Lecture 1

CS625: Advanced Computer Networks
Fall 2004

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http://www.cse.iitk.ac.in/users/braman/courses/cs625-fall2004/outline.html

Agenda for Today

- Introductions
- Course structure, outline, and purpose
- *Scribe for today?*
- Communication: what and how?
- Internet history
- Internet design and architecture
- OSI layering

# Communication: what and how?

- *Communication: The exchange of thoughts, messages, or information, as by speech, signals, writing, or behavior.*
- Requirements for communication
  - Medium + Energy, Protocol
- Design goals/criteria
  - Reliability, Security, Efficiency (time, cost, energy), etc...

Communication networks

- Before the electronic age
  - Using doves/pigeons
  - Postal system
- Telegraph
- Telephone network
- Internet
- Cellular/Wireless

Inter-Network (Internet)

- Connect different "networks"
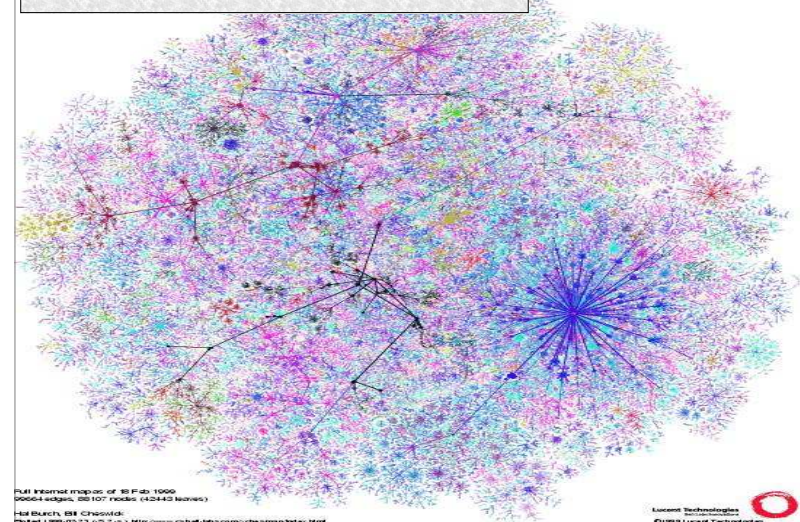- Pigeon-powered Internet takes flight
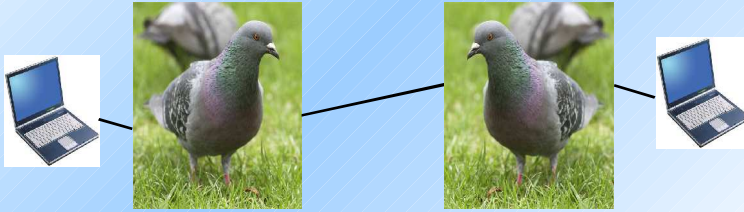
History of the Internet

- 1961-62: Packet-switching as a concept
- 1969: Four host computers on ARPANET
- 1972: E-mail application launched
- Network Control Protocol (NCP) used in ARPANET
- 1980s: LANs, PCs, Workstations
- Until 1985: Internet used by researchers/developers

History (continued)

- Networks from DoE, NASA, NSF, AT&T
- NSFNET backbone was created
- Privatization: 1985-1995
  - 6 nodes (56kbps links) to 21 nodes (45Mbps links)
- Steady exponential growth for 15 years
  - In bandwidth, number of hosts, total traffic, etc.
- http://www.isc.org/ds/

The Internet, as of 1999

Full Internet map as of 18 Feb 1999
99664 edges, 88107 nodes (42443 leaves)

Hal Burch, Bill Cheswick
Plotted 1999-02-23 (V5.2.e) http://www.cs.bell-labs.com/~ches/map/index.html

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Internet Design Goals
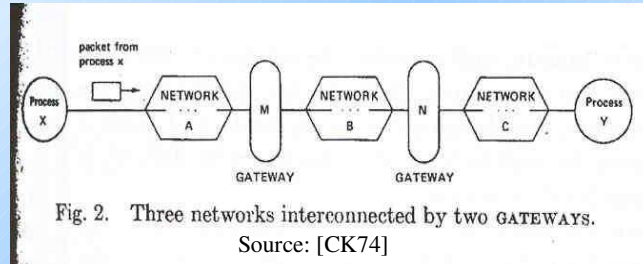
- Primary goal: Inter-networking

Fig. 2.   Three networks interconnected by two GATEWAYS.
Source: [CK74]

- Sources of variability: addressing, MTU, delivery guarantees, delay/bandwidth, routing

Internet Design Goals

1. Communication in the presence of failures
2. Multiple types of service
3. Accommodate different networks
4. Distributed management
5. Cost effective
6. Dynamic host attachment, removal
7. Resource accounting

OSI Layering

- What is layering?
  - *"Structuring technique which permits the network... to be viewed as logically composed of a succession of layers, each wrapping the lower layers and isolating them from higher layers"* [Zim80]

Application
Presentation
Session
Transport
Network
Link-Layer-Ctrl Medium-Access
Physical

Advantages of Layering

- Handle heterogeneity
- Software reuse, modularity
- Allows extensibility, new technologies

Internet Service Semantics

- Best-effort
- Packets may be:
  - Dropped
  - Delayed
  - Duplicated
  - Reordered
- Packets will NOT be *created*

Later in the Week

- The end-to-end principle
  - *How to* separate functionalities into layers?
  - Assigned reading [SRC84]
- MAC and LLC issues
  - Techniques for multiple-access
  - Adaptive LLC for wireless links