Networking Trends

Future

White House Astrologer

Joan Quigly

All I want you to tell me is what will be the networking technology in the year 1998.

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- Networking Trends
- Impact of Networking
- Current Research Topics

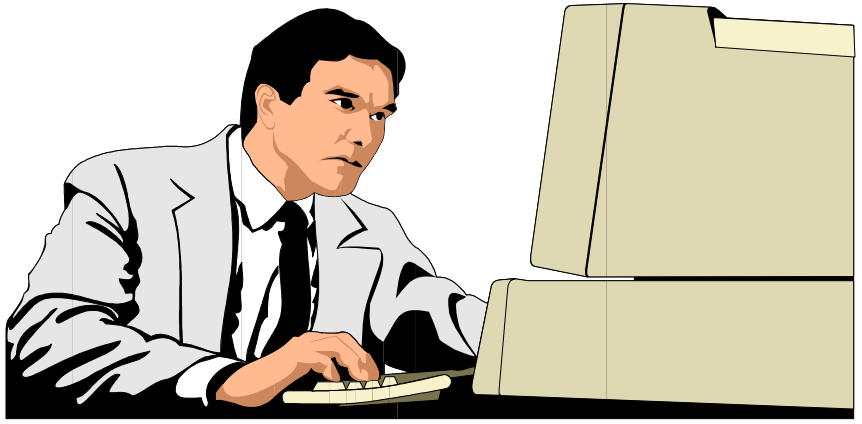
Trends

- 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

Social Impact of Networking



- No need to get out for
  - Office
  - Shopping
  - Entertainment
  - Education
- Virtual Schools
- Virtual Cash
- Virtual Workplace

(55 Million US workers will work remotely by 2000)

