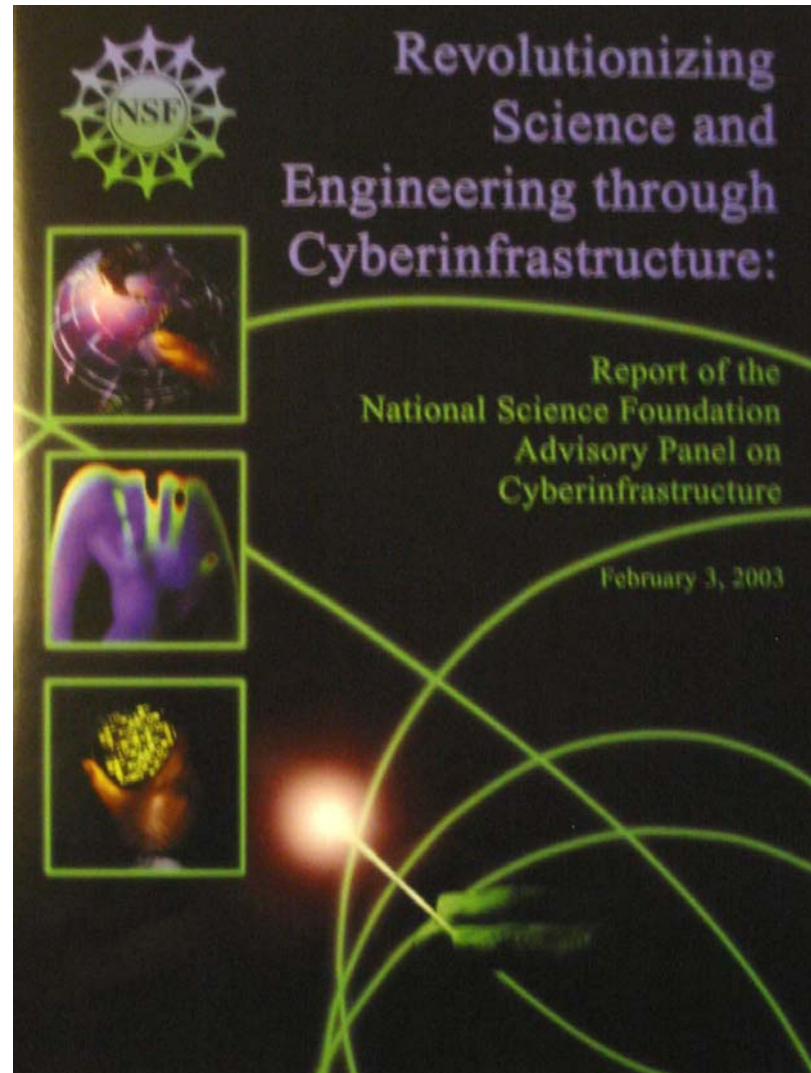
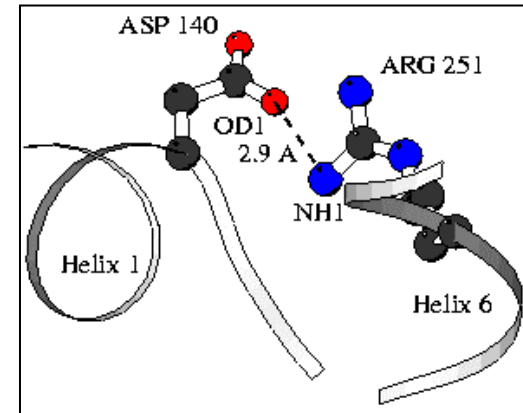
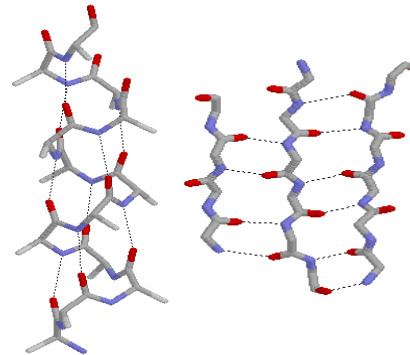
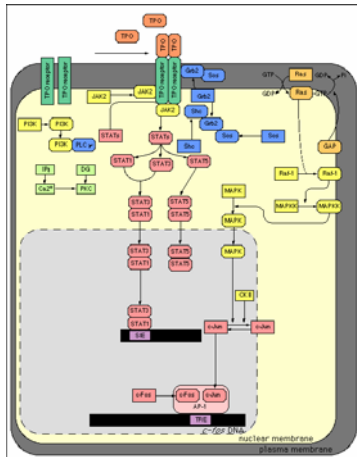


