

CS425: Computer Networks

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Department of CSE, IIT Kanpur
Jul-Dec 2006

Lecture 01: Mon, 31 July 2006

Course Contents

- Internet design principles
- Layering
- Encoding
- Framing
- Error detection, correction
- Medium Access Control
- Addressing
- Routing
- Congestion Control
- Flow Control
- Application Protocols
- Security
- Socket Programming
- Network Simulator

Related Courses

- CS625: Advanced Computer Networks
- CS725: Topics in Networking
- CS698t: Wireless Networks – Principles and Practice
- EE673: Digital Communication Networks
- EE679: Queuing Theory
- CS628: Computer Systems Security

Course Structure

- 1 + 1.5 hour lecture
- 1.5 hour tutorial once in two weeks
 - Batches of ~30 each
- Tutorials & lectures possibly combined with EE673 (Digital Communication Networks)
- Proposed timings:
 - Lectures: Mon & Wed 5-6:30pm
 - Tutorials: Thu 5-6:30pm, Fri 3-4:30pm & 5-6:30pm
 - Office hours: Thu 11am-12noon [CSE-212]
 - Class time discussion: Tue 01 Aug 7:30pm, CSE-101

Evaluation Plan

Class Participation	5%
Quizzes	2x5=10%
MidSem2	20%
EndSem	45%
Project	20%

Project Plan

- To be done in groups of three
- On socket programming
- Will be assigned before Mid-Sem break
- Due in one month

