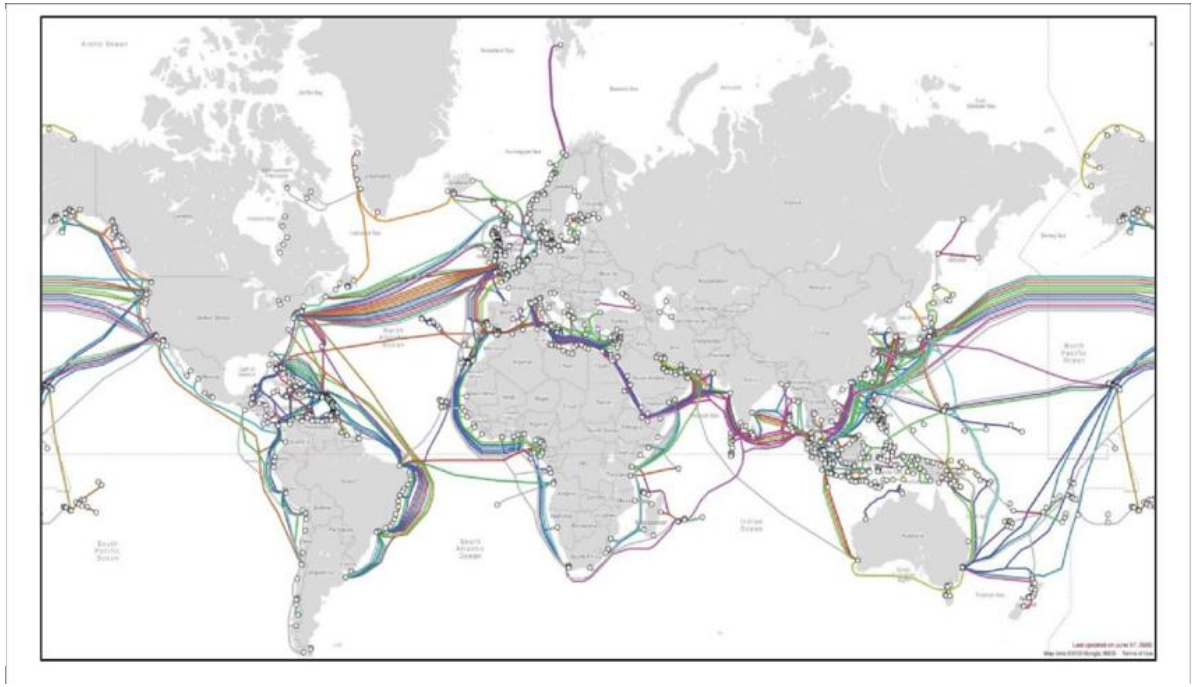
Internet architecture

- **Definition**: is the design of the internet. This consists of multiple layers of protocols for sending and receiving information
- Defined by IETF (via RFC specifications)



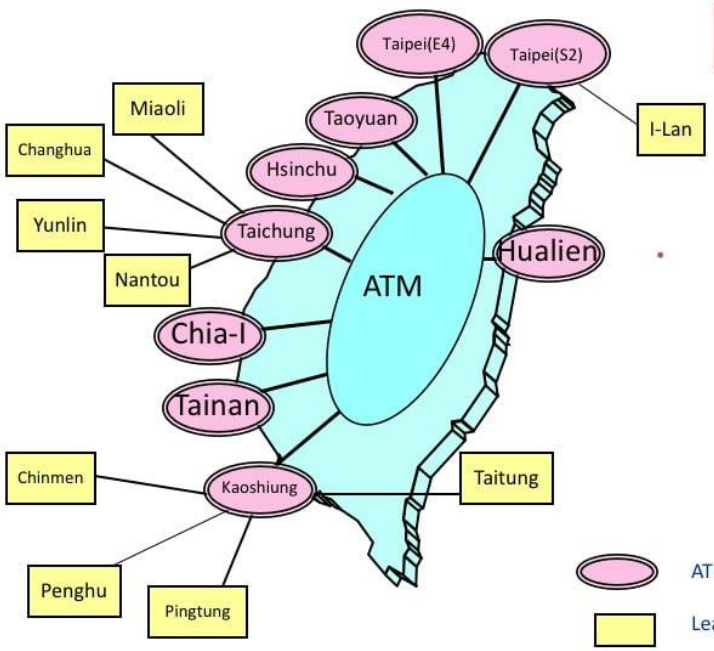
Credit to Miles Dennis



Credit to Gilberto C. Gallopín

Taiwan Internet Architecture

HiNet Initial Network Architecture

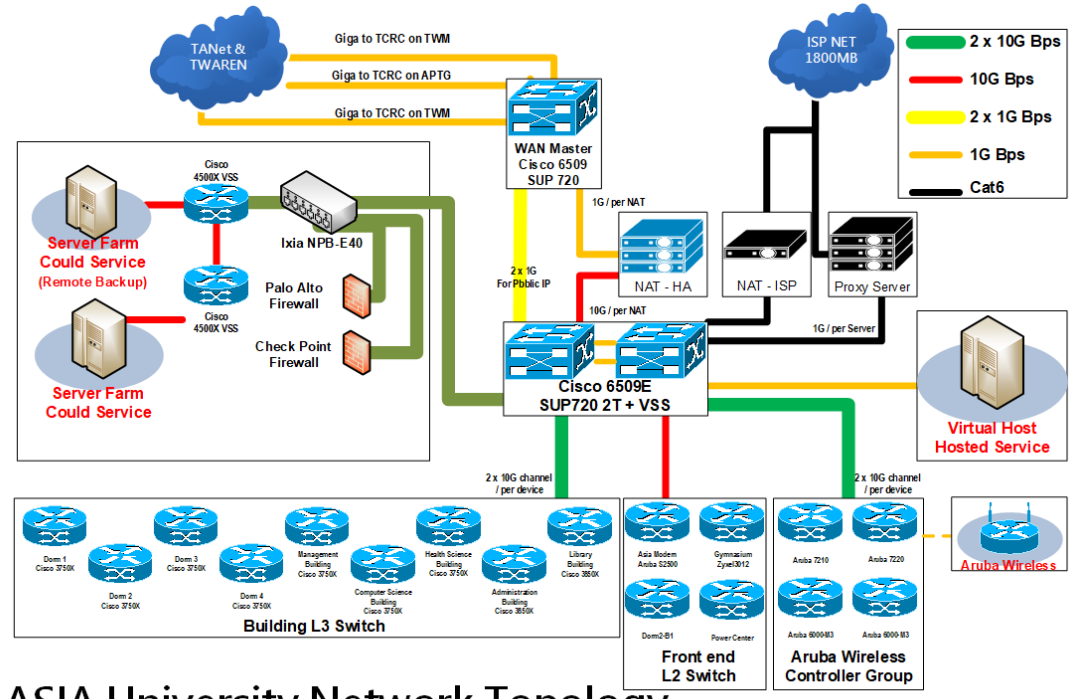


HiNet Backbone Diagram

- Backbone core is OC-3 (155Mbps) ATM network
- 9 major POPs connect into backbone via ATM switch node with OC-3(155Mbps) in fully mesh
- small scale POPs connect into adjacent ATM ode via T3 or T1xN

ATM switch node: 155Mbps

Leased line network node:1.544Mbps x N/45Mbps



ASIA University Network Topology

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