

Network Basics

What is the Internet?

Internet v.s. internet

- **internet**: a set of **computer networks** that are connected to each other
- **Internet**: a **worldwide** sets of networks that **interoperate** using **TCP/IP** protocols

Internet v.s. WWW

- WWW: an **information sharing model** on top of the Internet
- Internet: a **networking infrastructure** and the related **communication standard** [WWW on top of Internet]

Internet major components (4)

- Internet applications
- Internet protocols
- Internet addresses
- Physical infrastructure

Physical infrastructure

- Hosts: an internet-connected computer with an internet address
- Routers: a device that routes data packets towards the destination
- Wiring: fiber-optic, telephone, satellite

Internet addressing

Machines: Ip address (network interface address)

Hostname: be assigned to a host (human can understand)

- DNS: converting between IP address and hostname

Internet protocols — rules for communicating

Network layer protocols: Internet Protocol (IP)

- unreliable delivery
- Versions: IPv4 — 32bit, IPv6 — 128bit
- **All internet applications use at least IP**, most use TCP/UDP and ID

Transport layer protocols

- TCP: reliable data transmission, connection-oriented
- UDP: unreliable, no connection

Application Protocols

- FTP (file transfer)
- SMTP (simple mail transfer)
- HTTP (hypertext transfer)

...

Internet applications

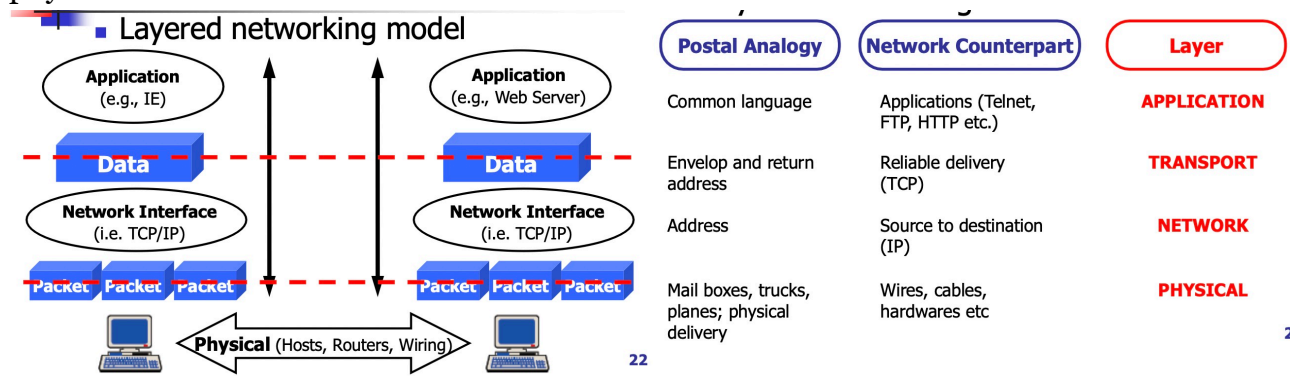
- E.g. ftp, telnet, email, www, ...
- Most are based on **client-server** model
- Different applications use different protocols in addition to TCP/UDP and IP
 - ftp: FTP, telnet: TELNET, Email: SMTP, WWW: HTTP

Two important design concepts of Internet

- Layered networking model
- Client-server paradigm

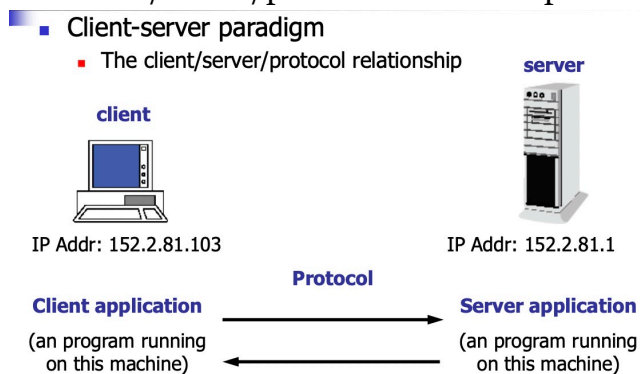
Layered networking model

ISO's 7 layer model: application, presentation, session, transport, network, datalink, physical