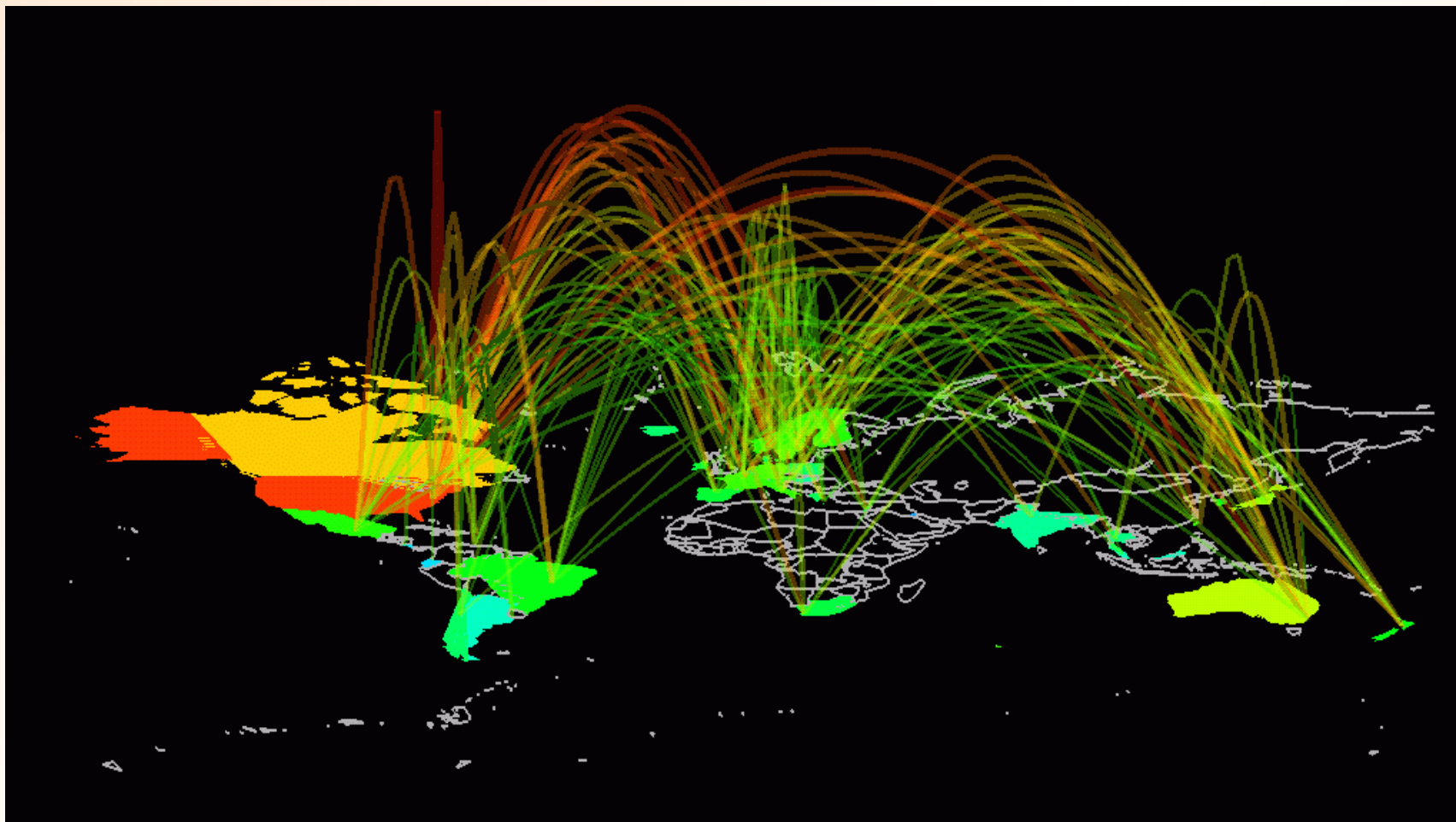
Reference Material

- Papers
- Web material
- Textbooks
 - *Computer Networks – A Systems Approach*, by Peterson and Davie, 3rd Edition, published by Morgan Kaufmann
 - *Data Networks*, by Bertsekas and Gallager, 2nd Edition, published by Prentice Hall of India

Values

- Sincerity, hard-work: committed learning
- Time management: methodical learning
- Discussion & participation: group learning
- Straightforwardness, honesty, no short-cuts: ethical learning

Enter the World of Communication Networks



Picture of the Internet, from the Internet

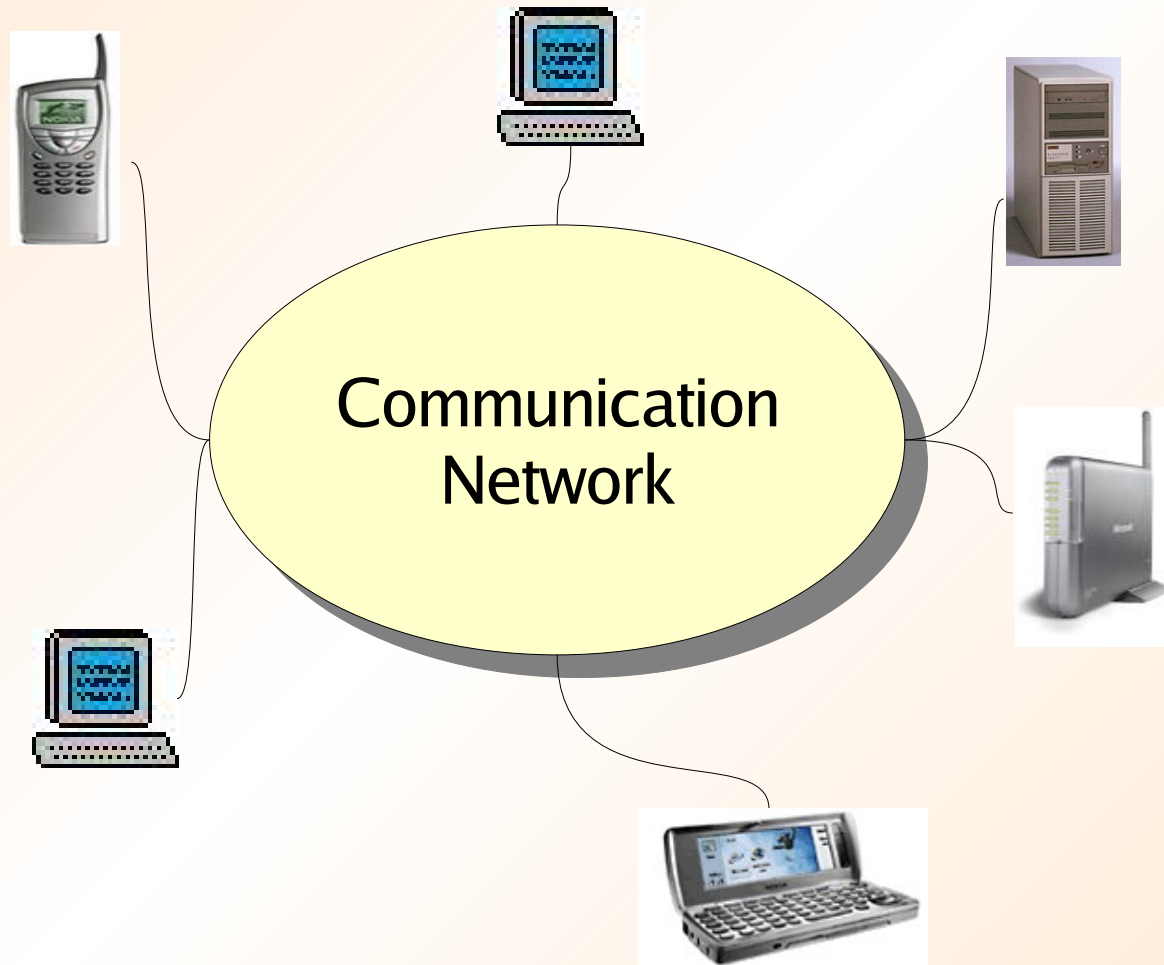
Communication: what and how?