Encounter at NSF, Spring 2003



Cyberinfrastructure for ~~Pharmaceutical~~ R&D



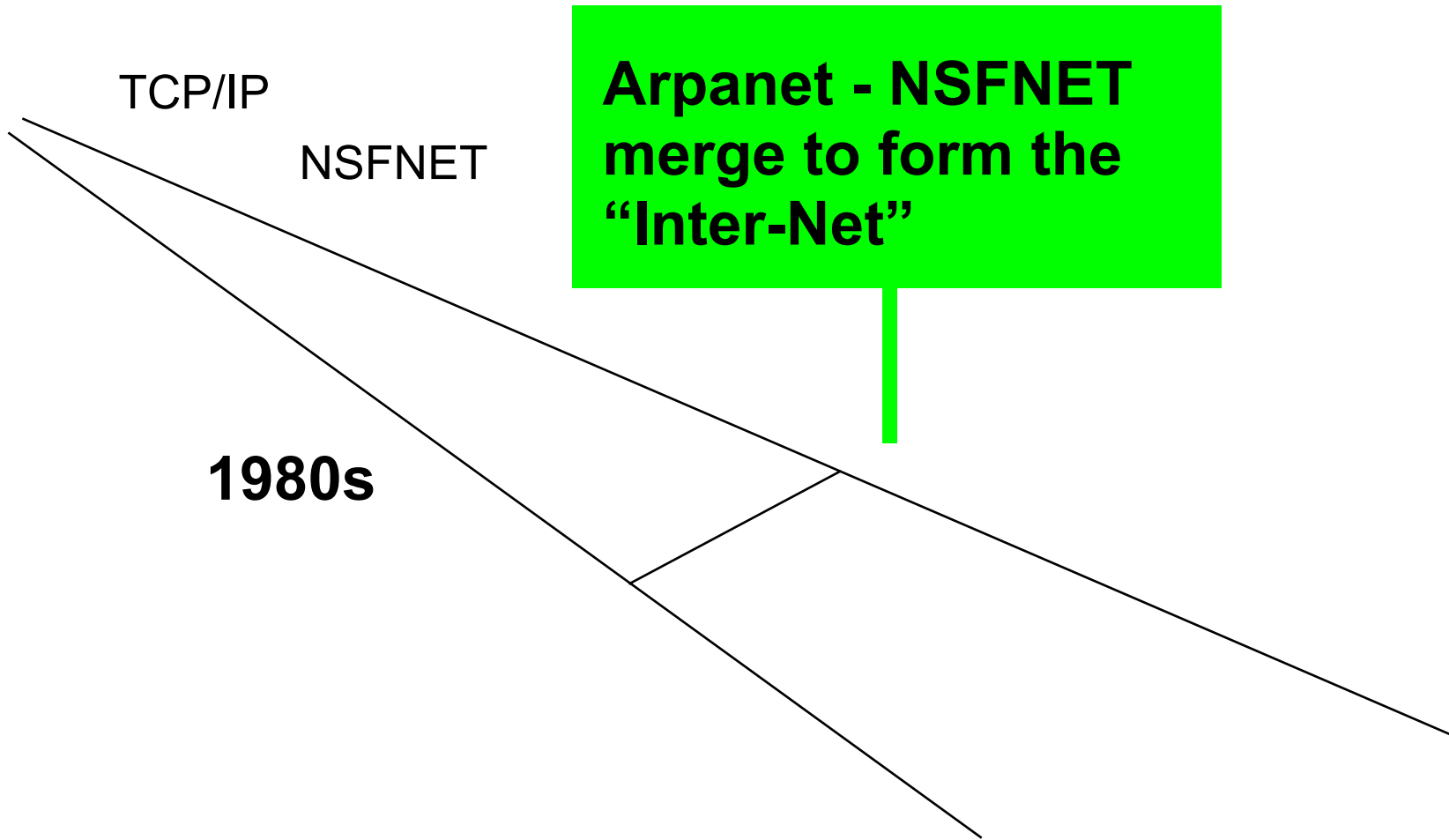
Cyberinfrastructure for the National R&D Community

Sangtae Kim, PhD
Purdue University (on leave)
National Science Foundation (2004-06)

skim@nsf.gov

Outline

- The Past (or how NSF changed the world ...)
- The Present (from compute-centric to cyberinfrastructure)
- The Future (the network of things ...)