Client-server paradigm

The client/server/protocol relationship



IPv4 and IPv6

Problems of IPv4:

1. Insufficient addressing space
2. Real-time application is not provided
3. Short of security/mobility support

Terms for Network Devices

- Node: a device that is connected as a part of a network with network address
- Host Node: the computer attached directly to the Internet (end point)
- Link: the inter-connection between network devices
- Network Component: equipment that is part of the network infrastructure

Terms for Network Performance Parameters

- Bandwidth: **how much stuff** you can send through a connection
- Delay: **how much time** it takes for a packet of data to get from one point to another
- Jitter: the **variation** in delay
- Error Rate: the **probability** of the data units which are transmitted in **error**, **lost** or **retransmitted**

Source of delay:

1. Transmission delay
2. Propagation delay
3. Nodal processing delay

4. Queuing delay

Throughput: the average rate of successful message delivery over a communication

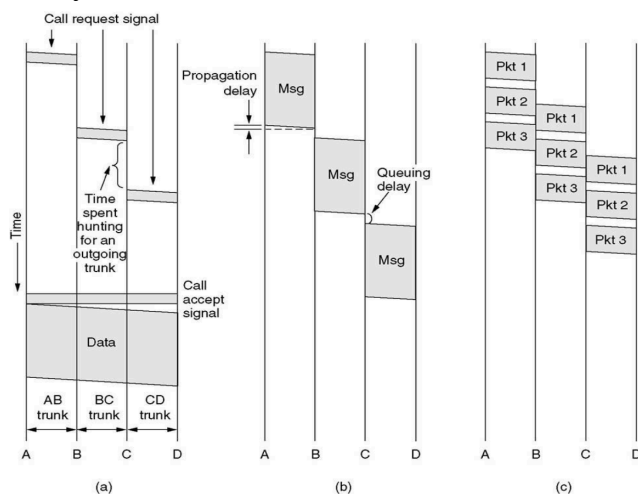
High → low (sensitive to delay)

Session Class, Interactive Class, Streaming Class, Background class

Terms for **network types**

According to **switching functions**

- Circuit switching network
- Message switching network
- Packet switching network
- (Hybrid)



Different channel **access technologies**

Multi-access (shared medium)

- Many end-systems share the **same physical communication**
- **Efficient** resource usage, **complex** channel access control (trade off)
- e.g. LANs

Point-to-point

- Between **two points** in the network, there must exist a physical channel
- **No** contention or **collision**
- **Simple** access control, **bandwidth waste**
- e.g. WANs

According to the **range of the network** (WAN, MAN, LAN, PAN)

	Range	Channel access technology	Example
WAN (Wide)	Large geographic area 10–1000km	Point-to-point	“long-haul network”, connects computers far apart
MAN (Metropolitan)	Medium area (campus, city) <10km	Multi-access	City network

	Range	Channel access technology	Example
LAN (Local)	Limited area (building, lab) <1km	Multi-access	Connects computers that are physically close together
PAN (Personal)	Small space (room) <10m		

According to the **user of the network**

Public network: **All the users can use** as long they pay the money

- Large scale, built by telecommunication companies

Private network: Only providing services to the **user inside the agency**

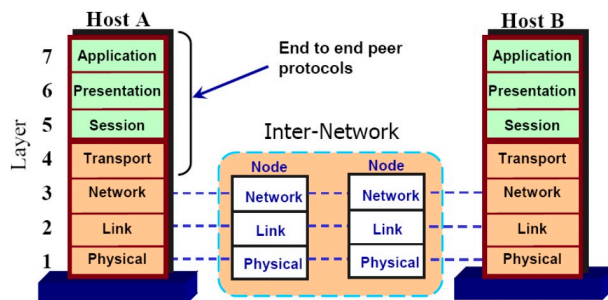
- Built by a certain agency, special requirements