- *Communication: The exchange of thoughts, messages, or information, as by speech, signals, writing, or behaviour.*
- Requirements for communication
 - Medium + Energy, Protocol

Communication networks

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

What is a Communication Network?



Icons courtesy Google

Network Components: Hosts

Communication end-points

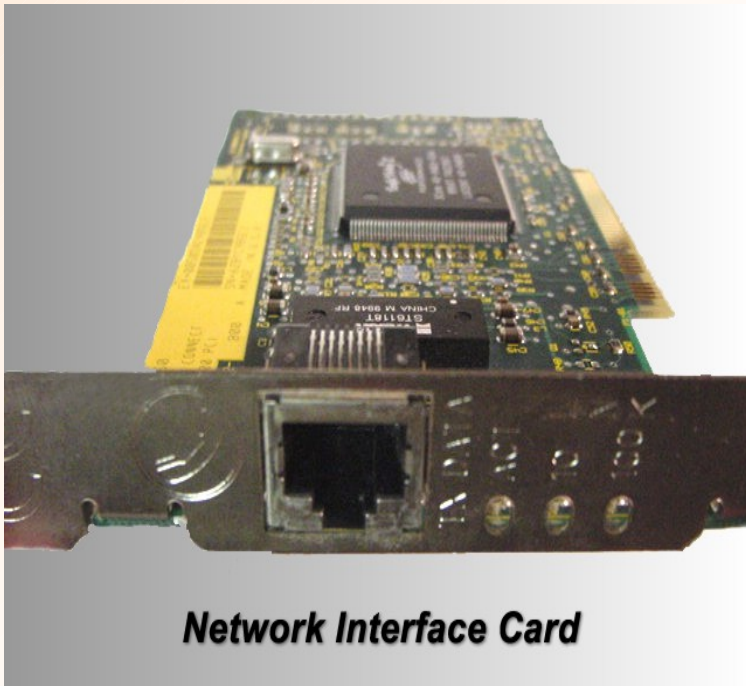
- PCs, Workstations, PDAs, Cellphones, Servers



Pictures courtesy Google

Interface Cards

Attach the host to the link



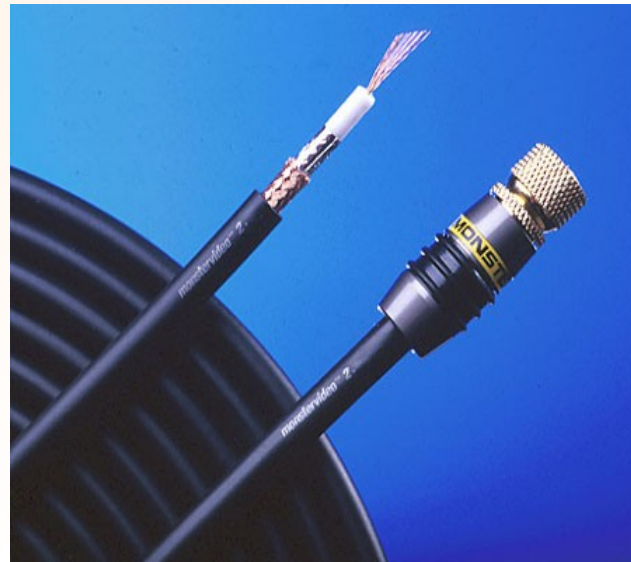
Pictures courtesy Google

Links

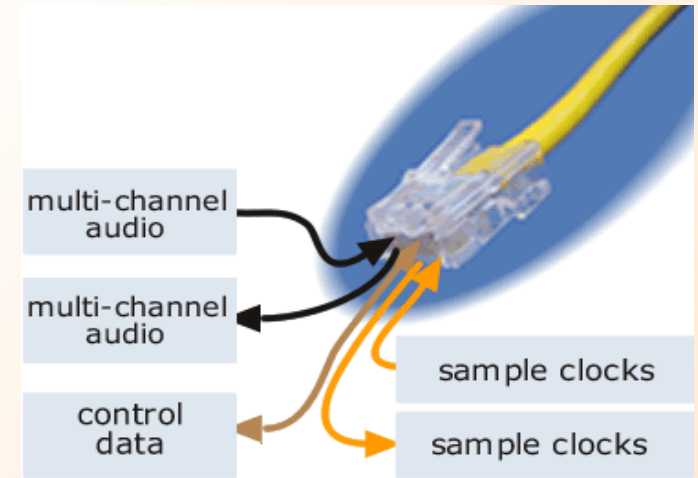
Carry signals from one place to other place(s)



