

Goals and Metrics

Kameswari Chebrolu

All the figures used as part of the slides are either self created or from the public domain with either 'creative commons' or 'public domain dedication' licensing. The public sites from which some of the figures have been picked include: <http://commons.wikimedia.org> (Wikipedia, Wikimedia and workbooks); <http://www.sxc.hu> and <http://www.pixabay.com>

Goal

- Enable Efficient, Robust and Scalable Communication
 - Efficient in terms of delay, cost etc
 - Robust towards failures or errors
 - Scalable with more users and data

Means

- Technology Development (Hardware)
 - Faster/Cheaper/Energy-efficient Routers, Links and Hosts
- Protocols (Software): Implement many of the required functionality to support communication
 - Provide reliability
 - Route packets
 - Share physical media etc
 - Each protocol tries to achieve a specific goal

Protocol

- Defines format and rules for exchange of messages
 - What to send: Format
 - When to send & How to act : Rules
- E.g. TCP, IP, CSMA/CD (Ethernet)

Challenges

- Tradeoff
 - Cost vs delay vs Energy
 - Need to strike the right balance based on usage scenario
- System Failure
 - Nodes can die; Links corrupt packets; Processing can duplicate or reorder packets
- Backward compatibility
 - Newer versions of protocol should support older devices

Popular Metrics

- Capture performance of protocols (determines whether goals are being met or not)
 - Eg. Throughput, Latency, Energy-consumption
- Example:
 - Throughput vs Number of Nodes in the system
 - Throughput vs Energy consumption
 - Loss Rate/Delay vs Number of Hops

Throughput

- Also called Bandwidth or Data-Rate
 - Measured in Mbps, Kbps (less often in MBps, KBps)

Latency/Delay

- Delay experienced by a packet/message from source to destination (one way delay)
- Round Trip Time (RTT): source-destination-source
- Measured in us (micro-second), ms, s
- Made up of
 - Processing, Transmission, Propagation and Queuing

Latency/Delay

- Processing: Time to inspect the packet
 - Examine headers, check for errors
- Queuing: waiting time in a queue
- Transmission: size (of packet or message)/bandwidth
- Propagation: distance/speed of light
 - $2.3 * 10^8$ ms/s in cable; $2 * 10^8$ m/s in fiber; $3 * 10^8$ m/s in vacuum
- Latency = processing + queuing + transmission + propagation

Loss

- Causes: limited storage space at switches, corruption of packet
- Often measured as a probability
 - Eg. 0.1 or 10% loss (on average one out of every 10 packets are lost)

Summary

- Understood the goal of computer networks
- Goal reached through design of hardware and protocols
 - Challenges to overcome
- Performance metrics
 - Throughput, latency and loss