Layered Architecture

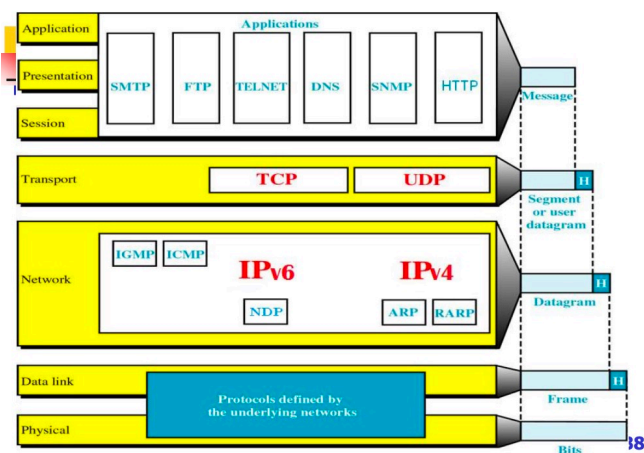
- OSI Layer Model
- TCP/IP Layer Model
- Revisory Layer Model

Benefits from Layered structure: simplify the task to design, implement, maintain

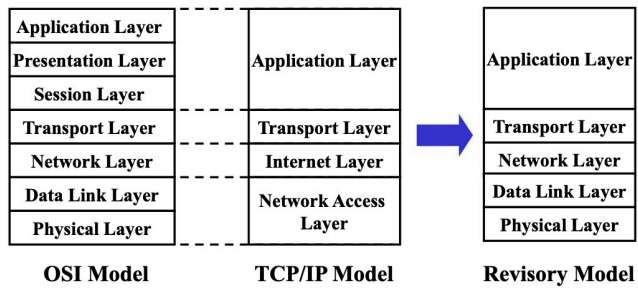
OSI Layer Model



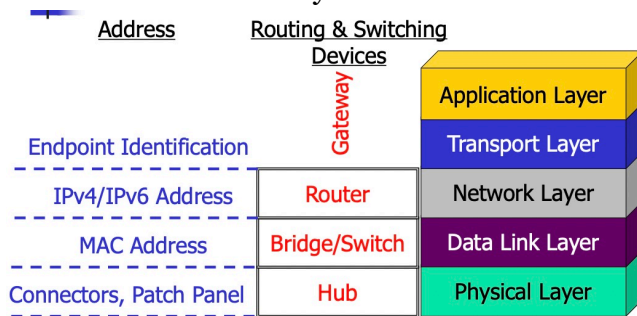
TCP/IP Layer Model



Revisory Model



Devices at different layers



Network Basics (summary)

Internet v.s. internet:

internet → set of computer networks, connect

Internet → a worldwide sets of networks, TCP/IP protocols

WWW v.s. Internet:

WWW on top of Internet, WWW → information sharing model

Internet major components (4)

- Physical infrastructure (hosts, routers, wiring)
- Internet addresses (IP address, hostname, DNS)
- Internet protocols
 - Network protocol (IPv4, IPv6)
 - Transport protocol (TCP, UDP)
 - Application protocol (FTP, SMTP, HTTP)
- Internet applications (ftp, telnet, email, www, ...)

Two important design concepts of Internet

- Layered networking model
- Client-server paradigm
 - client: use the service, server: provide the service
 - protocol: define the interaction between them

Terms for Network Devices

- Node (computer, cell phone, router, switch)
- Host node (ISPs, NSPs)
- Link
- network component (gateway, router, switch, hub)

Terms for network performance parameters

- Bandwidth (bps, Bps)
- Delay (processing, transmission, queue, propagation)
- Jitter → variation
- Error rate (BER, FER, PER, PLR)
- Throughput → successful message delivery

Different channel access technologies: multi-access (LANs), point-to-point (WANs)

Network types

According to the switching functions: circuit switching, message switching, packet switching

According to the range of the network: LAN, MAN, WAN, PAN

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PAN (Personal)	Small space (room) <10m		

According to the user of the network: public (all users), private (users in agent)

Layered architecture: ISO/OSI (7), TCP/IP (4), Revisory (5)

Devices at different layer:

- Hub — physical layer
- Switch — link layer (MAC address)
- Router — network layer (IPv4/IPv6 address)
- Gateway — transport layer + application layer (**Endpoint identification, point-to-point**)