Fiber Optics

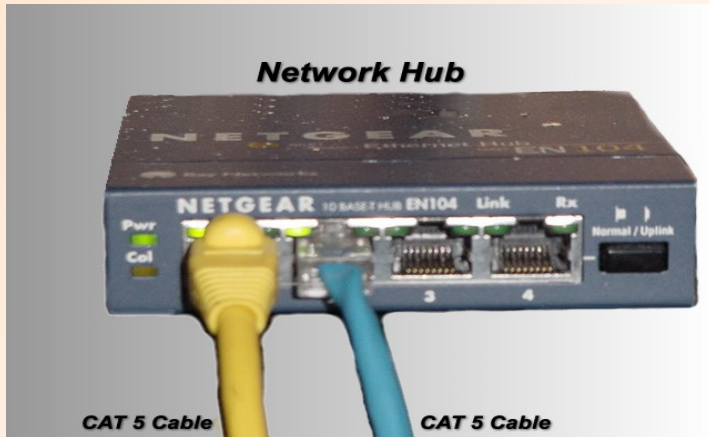


Co-axial



Cat5-twisted pair

Hubs/Switches/Routers



Hub

Switch



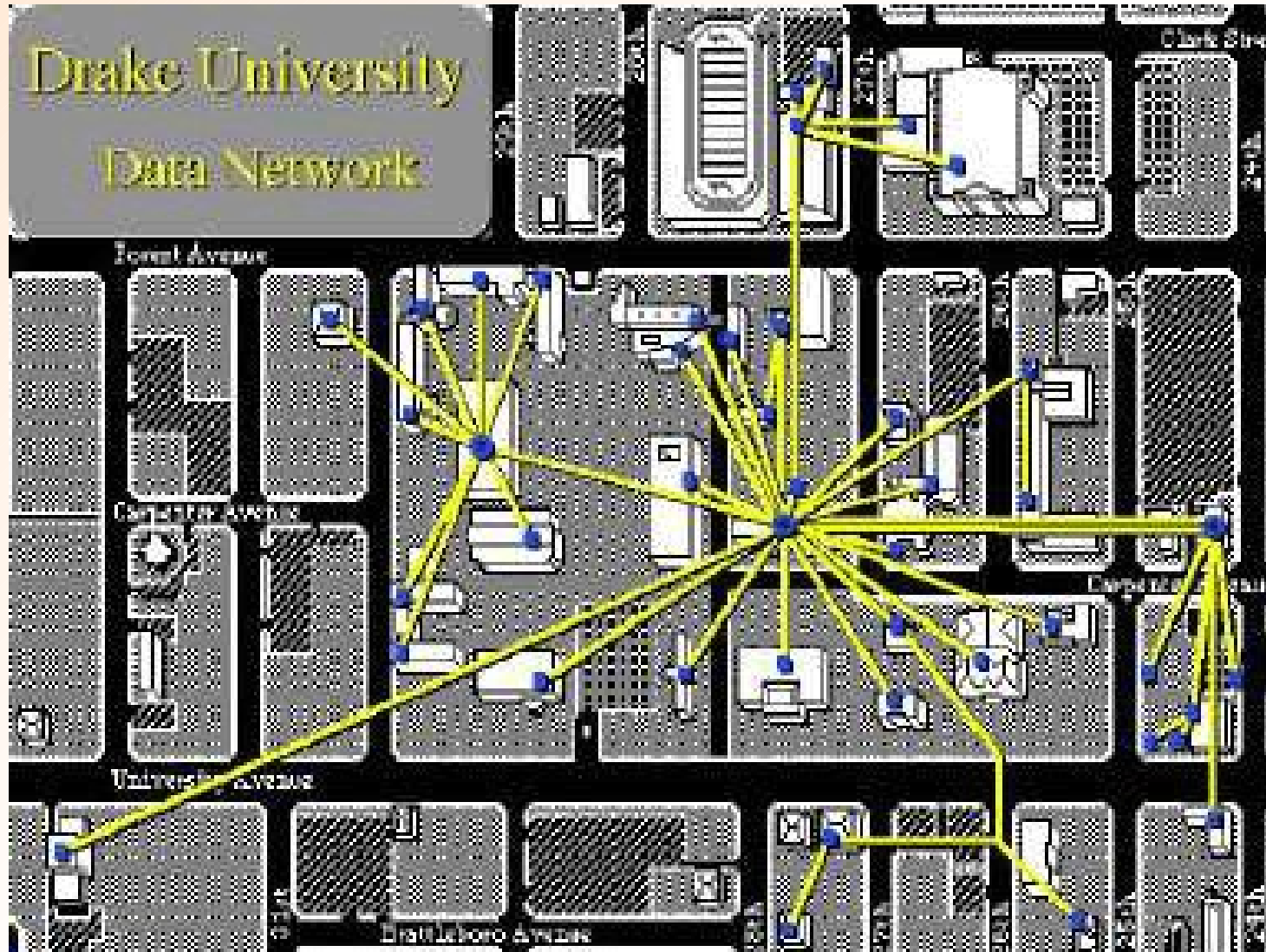
Router

Pictures courtesy Google

Types of Networks

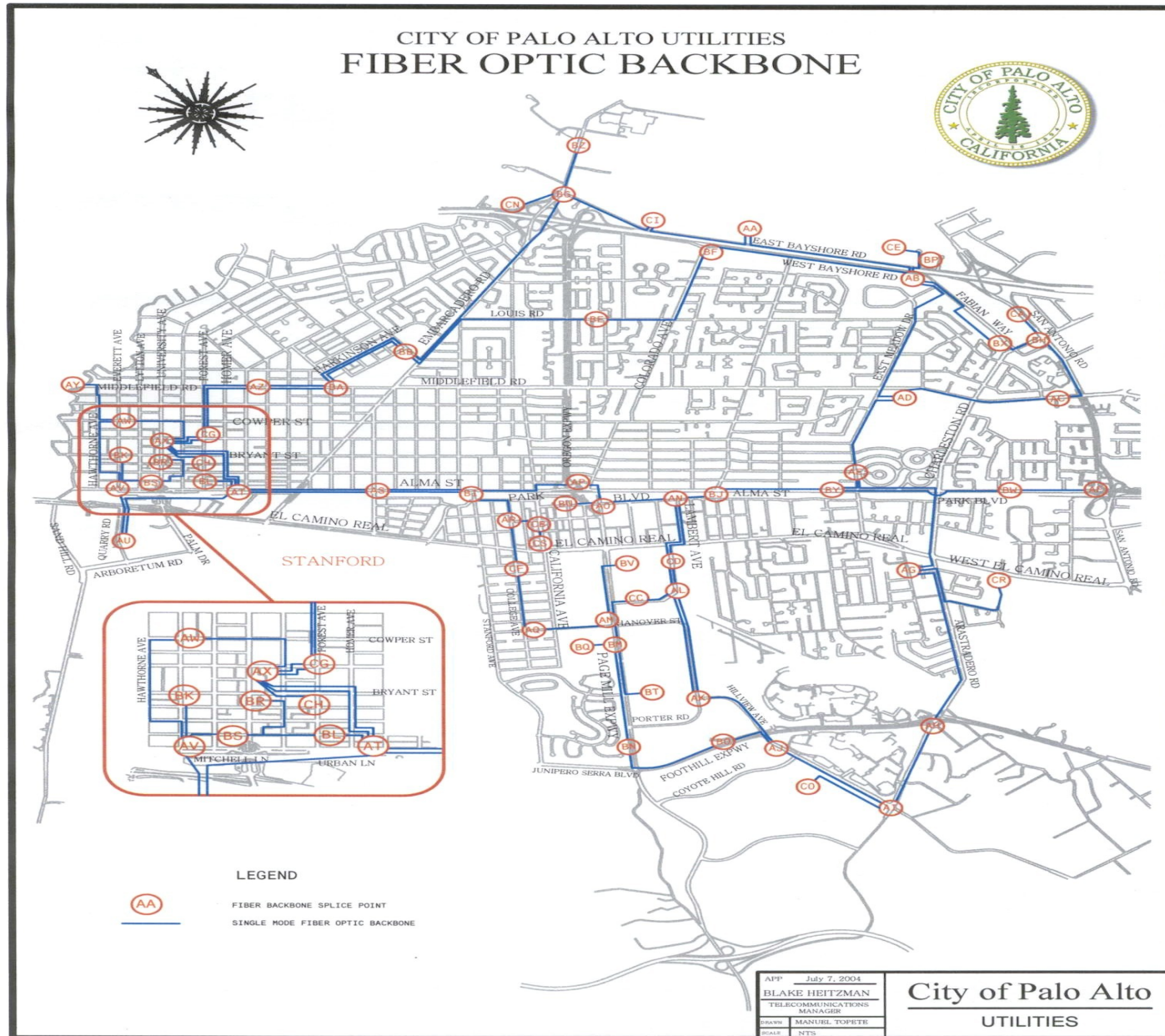
Inter-node distance	Type of network
<1m	Multi-processor network
1-10m	Personal Area Network
10m-1km	Local Area Network
10-100km	Metropolitan Area Network
100-1000km	Wide Area Network
10000-100000km	Internet
>100000km	Inter-planetary Internet