Cave Persons of 2050

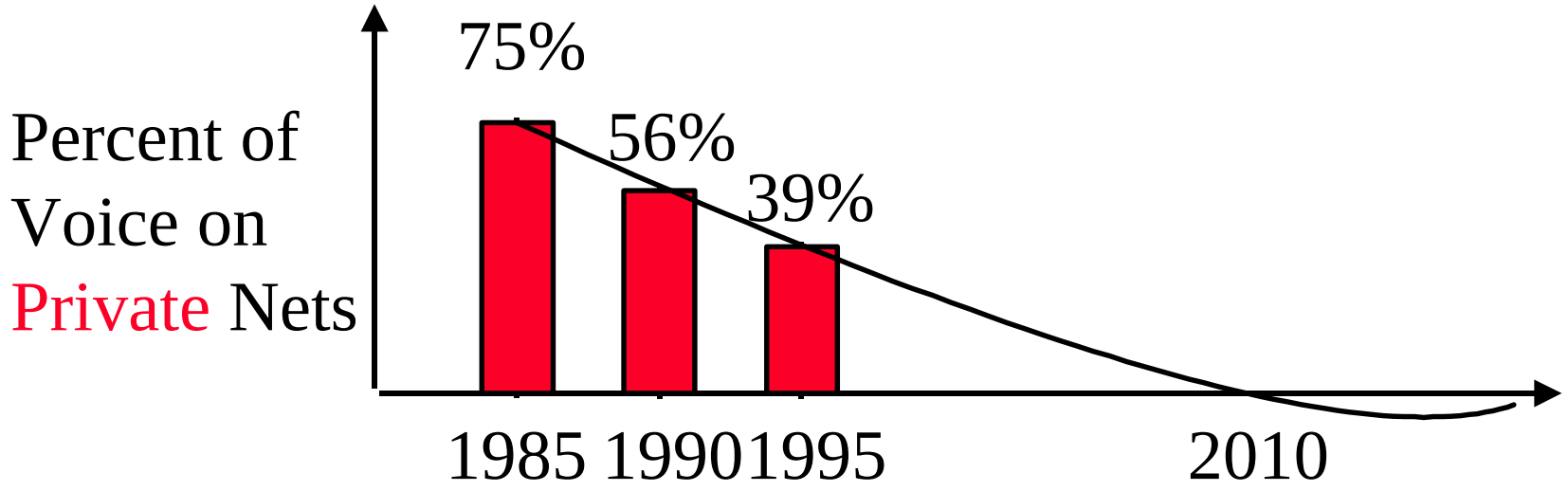
Garden Path to I-Way

- 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

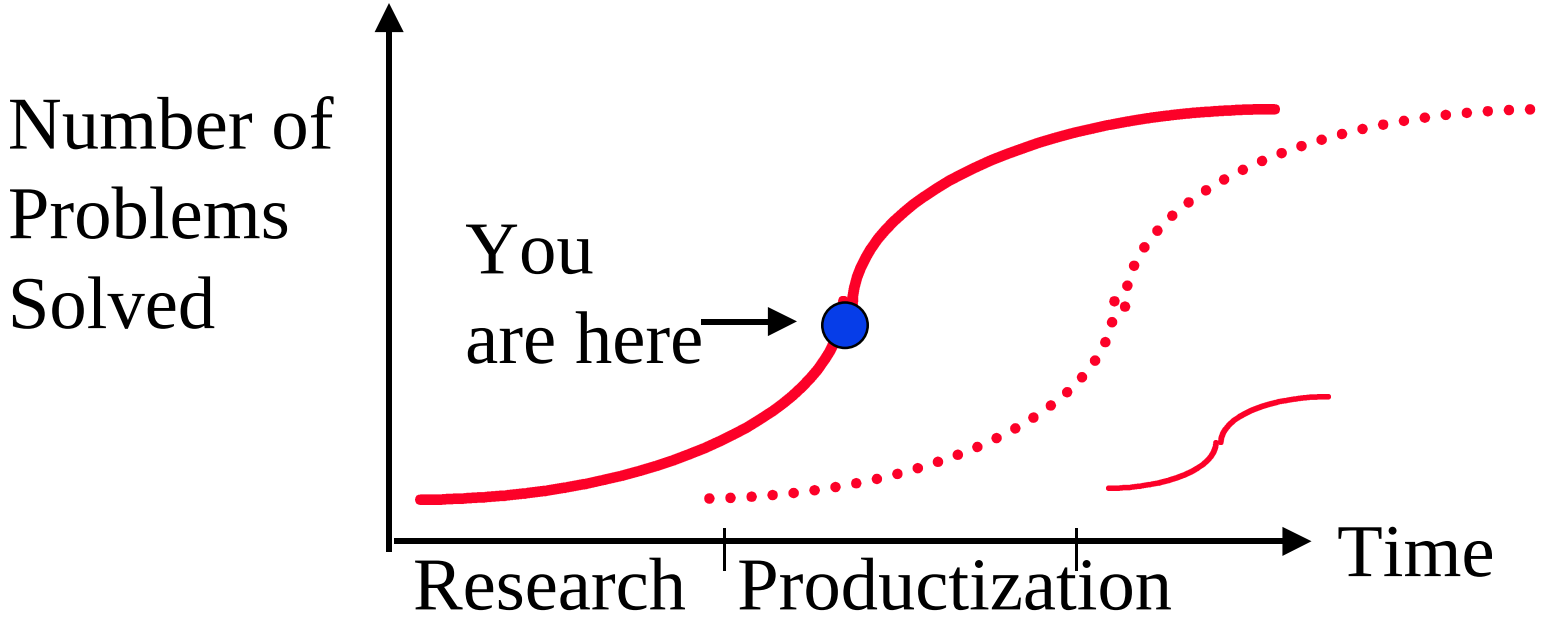
Trends in Applications

- Little Voice
- AT&T: 125 to 130 M calls/day @ 5 min/call
  64 kbps/call ⇒ 28.8 Gbps = 1/1000 of one fiber
- 200 Million X 24 hr/day X 64 kbps = 12.8 Tbps