TCP/IP

NSFNET

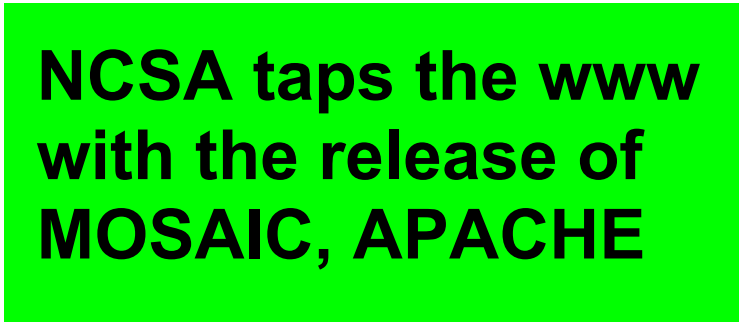
**Arpanet - NSFNET
merge to form the
"Inter-Net"**

1980s

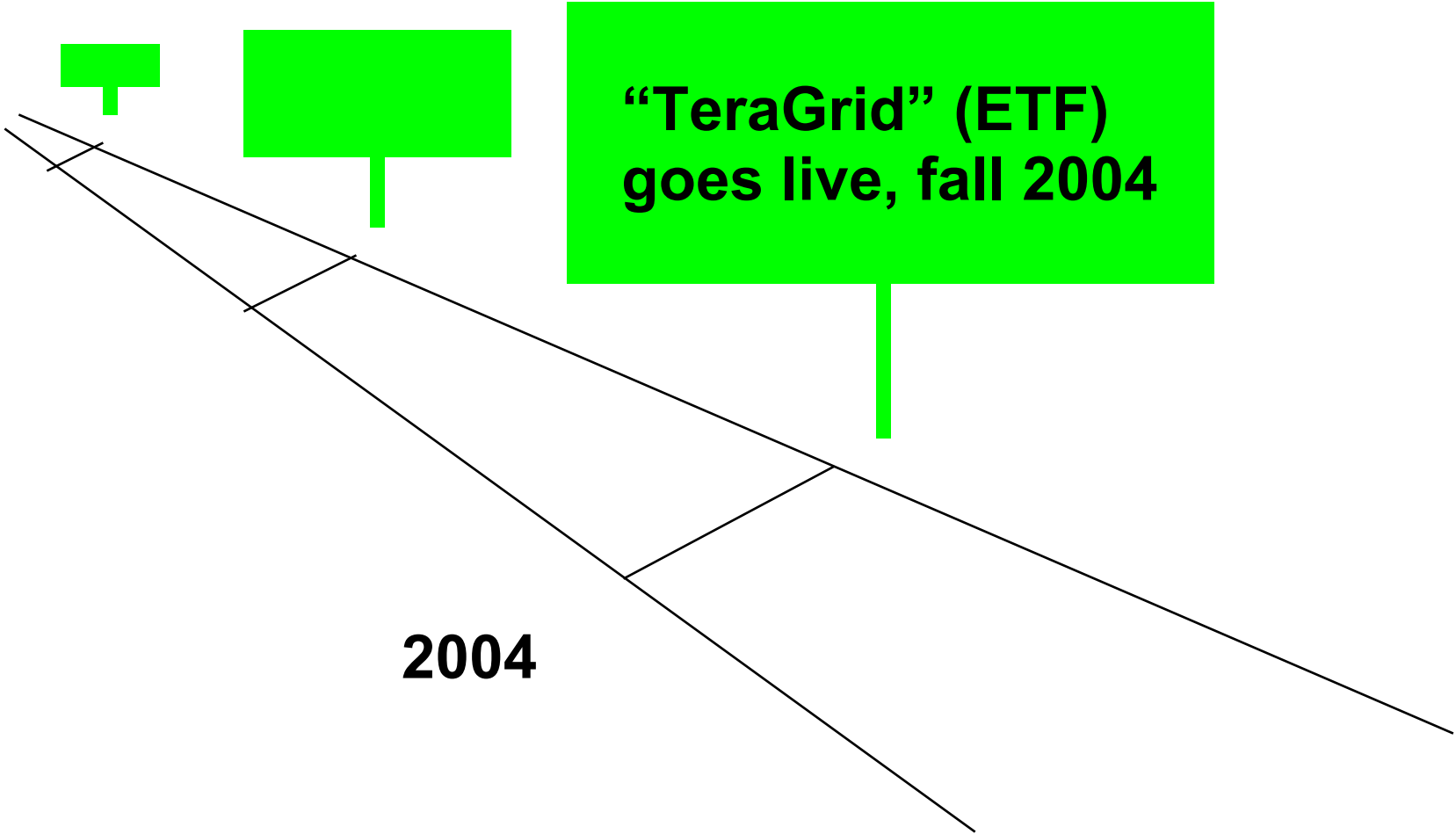
"NSFNET"