Local Area Network



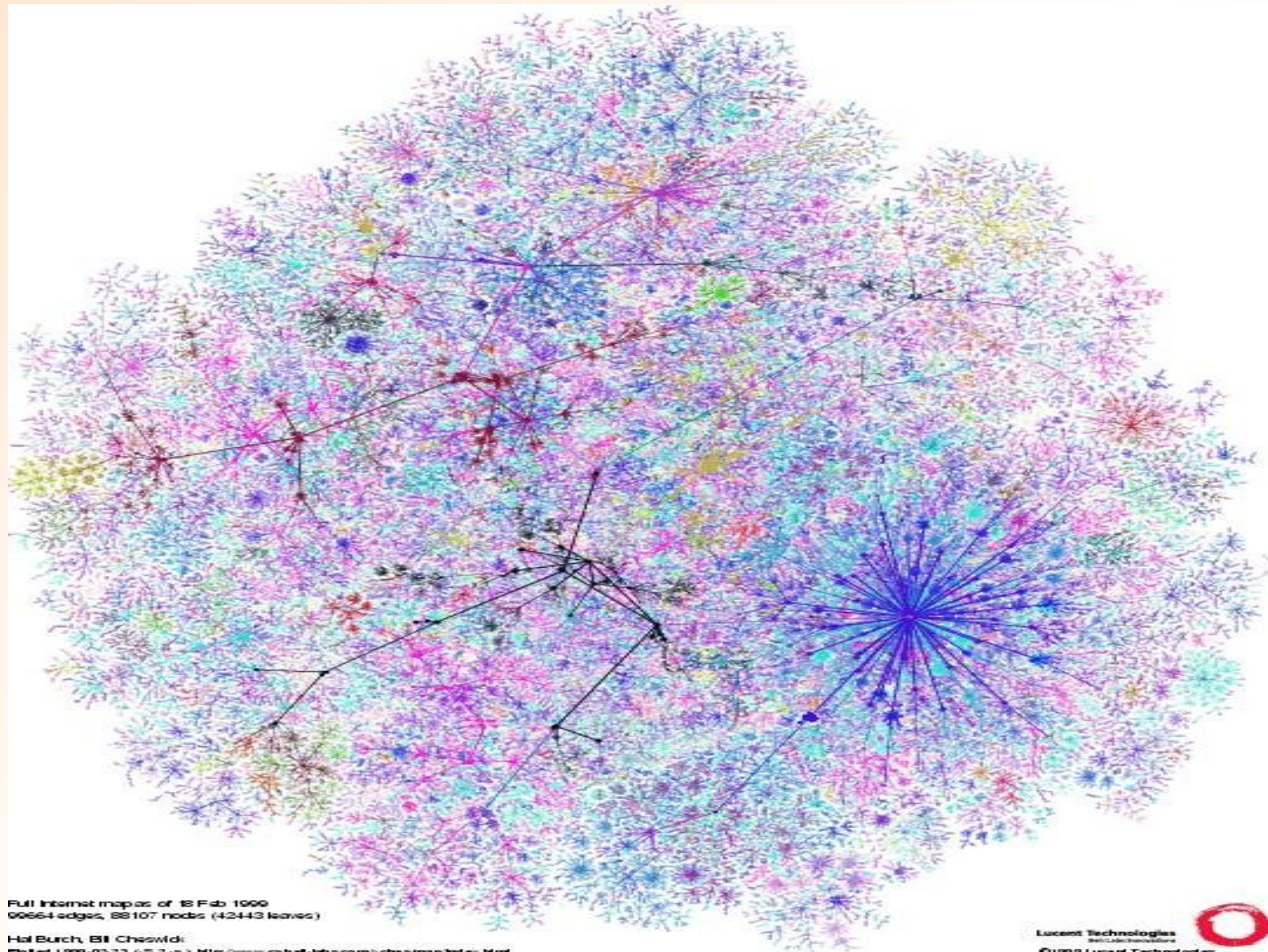
Picture courtesy Google

Wide Area Network



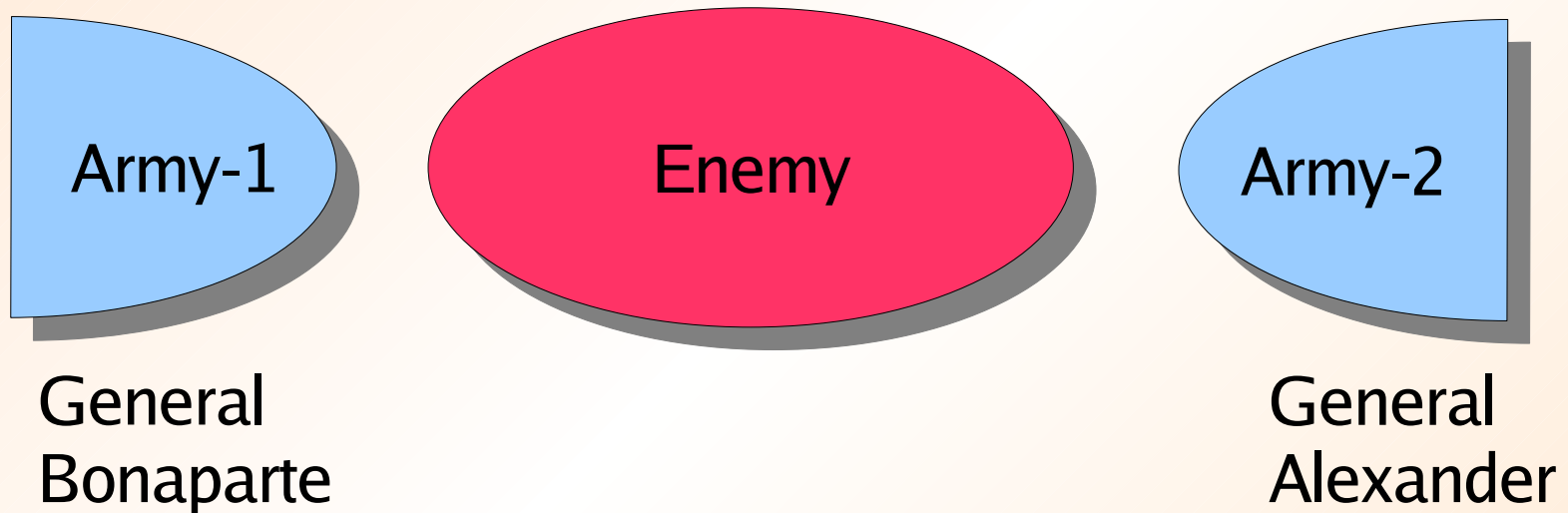
Picture courtesy Google

Internet as of 1999



Picture courtesy Google

The Two-Army Problem



The attack will succeed *if and only if* both armies attack the enemy at the same time

What strategy to adopt?

Designing a Protocol

- **What** information to send?
 - Sequence Numbers, CRC etc
- **When** to send?
 - Define possible message sequences

Metrics for Protocol/Network Design

- Efficiency
 - Time, cost, energy, etc.
