L9: Intro Network Systems

6.033 Spring 2007
http://web.mit.edu/6.033
Slides from many folks

What have you seen so far?

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Client/service using network

- Sharing irrespective of geography
- Strong modularity through geographic separation

Network is a system too!

- Network consists of many networks, many links, many switches
- Internet is a case study of successful network system

Today’s topic: challenges

- Economical:
  - Universality
  - Topology, Sharing, Utilization
- Organizational
  - Routing, Addressing, Packets, Delay
  - Best-effort contract
- Physical
  - Errors, speed of light, wide-range of parameters
### Circuit Switching
- It’s the method used by the telephone network
- A call has three phases:
  - Establish circuit from end-to-end (“dialing”),
  - Communicate,
  - Close circuit (“tear down”).
- If circuit not available: “busy signal”

### Isochronous Multiplexing/Demultiplexing
One way for sharing a link is TDM:
- A time interval is divided into n frames
- Each frame carries the data of a particular conversation
  - E.g., frame 0 belongs to the red conversation

### Circuit Switching
- Assume link capacity is C bits/sec
- Each communication requires R bits/sec
  - #frames = C/R
- Maximum number of concurrent communications is C/R
- What happens if we have more than C/R communications?
- What happens if the communication sends less/more than R bits/sec?
  Design is unsuitable for bursty communications

### Packet Switching
- Used in the Internet
- Data is sent in Packets
  (header contains control info, e.g., source and destination addresses)
- Per-packet routing
- At each node the entire packet is received, buffered, and then forwarded)
- No capacity is allocated

### Asynchronous Multiplexing/Demultiplexing
- Multiplex using a queue
  - Switch need memory/buffer
- Demultiplex using information in packet header
  - Header has destination
  - Switch has a forwarding table that contains information about which link to use to reach a destination

### Aggregate Internet Traffic Smooths
5-min average traffic rate at an MIT-CSAIL router
- Max In: 12.2 Mb/s
- Avg. In: 2.5 Mb/s
- Max Out: 12.8 Mb/s
- Avg. Out: 3.4 Mb/s
Best Effort

No Guarantees:
- Variable Delay (jitter)
- Variable rate
- Packet loss
- Duplicates
- Reordering

Plan for studying network systems

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