

# Networking Trends and Their Impact



**Raj Jain**  
**The Ohio State University**  
**Columbus, OH 43210**  
**Jain@CIS.Ohio-State.Edu**

<http://www.cis.ohio-state.edu/~jain/cis788-97/>

Email questions to [question@netlab.ohio-state.edu](mailto:question@netlab.ohio-state.edu)



- ❑ Internet History and Growth
- ❑ Networking: Key Technologies
- ❑ Networking Trends
- ❑ Impact of Networking

Sources: See references at the end.

# Computing Growth

- ❑ Processor in video game is 10,000 times faster than ENIAC (1947)
- ❑ Genesis's game has more processing than 1976 Cray supercomputer.
- ❑ Sony's game has a 200 MIP processor in it.
- ❑ Greeting cards contain more computing power than all computers before 1950.
- ❑ Chips in some video cameras are more powerful than IBM 360.
- ❑ Computing Power in MIPS =  $2^{(\text{year}-1986)}$   
⇒ 256 MIPS in 1994, 2 GIPS in 1997

# Internet Growth

- ❑ 3 Hosts in June 1969
  - ❑ 0.7 M hosts in 1991
  - ❑ 1.3 M hosts in Jan 93
  - ❑ 2.2 M by Jan 94
  - ❑ 4.9 M by Jan 95
  - ❑ 9.5 M by Jan 96
- ⇒ 300 M by 2000
- More than 5 Billion (population) by 2003

# Internet History

- ❑ 1962 - Licklider memos on “Galactic Networks”
- ❑ 1964 - Paul Baran wrote reports outlining packet networks
- ❑ 1964 - Donald Davies, UK on packet switching
- ❑ 1969 - ARPAnet commissioned UCLA, SRI, UCSB, and U of Utah
- ❑ 1972 - Internetworking Group created (chaired by Vint Cerf)
- ❑ 1982 - TCP/IP

# History (Cont)

- ❑ 1984 - DNS
- ❑ 1989 - 100,000 hosts on the Internet
- ❑ 1990 ARPAnet ceased
- ❑ 1992 WWW released by CERN
- ❑ 1992 1M hosts on the Internet
- ❑ 1993 Whitehouse on-line

# Networking: Key Technologies

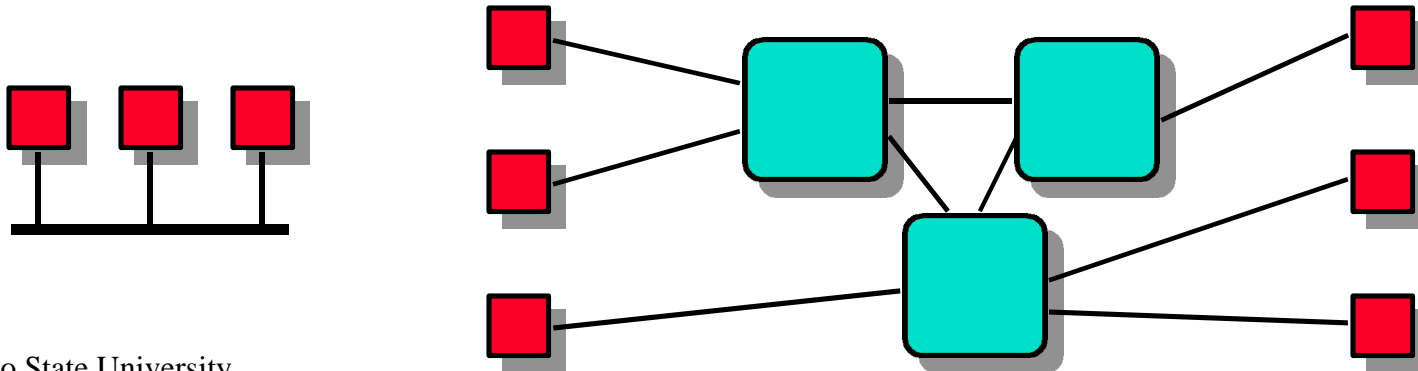
- ❑ TCP/IP
- ❑ Ethernet
- ❑ 10Base-T
- ❑ USENET
- ❑ Web
- ❑ ATM  $\Rightarrow$  LAN and IP Switching