 - Throughput versus latency
- Reliability
- Security

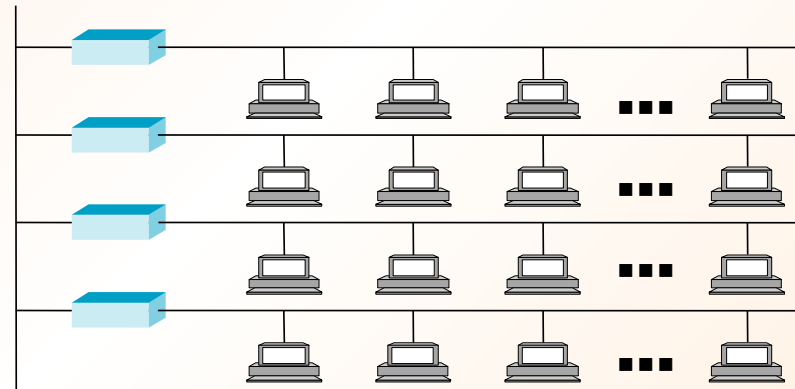
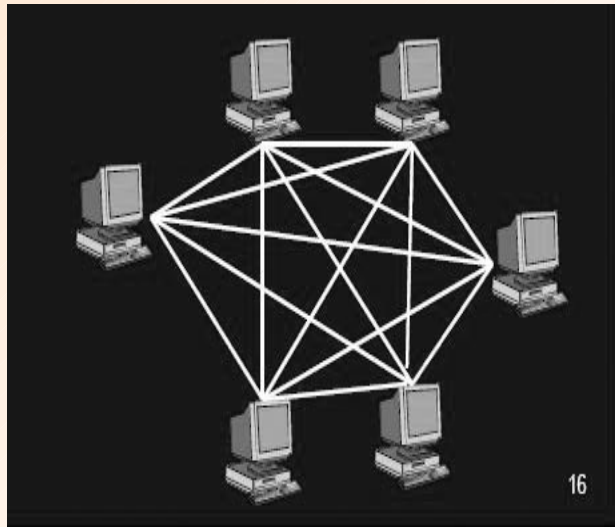
Several Levels of Issues

- How do two computers communicate on a **single link**?
- How do several computers **share** a common medium?
- The notion of a **network**: when not all computers are connected to each other directly

Communication on a Single Link

- Depends on the physical medium in use
 - Ethernet: converted to electrical signals
 - SONET: optical signals
 - Satellite, WLAN: RF modulation in some frequency
- Framing
- Error Detection/Correction

