Trends in Networking Research

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Technology Trends

Impact on research

Current Hot topics: A sample
Trends

- Communication is more critical than computing
  - Greeting cards contain more computing power than all computers before 1950.
  - Genesis's game has more processing than 1976 Cray supercomputer.
- Internet: 0.3 M hosts in Jan 91 to 9.5 M by Jan 96
  \[\Rightarrow\] More than 5 billion (world population) in 2003
Stone Age to Networking Age

- Microwave ovens, stereo, VCRs, had some effect. But, Stone, iron, …, automotive, electricity, telephone, jet plane,…, networks caused a fundamental change in our life style

- In 1994, 9% of households with PC had Internet link. By 1997, 26%. Soon 98% … like TV and telephone.

- URL is more important than a company's phone number. (54 URLs in first 20 pages of March’97 Good Housekeeping.)

- Email is faster than telegrams
Impact on R&D

- Too much growth in one year
  ⇒ Can't plan too much into long term
- Long term = $1 \frac{1}{2}$ year or $10 \frac{1}{2}$ 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
  ⇒ Collaboration between researchers and developers
  ⇒ Academics need to participate in industry consortia
Garden Path to I-Way

- Plain Old Telephone System (POTS) = 64 kbps = 3 ft garden path
- ISDN = 128 kbps = 6 ft sidewalk
- T1 Links to Businesses = 1.544 Mbps = 72 ft = 4 Lane roadway
- Cable Modem Service to Homes: = 10 Mbps = 470 ft = 26 Lane Driveway
- OC3 = 155 Mbps = 1 Mile wide superhighway
- OC48 = 2.4 Gbps = 16 Mile wide superhighway
Life Cycles of Technologies

Number of Problems Solved

Research  Productization  Time

You are here
New Challenges

- Networking is moving from specialists to masses ⇒ Usability (plug & play), security
- Exponential growth in number of users + Exponential growth in bandwidth per user ⇒ Traffic management,
- Standards based networking for reduced cost ⇒ Important to participate in standardization forums
  ATM Forum, Frame Relay Forum, …
  Internet Engineering Task Force (IETF),
  Institute of Electrical and Electronic Engineers (IEEE)
  International Telecommunications Union (ITU), …
Recent Trends

- Copper is still in.
  - 6-27 Mbps on phone wire.
  - Fiber is being postponed.
- Shared LANs to Switched LANs
- Routing to Switching. Distinction is disappearing
- LANs and PBX's to Integrated LANs
- Bandwidth requirements are doubling every 4 months
Hot Topics: A Sample

- Terabit networking: Wavelength division multiplexing, all-optical switching
- High-speed access from home
  ⇒ Robust and high-bandwidth encoding techniques
- High-speed Wireless = More than 10 bit/Hz
  28.8 kbps on 30 kHz cellular ⇒ 1 bit/Hz
- Traffic management, quality of service, multicasting:
  - Ethernet LANs, IP networks, ATM Networks
- Mobility
- Large network management Issues.
Hot Topics (Cont)

- Information Glut ⇒ Intelligent agents for searching, digesting, summarizing information
- Scalable Voice/Video compression:
  2400 bps to 1.5 Mbps video, 8 kbps voice
- Electronic commerce ⇒ Security, privacy, cybercash
- Active Networks ⇒ A "program" in place of addresses
Networking is the key to productivity

It is impacting all aspects of life ⇒ Networking Age

Profusion of Information

Collaboration between researchers and developers

Usability, security, traffic management
References

- All our ATM Forum contributions and papers are available on-line at
  [http://www.cis.ohio-state.edu/~jain/](http://www.cis.ohio-state.edu/~jain/)
  Specially see “Recent Hot Papers”
  and “References on Recent Advances in Networking”

