Networking Trends and Their Impact

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Overview

- 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 = $2^{\text{(year-1986)}}$
  $\Rightarrow$ 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

  $\Rightarrow$ 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

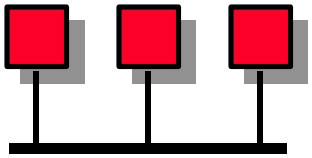
- TCP/IP
- Ethernet
- 10Base-T
- USENET
- Web
- ATM ⇒ LAN and IP Switching

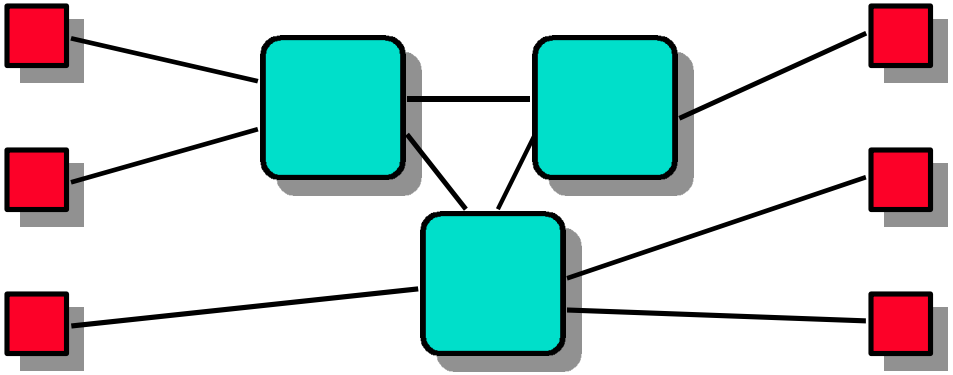
Networking Trends

- Stone age to Networking Age
- Networking is moving from specialists to masses $\Rightarrow$ Usability (plug & play), security
- URL is more important than a company's phone number
- Standards based networking $\Rightarrow$ Reduced cost
- Proprietary to standards
  $\Rightarrow$ On-line services to Internet
  $\Rightarrow$ GroupWare to Intranets
  Intranet = 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 ⇒ 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
  $\Rightarrow$ 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

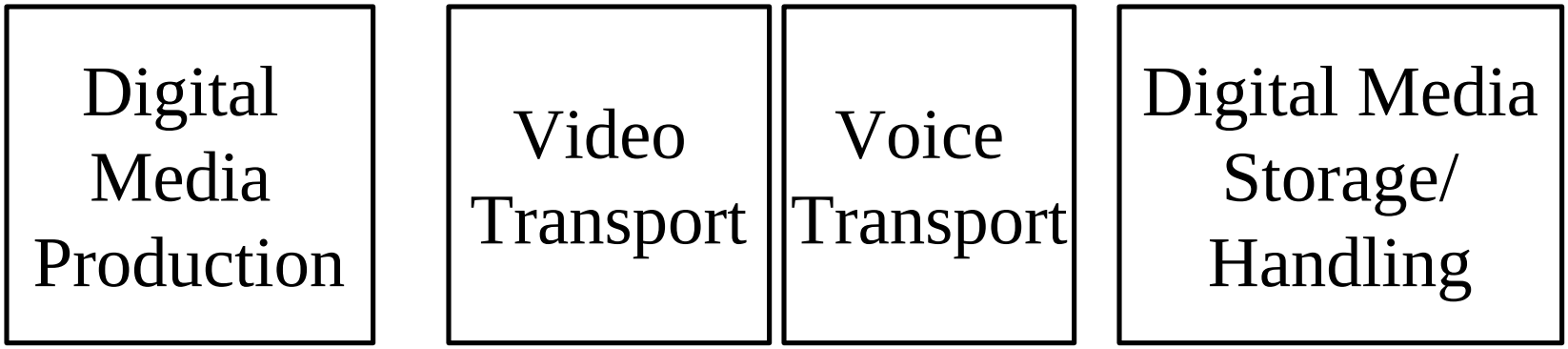
Convergence

Entertainment
Video Games
Publishing
News
Advertising

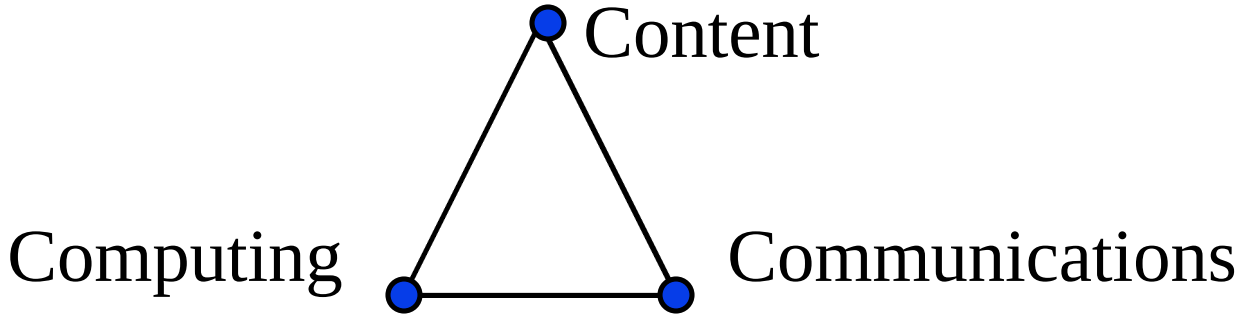
Cable TV

Telephone

Computer



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

Impact on R&D

- Too much growth in one year
  $\Rightarrow$ Can't plan too much into long term
- Long term = 1_2 year or 10_2 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
  $\Rightarrow$ 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
  $\Rightarrow$ 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 ⇒ Information production and dissemination costs are almost zero
  ⇒ 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

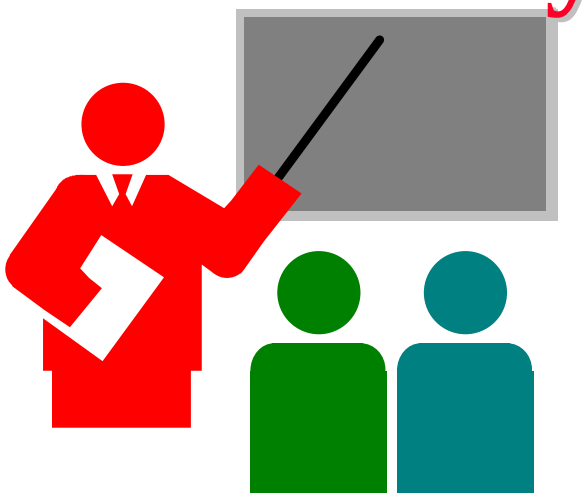
Impact on Commerce

- All companies are at the same intersection
- World-wide competition
  $\Rightarrow$ 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
  $\Rightarrow$ 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 ⇒ Networking Age
- Profusion of Information
- Virtualization, Globalization, Immediacy

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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: _____