Sharing a Medium

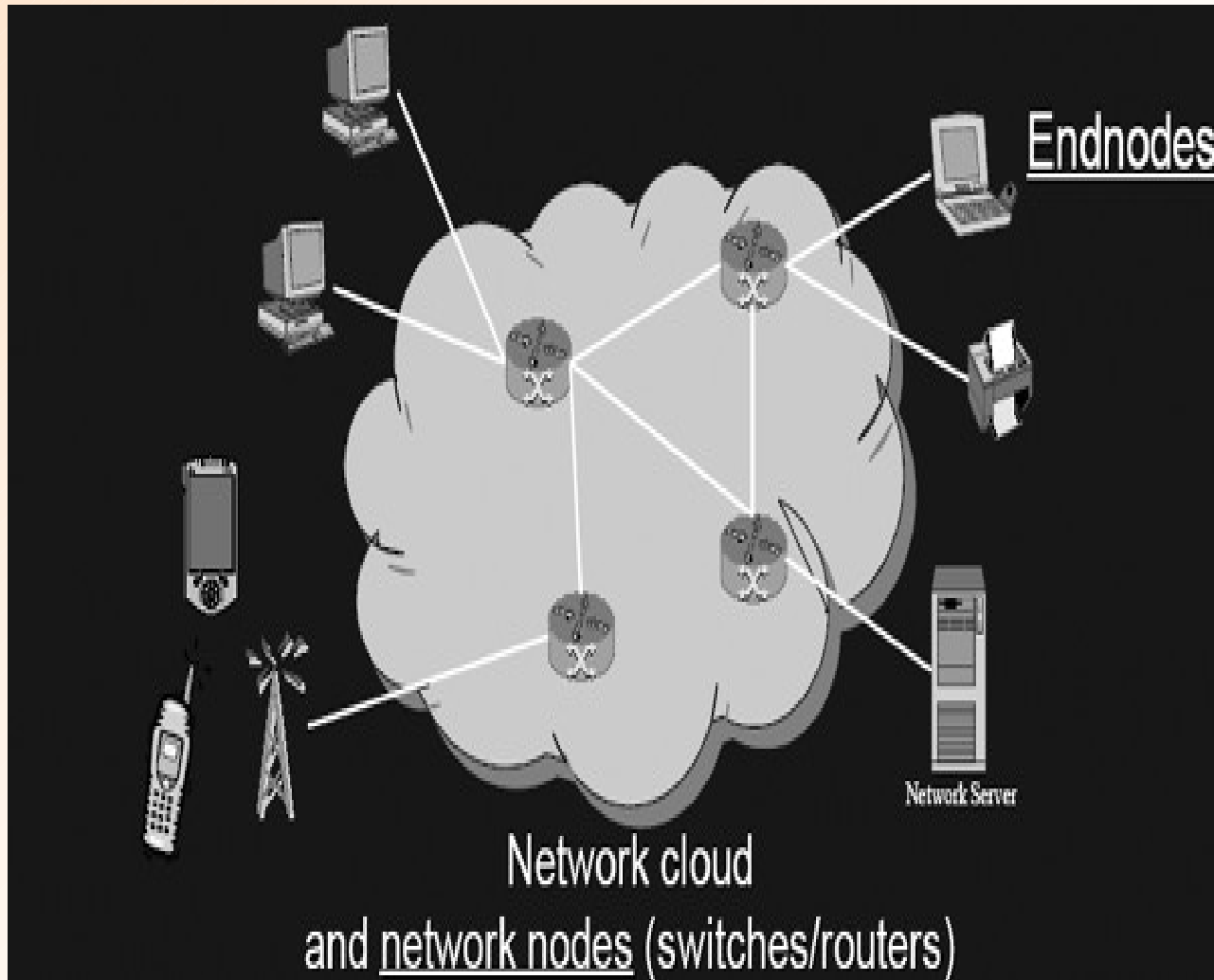


- Notion of **Medium Access Control (MAC)** protocol
- Possibilities: central control vs. distributed control

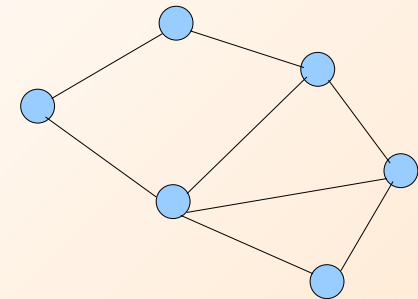
Medium Access Control (MAC)

- Time-division multiple access (TDMA)
 - Satellite link, T1, SONET
- CSMA/CD
 - Ethernet
- CSMA/CA (RTS/CTS optional)
 - Wireless LAN
- Other possibilities: FDMA, CDMA
 - GSM uses TDMA + central control

Beyond Direct Communication



- Need **naming**
- Network **topology**:
 - All-to-all
 - Star
 - Intermediate, e.g.



- This is natural:
 - Roads, railway, airlines

Picture courtesy Peterson & Davie

Beyond Direct Communication

- Notion of **routing**
 - Centralized vs. distributed routing
- Distributed routing:
 - Source routing vs. destination-based routing
- Destination-based routing:
 - Each “node” has a **routing table**
 - Send packets to node 5 via node 2
 - Send packets to node 6 via node 3 etc

Other Issues

- Transport
 - Reliability
 - Flow/Congestion Control
- Applications
 - HTTP, Email
- Network Security
 - Cryptography fundamentals
 - Public key/ private key management

Impact

- Personal
 - Emails, chat, VoIP, video, entertainment
- Business
 - Online purchases, information availability
- Health
 - Tele-medicine
- Education
 - Distance education, easy research/publication