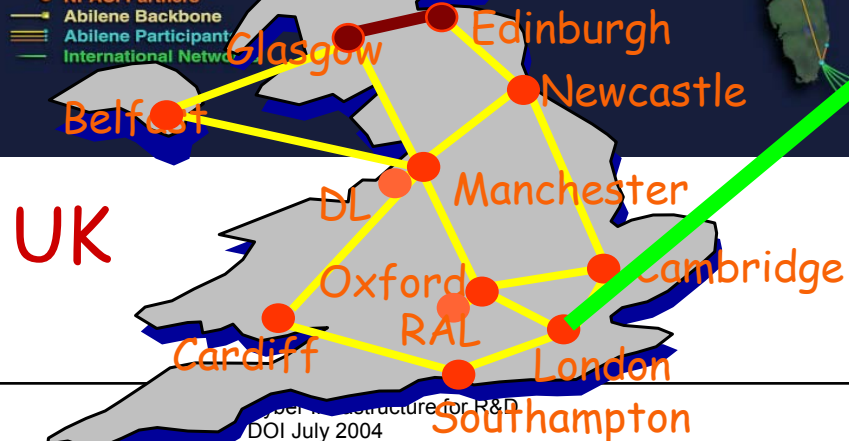
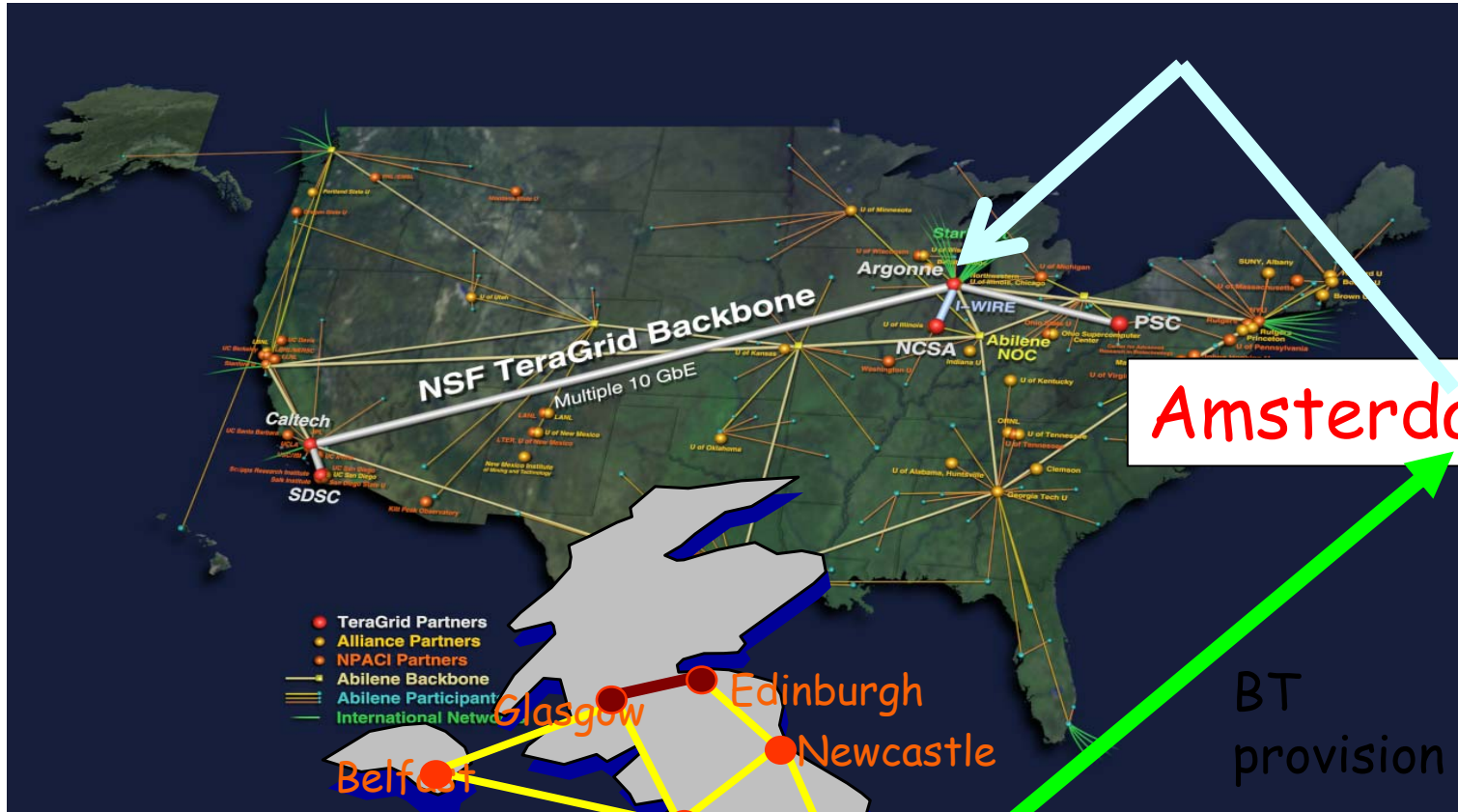
**NCSA taps the www
with the release of
MOSAIC, APACHE**