# Networking Trends

- ❑ Stone age to Networking Age
- ❑ Networking is moving from specialists to masses ⇒ Usability (plug & play), security
- ❑ URL is more important than a company's phone number
- ❑ Standards based networking ⇒ Reduced cost
- ❑ Proprietary to standards
  - ⇒ On-line services to Internet
  - ⇒ GroupWare to IntranetsIntranet = Internet technology for internal use

# Trends (Cont)

- ❑ Copper is still in.  
Fiber is being postponed.
- ❑ Shared LANs to Switched LANs
- ❑ Routing to Switching
- ❑ LANs and PBX's to Integrated LANs
- ❑ Active Networks  $\Rightarrow$  A "program" in place of addresses in packets to compute the next hop



# Information Push

- ❑ Advertising on all transport media (bill boards, TV commercials)
- ❑ Search engines and other public servers use advertising dollars
- ❑ BackWeb, Pointcast
- ❑ Costanet from Marimba uses TV paradigm
- ❑ Channels of "Adformations" (Ads looking like information)

# Impact of Networking

- ❑ Knowledge Economy
- ❑ Digitalization
- ❑ Virtualization
- ❑ Convergence
- ❑ Globalization
- ❑ Profusion of Information
- ❑ Immediacy
- ❑ Impact on Education
- ❑ Impact on Learning
- ❑ Electronic Commerce

# Digitalization

- ❑ Atoms vs bits. Physical vs digital.
- ❑ Easier to manipulate, customize, encrypt, ...
- ❑ TV, Telephony, Cellular telephony, news papers, are all becoming digital
- ❑ Wireless bandwidth crunch  $\Rightarrow$  Communication between stationary objects need not be wireless
- ❑ Negroponte Switch: Whatever is wired will become wireless and what is wireless will be wired  
 $\Rightarrow$  Cable TV, Wireless phones

# Virtualization

- ❑ Everything is becoming virtual:  
Virtual stores, virtual workplace,  
virtual organizations, virtual cash,  
virtual networks, Virtual routers, ...
- ❑ 55 Million US workers will work remotely by 2000
- ❑ Remote management, remote access, remote support,  
virtual support, ...

# Virtual Organizations

- Virtual Organizations:
  - Meet on-line
  - Help gather, retrieve, share relevant knowledge
  - Can be rapidly assembled
- Virtual Companies:
  - Complementary resources in cooperating companies are integrated to support a particular product.
  - Underused resources are allocated. Not moved.

# Globalization

- ❑ Better communication  
⇒ Distance not important
- ❑ One language
- ❑ Media (network news, and even TV, Newspapers) are distributed world-wide
- ❑ Language boundaries are disappearing
- ❑ English is becoming the language of the Internet (and the world)

# Knowledge Economy

- ❑ Outsourcing of labor-intensive jobs
- ❑ 60% of American workers are knowledge workers
- ❑ 8 of 10 jobs are in information-intensive sectors
- ❑ More Americans make computers than cars
- ❑ More Semiconductors than construction machinery
- ❑ Work in data processing than petroleum refinery
- ❑ Smart cards, cars, houses, and phones

