MegaATM: ATM Technology for Gigabit Networking

Raj Jain

Raj Jain is now at
Washington University in Saint Louis
Jain@cse.wustl.edu
http://www.cse.wustl.edu/~jain/
Overview

- Requirements for Success
- Economy of Scale
- High Performance
- Scalability
- MegaATM Technology
Networking: Failures vs Successes

- 1980: Broadband (vs baseband)
- 1981: PBX (vs Ethernet)
- 1984: ISDN (vs Modems)
- 1986: MAP/TOP (vs Ethernet)
- 1988: OSI (vs TCP/IP)
- 1991: DQDB
- 1992: XTP (vs TCP)
Requirements for Success

- Low Cost
- High Performance
- Killer Applications
- Timely completion
- Manageability
- Interoperability
- Coexistence with legacy LANs
  
  Existing infrastructure is more important than new technology
Challenge: Economy of Scale

- Technology is far ahead of the applications. Invention is becoming the mother of necessity. We have high speed fibers, but not enough video traffic.

- Low-cost is the primary motivator. Not necessity. ⇒ Buyer's market (Like $99 airline tickets to Bahamas.) Why? vs Why not?

- Ten 100-MIPS computer are cheaper than one 1000-MIPS computer ⇒ Parallel computing, not supercomputing

- Ethernet was and still is cheaper than 10 one-Mbps links.

- No FDDI if it is 10 times as expensive as Ethernet.

- Q: Given ATM or 100 Mbps Ethernet at the same cost, which network will you buy?
  A: Ethernet. Proven Technology.
Challenge: Performance

- Application Designers
  - Video Coding, FTP
- Protocol Architects/Implementers
  - TCP/IP, UDP
- O/S Architects/Implementers
  - UNIX, DOS
- CPU, Memory, Disk Designers
  - Pentium, Alpha
- LAN Interface Designers
  - Adapters
- Media Access (LAN) Architects
  - FDDI, ATM
- Optic Device Designers
  - Fibers, Lasers

- Faster link ≠ Faster applications
- Need to consider trends of all layers
Challenge: Scalability in Speed

- Queueing Theory:
  - Mean(response time) $\propto$ cell-time
  - Var(resp time) $\propto$ cell-time$^2$ + Var(cell time)
- Smaller cell $\Rightarrow$ Lower delay jitter, also lower efficiency
- Delay jitter= fn(cell-time) not fn(cell-size)
- At higher speeds: Video still recorded at 30 frames/sec
  $\Rightarrow$ No change in time jitter required
  $\Rightarrow$ No change in cell time as in SONET
  6 ms = 48 bytes at 64 kbps but 900 kB at 1.2 Gbps
  HDTV Frame = 20 Mb = 50,000 Cells
- Switch cost $\propto$ cell rate $\propto$ 1/(Cell size)
  2 Gbps = 3 M cells/s $\Rightarrow$ 3n MIPS
The MegaATM Technology

- Keep all good aspects of the ATM technology
  - Constant Cell Size
  - VP/VC Labels (instead of addresses)
  - Switching
- Cell Size $\propto$ Speed
  Cell time = Constant at all speeds (As in SONET)
- One-way delay $\geq$ Cell time $\times$ Number of hops
  Cell time $\approx$ Hundred $\mu$s
- Cell Time = 125 $\mu$s $\Rightarrow$ Cell Size = 1/64 MByte = 1/8 Mb
  $\Rightarrow$ MegaATM
- At one Gigabit: 8000 Cells/second (instead of ??)
- HDTV frame = 20 Mb = 160 cells
What Do We Plan To Do?

- Multiplexing: Multiple lower speed cells to one higher speed cell
- Optimal size
- Effect on the message delay variation (instead of cell delay variation)
- Complete check of ATM technology for gigabit rate
- Modify current switch design
- Interfacing ATM networks to MegaATM networks
Summary

- High speed networking iff economy of scale
- Delay requirements remain in ms even at gigabit speeds
- Nano-second cell time $\Rightarrow$ increased cost with no perceptable difference to humans
- 125 $\mu$s cell $\Rightarrow$ 1/64 MByte cells at 1 Gbps $\Rightarrow$ MegaATM
Thank You!