1990s



Network of Computers “the Grid”



NCSA Scientific Computing Environment - 32 TF



Tungsten

Dell IA-32 Linux Cluster

16.4 TF Peak + 1.2TF w/140 TB storage



TeraGrid - Mercury

IBM Itanium2 Linux Cluster

10.6 TF, 230 TB storage



Copper

IBM Power4 SMP Cluster

2 TF



Titan

IBM Itanium Linux Cluster

1 TF



Platinum

IBM Pentium III Linux Cluster

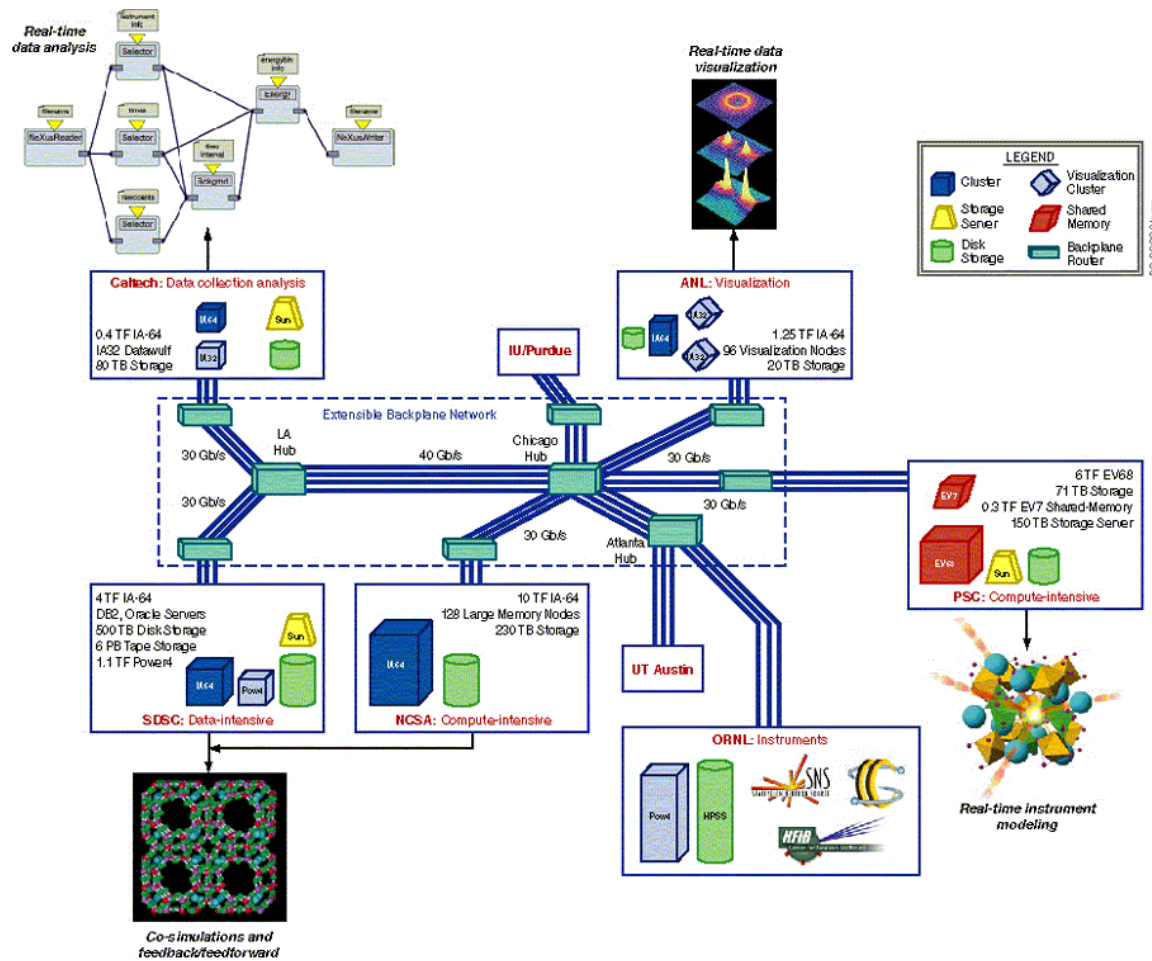
1 TF



UniTree Archive

ADIC Tape Library

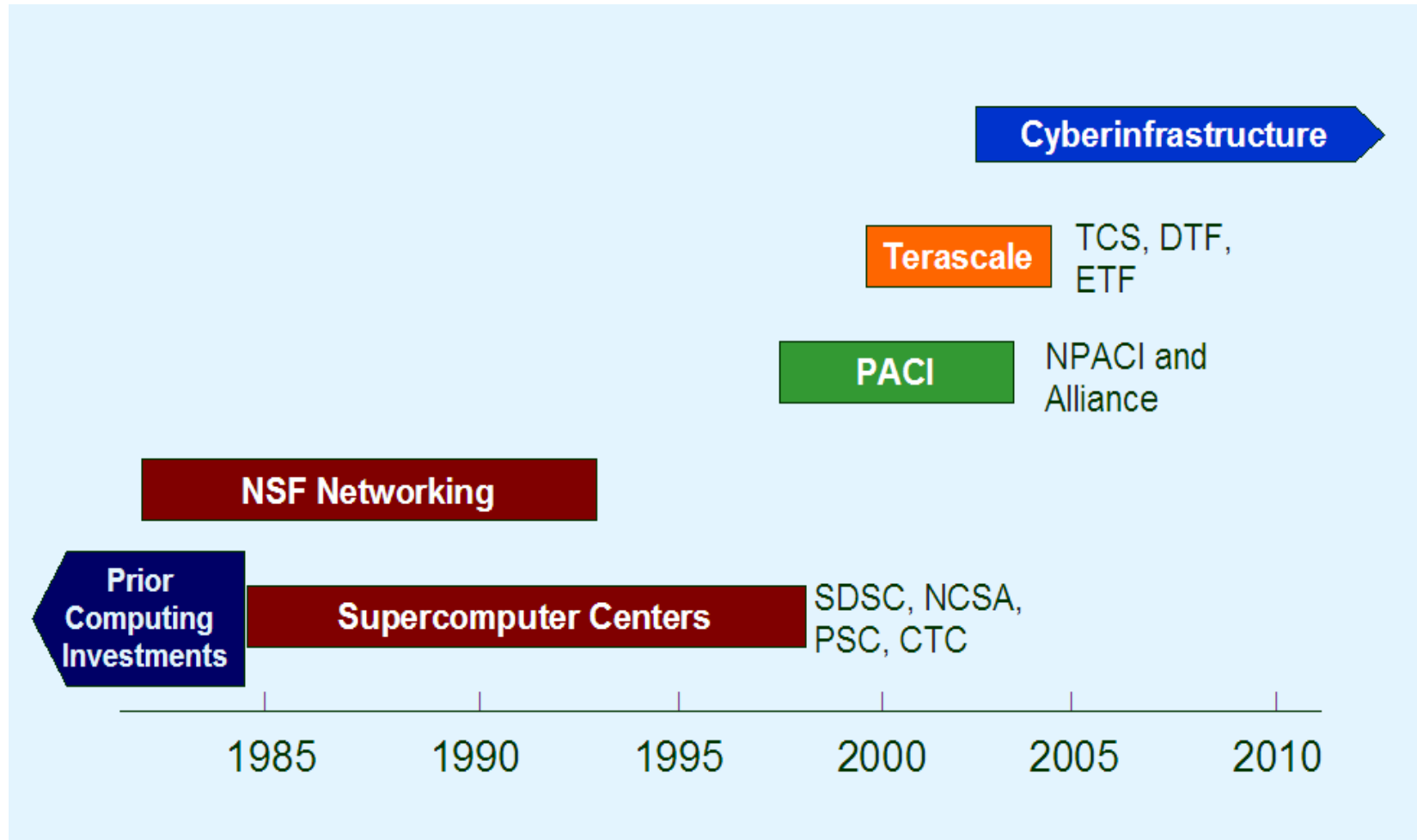
Extensible Terascale Facility (ETF)