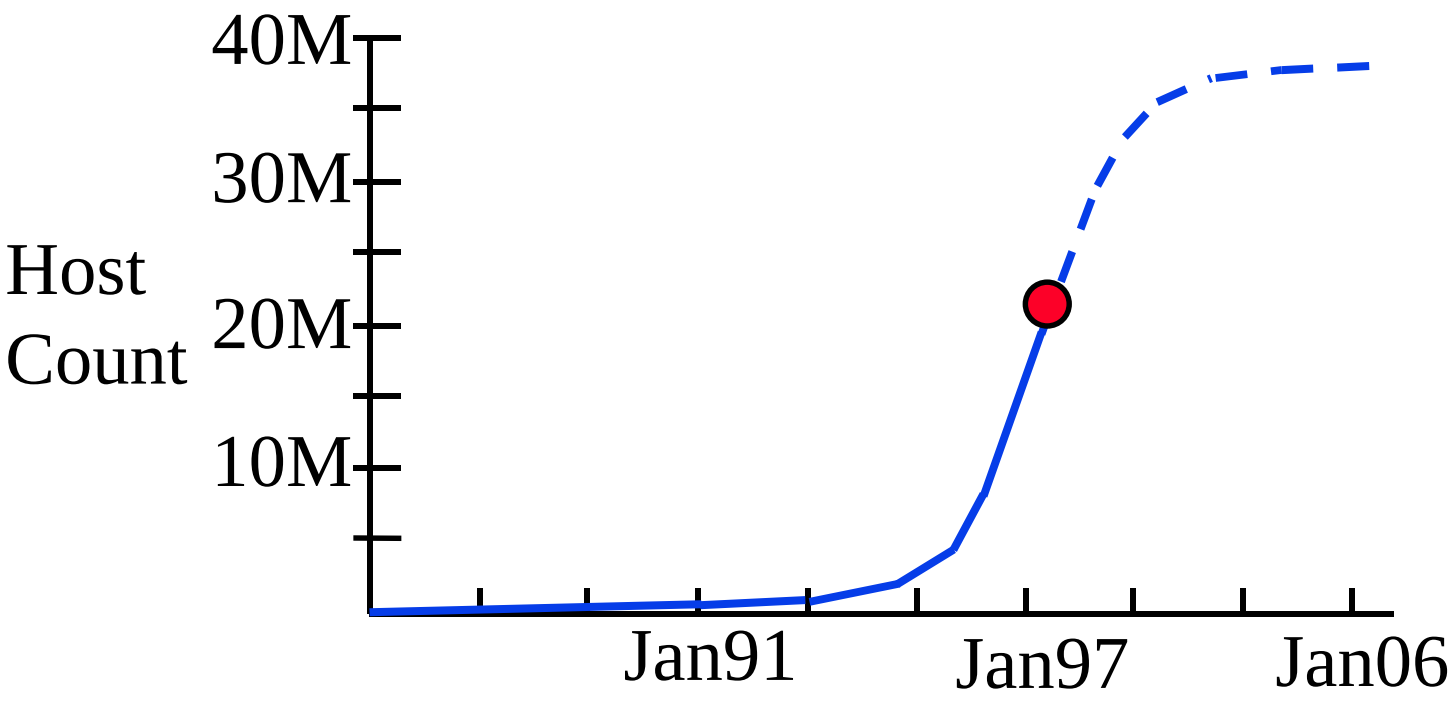


- Ref: IEEE Spectrum, August 1992, p 19.

Life Cycles of Technologies

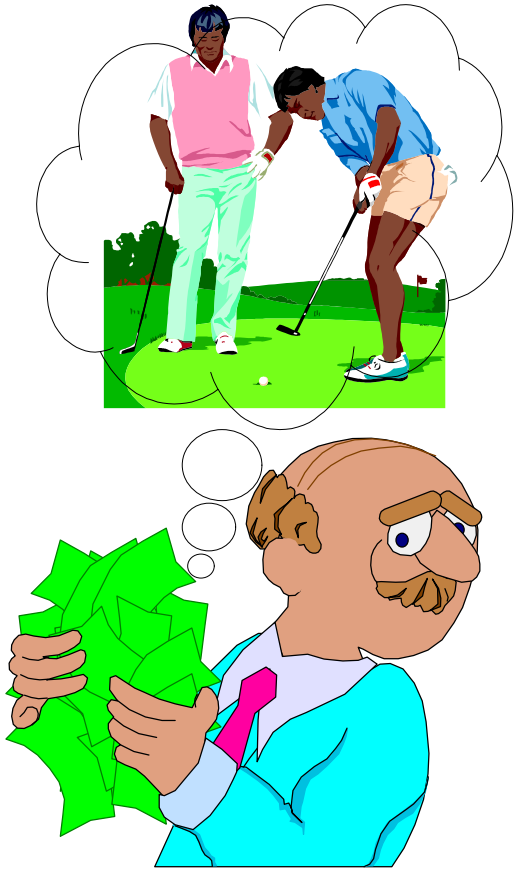


Internet Technology



- **New Challenges**: Exponential growth in number of users. Exponential growth in bandwidth per user. Traffic management, Security, Usability, ...

High Technology ≠ More vacation



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
  $\Rightarrow$ Collaboration between researchers and developers
  $\Rightarrow$ Academics need to participate in industry consortia

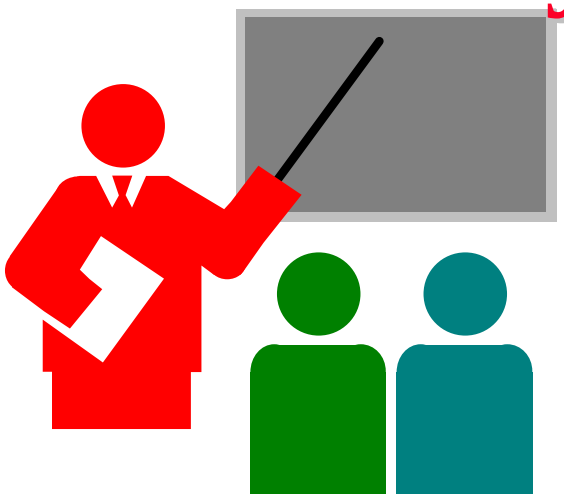
Impact on Education

- 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, …
- 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

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), …

Summary



- 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

Key References

- See http://www.cis.ohio-state.edu/~jain/ref_trnd.htm
- "The Next 50 years," Special issue of Communications of the ACM, Feb 1997.
- D. Tapscott, "The Digital Economy: Promise and Peril in the Age of Networked Intelligence," McGraw-Hill, 1995.
- T. Lewis, "The Next $10,000_2$ years," IEEE Computer, April/May 1996