# Convergence

Entertainment  
Video Games  
Publishing  
News

Advertising

Cable TV

Telephone

Computer

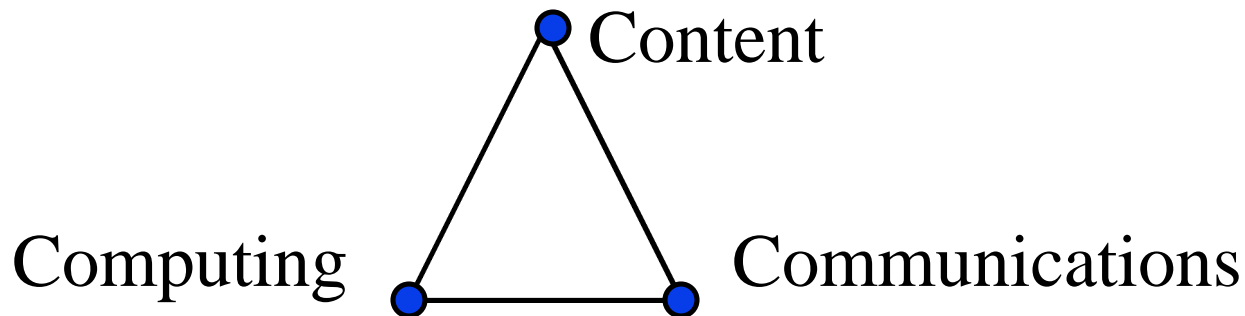
Digital  
Media  
Production

Video  
Transport

Voice  
Transport

Digital Media  
Storage/  
Handling

# Convergence (Cont)



- ❑ Merging of Content Providers and Content transporters
- ❑ Phone companies, cable companies, entertainment industry, and computer companies
- ❑ World-wide deregulation of telecommunication industry
- ❑ Single department for telephone and computer networking

# Immediacy

- ❑ Computing power, bandwidth, number of hosts double every 12-18 months  
⇒ Logarithm growth charts are now more common than linear
- ❑ Similar to nuclear chain reactions
- ❑ Moore's Law: processor speeds double every 18 months ⇒ 1.48 per year
- ❑ Network capacity is increasing faster 1.78 per year
- ❑ High bandwidth ⇒ More bits per second
- ❑ Hundreds of telegrams per day ⇒ Fast pace of life

# Impact on R&D

- ❑ Too much growth in one year  
⇒ Can't plan too much into long term
- ❑ Long term = 1<sub>2</sub> year or 10<sub>2</sub> years at most
- ❑ Products have life span of 1 year, 1 month, ...
- ❑ Short product development cycles.  
Chrysler reduced new car design time  
from 6 years to 2.
- ❑ Distance between research and products has narrowed

# Impact on Education

- ❑ Technology is changing faster than our ability to learn
  - ⇒ Your value (salary) decreases with experience (years out of college)
- ❑ Recent graduates know C++, HTML, Java, TCP/IP, ...
- ❑ Need personal career management strategies
- ❑ New Opportunities/Challenges for educators
- ❑ New challenges for learners

# Impact on Learning

- ❑ A handheld device will have storage enough to carry a small library
- ❑ Computers have bigger memory than humans  
⇒ Knowing where to find the information is more important than the information
- ❑ Human memory is pointer cache
- ❑ To Succeed, welcome change, try new technology

# Information Glut

- ❑ Web  $\Rightarrow$  Information production and dissemination costs are almost zero  
 $\Rightarrow$  Too much information  
= Needles in the haystack
- ❑ Thousands of hits on each search
- ❑ Need tools for summarizing the information
- ❑ Opportunities for artificial intelligence
- ❑ Need to express information so that both human and computers can understand

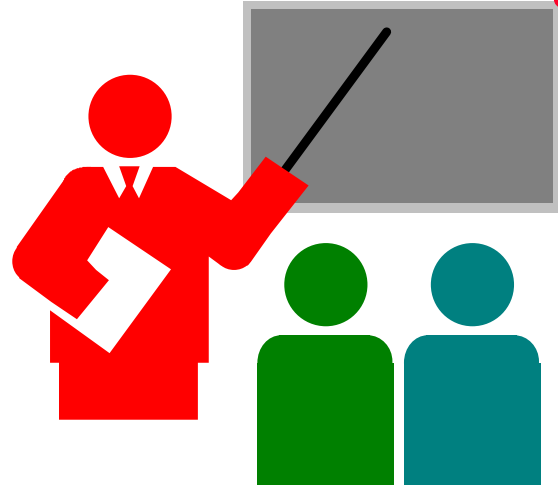
# Impact on Commerce

- ❑ All companies are at the same intersection
- ❑ World-wide competition  
⇒ Thinner margins
- ❑ Profit by quantity
- ❑ Need a virtual feel of the products
- ❑ Electronic Cash
- ❑ Need security
- ❑ Intelligent agents do the trading (stock markets)
- ❑ Mass Customization: Custom News, Custom Hotel rooms (Ritz-Carlton)

# Production Opportunities

- ❑ Zero production and transmission cost  
⇒ Everyone is a publisher/producer
- ❑ Anyone can publish papers or books
- ❑ Anyone can produce/distribute his/her TV show
- ❑ Intermediate distributors are being avoided  
IBMdirect, DECdirect, CompaqDirect,...