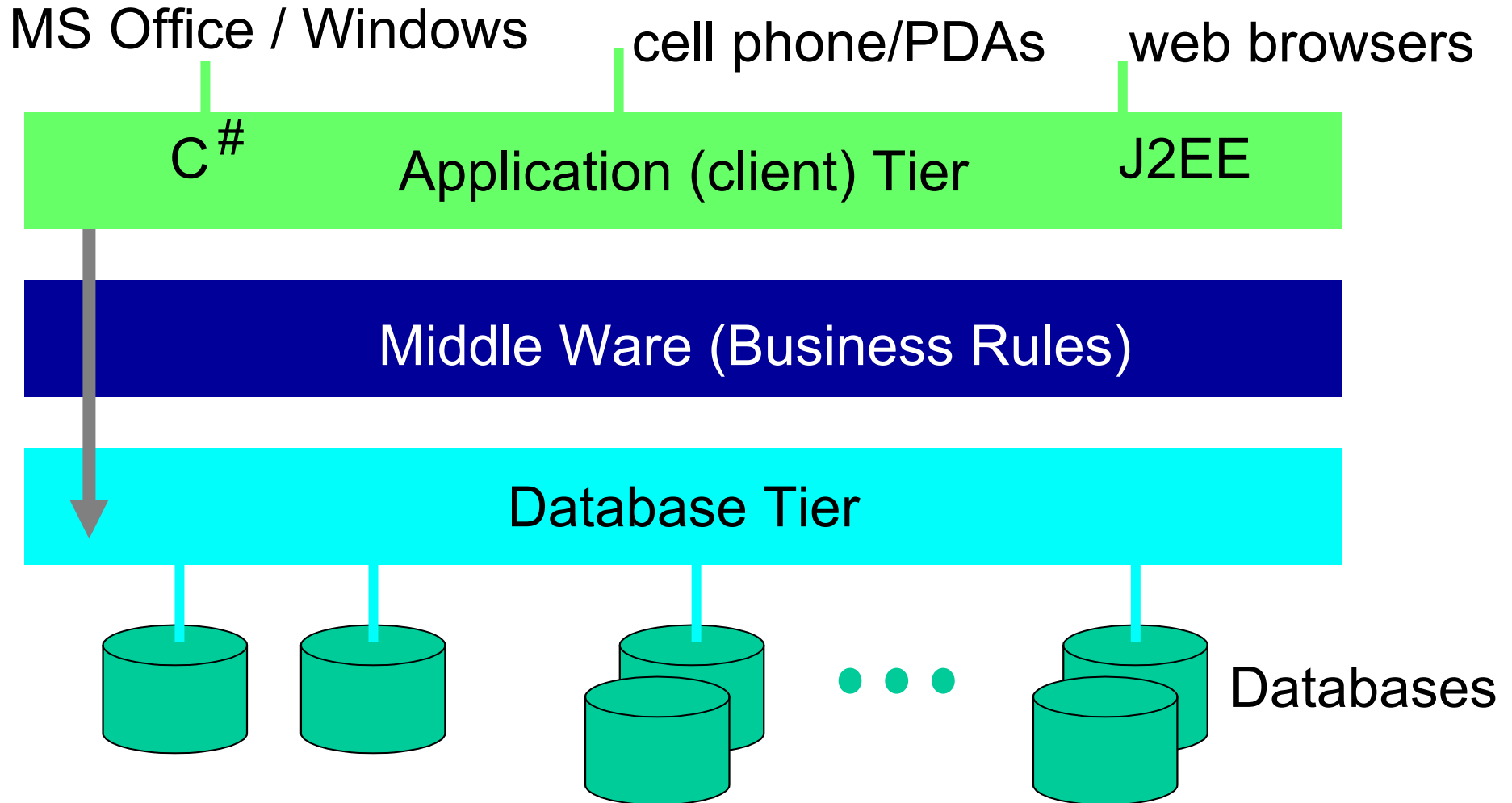
Observations on the Present

- **A golden age of computing, but ...**
- **Scalability no longer a free ride on Moore's Law**
 - Contrast this with recent past: 32 CPU-hrs in 1997, takes 2 hrs in 2003
- **Shift from compute-centric to balance with data**
 - Emerging awareness of the importance of middleware

