Lec 2

Content

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Store and forward transmission

- **Forward transmission**
  - Hub, Switch
- **Store and forward transmission**
  - Router

Hops in a Network

- How many times a packet or a message jumps from one router to another while travelling towards destination.

- When a packets moves from source to destination, it passes through several hops, at each hop(router), packet is processed and then passed to the next hop.

Latency, Delay, Bandwidth and Throughput

- **Latency:** How much time it takes for a data packet to travel from one designated point to another. It is also called delay or total transmission time or total delay.
- **Bandwidth:** Maximum amount of data that can be transmitted over a communication channel in a single amount of tim.
- **Throughput:** Actual amount of data transmitted from source to destination in a unit time. (Number of messages transmitted per unit time)
- **Jitter:** Variation in delay time (Causing flickering images on screen)
- **Loss:** Also known as packet lost. It occurs when one or more packets fail to arrive at the destination.

Types of Delays

- **Transmission delay** amount of time taken to put a message or a packet on a transmission medium. Also known as transmission delay.
  - Transmission delay = Length of a message / Bandwidth

- **Propagation delay** Amount of time taken to transfer a message from source to destination.
  - = Distance/Speed
- **Queueing delay** Amount of time a packet is waiting in a buffer before getting transmitted. No formula to calculate it.
- **Processing delay** Amount of time a router takes in processing a packet before forwarding it. No formula to calculate it.
- **Nodal delay**
- **End to end delay**

Queuing delay, processing delay, and nodal delay only occurs in packet switching.

Total Transmission Time (Total Delay)

- **Packet switch**
  - **= n (Transmission delay) + Propagation delay OR**
  - **= td + pd +qd + pd**
- **Circuit switch**
  - **Transmission delay + Propagation delay + Tear down time + Setup Time**
- **FDM**
  - **Transmission time = Message /(Transmission rate/ slots)**
- **TDM**
  - **Transmission time = Message /(Transmission rate/frame rate*frame size)**

Access Network

- **Access network** is a physical link that connects edges or end systems to the edge router. Edge router is the first router on a path from end system to ISP
    - Home Access
    - Enterprise Access
    - Mobile Access

Home Access

- **Dial Up modem:** Connection established by using modem. Modem is connected to a telephone line to which is connected to ISP. It uses PSTN to connect to ISP.

- **DSL:** (Digital Subscriber Line) a modem technology that uses existing telephone lines to transport high-bandwidth data, such as multimedia and video, to service subscribers. DSL provides dedicated, point-to-point, public network access. This DSL connection is typically between a network service provider (NSP) central office and the customer site.

    - **Difference:** DSL is hundred times faster than Dial Up modem. DSL allow you to use internet while using telephone whereas Dial Up dont.

- **HFC:** (Hybrid Fiber Coaxial cables) architecture tha use a combination of fiber optic cabling and coaxial cabling to distribute video, data and voice content to/from the headend and the subscribers.

Enterprise Access

- Uses Ethernet to connect an enterprise network to ISP

Mobile Access

- Mobile devices are connected to base station, base station connect them to the wired network.

Broadband

- The term broadband refers to high-speed and high-bandwidth communication infrastructure.
- **Six of broadband technologies:** digital subscriber line (DSL), cable modem, fiber, wireless, satellite, and broadband over power lines (BPL).
- The bulk of Internet users (92.6%) across the globe access broadband through their mobile phones.

Network of Networks

- Local network connected to the Internet through tiered hierarchy of Internet Service providers.
- **Access ISP** or tier-3 ISP are at the bottom (Jazz)
- **Tier-2 ISP** connecting national networks to internet or to global network (PTCL)
- **Tier-1 ISP** also known as network backbone are international ISP (Sprint, UUNet, AT&T))
- **Point of Presence** Point where one ISP is connected to another ISp. Usually one or more routers connected to each other.

Layering in Computer Networks

Layering: Decomposing a complex problem or a system into smaller more manageable parts or layers.

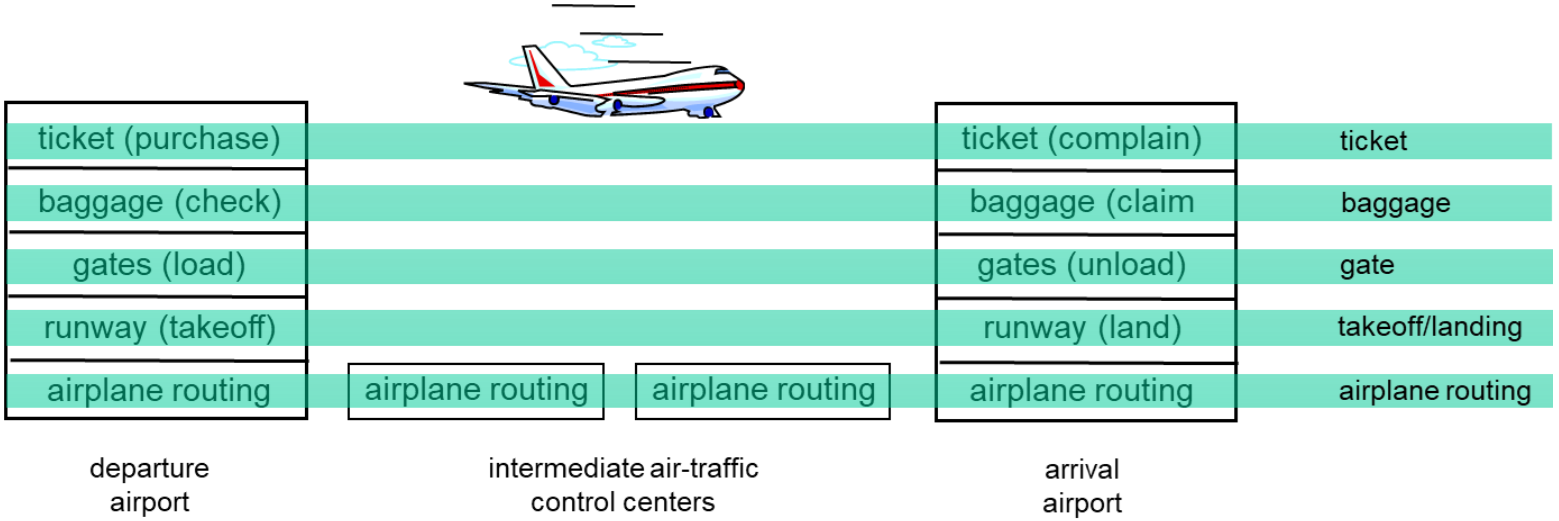
Organization of a program into separate functional components that interact with each other in sequential and hierarchical manner.

Advantages:

Layered architecture makes it easy to dissect, understand, and change a complex system.

It makes error finding and detection easier.

Example of Layering



- Each layer implements a service
- Via its own internal-layer actions
- Relying on services provided by layer below

Layered Computer Architecture

Organization of network protocols, software, and hardware into layers.

With this architecture, each protocol belongs to one layer.

Layers communicate with each other by exchanging messages called “layer n protocol data units” or simple “n-PDU”.

Protocols at each layer governs the activities of that layer

Set or group of protocols running concurrently a different layers is called protocol stack.

Layered Architectures

OSI Reference model

TCP/IP model

ISO/OSI Reference Model

Open System Interconnection developed by International Standard for Organizations.

It is a model or a set of guidelines for designing a network that is robust, flexible, and interoperable.

It is just a guideline, neither a software nor a protocol and therefore is called OSI reference model.

Purpose is to facilitate communication between two systems without getting into underlying hardware and software of the system.

OSI Reference Model