# Summary



- ❑ Networking is growing exponentially
- ❑ It is impacting all aspects of life  $\Rightarrow$  Networking Age
- ❑ Profusion of Information
- ❑ Virtualization, Globalization, Immediacy

# References

- ❑ "The Next 50 years," Special issue of Communications of the ACM, Feb 1997.
- ❑ T.E. Bell and M.J. Riezenman, "Technology 1997: Communications," IEEE Spectrum, Jan 1997, pp. 27-37.
- ❑ N. Negroponte, "Being Digital," Vintage Books, 1995.
- ❑ D. Tapscott, "The Digital Economy: Promise and Peril in the Age of Networked Intelligence," McGraw-Hill, 1995.
- ❑ K. Hafner and M. Lyon, "Where wizards stay up late: The origins of the Internet," Simon and Schuster, 1996.

- ❑ T. Lewis, "The Next 10,000<sub>2</sub> years,"  
IEEE Computer, April/May 1996
- ❑ W. Treese, "The Internet Index,"  
<http://www.openmarket.com/info/internet-index/current.html>
- ❑ R. H'obbes Zakon, "Hobbes' Internet Timeline 1.1,"
- ❑ B.M. Leiner, et al, "A Brief History of the Internet,"  
<http://info.isoc.org/internet-history/>
- ❑ "Internet Statistics: Growth and Usage of the Web and the Internet," <http://www.mit.edu/people/mkgray/net/>

- ❑ B. Laberis, "10 Trends that will reshape your network," Network World, April 29, 1996, available on <http://www.nwfusion.com>
- ❑ "Top 10 Technologies that will fail in the next 10 years," Network World, April 29, 1996, <http://www.nwfusion.com/>
- ❑ H. Meleis, "Toward the Information Network," IEEE Computer, October 1996.

# Current Schedule

6/24/97 Course Overview

6/26/97 Networking Trends and their impact

7/1/97 ATM - Introduction

7/3/97 LAN Emulation and ATM Emulation

7/8/97 IP Switching

7/10/97 Virtual LANs and LAN Switching

**7/15/97 Quiz 1 (No Mbone transmission)**

7/17/97 Gigabit Ethernet

7/22/97 Multimedia: Compression Standards

# Schedule (Cont)

7/24/97 Multimedia over IP: RSVP, RTP

7/29/97 Multimedia over ATM

**7/31/97 Quiz 2 (No Mbone transmission)**

8/5/97 Wireless LANs and WANs

8/7/97 Residential broadband: Cable Modems, xDSL

8/12/97 Mobile Networking: Mobile IP, Wireless ATM

8/14/97 IPng - IP Next Generation (IPng)

**8/19/97 Quiz 3 (No Mbone transmission)**

8/21/97 Graduating Seniors' grades due

# Credits

This MBone transmission was made possible by:

- ❑ Mark Fullmer, OSU/UTS
- ❑ Mike ??, OSU/UTS
- ❑ Bob Dixon, OSU/UTS
- ❑ Mike Douglas, OSU/UTS
- ❑ Jayaraman Iyer, OSU/CIS
- ❑ Sohail Munir, OSU/CIS

# Project Preference

Your Name: \_\_\_\_\_

First Preference: \_\_\_\_\_

Why: \_\_\_\_\_  
.....

Your Name: \_\_\_\_\_

Second Preference: \_\_\_\_\_

Why: \_\_\_\_\_  
.....

Your Name: \_\_\_\_\_

Third Preference: \_\_\_\_\_

Why: \_\_\_\_\_