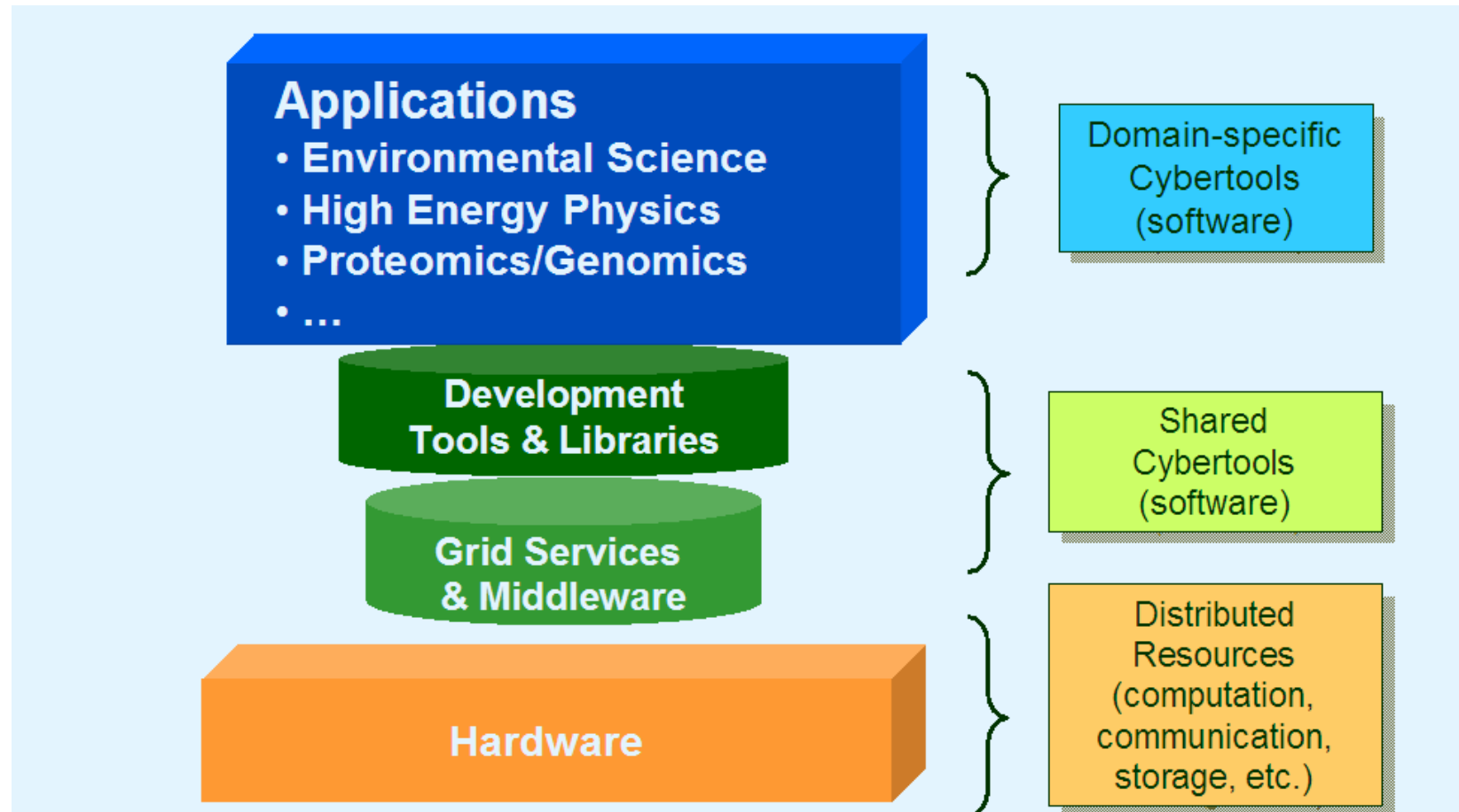
Timeline: Past, Present and Future



Pharmaceutical Informatics Architecture

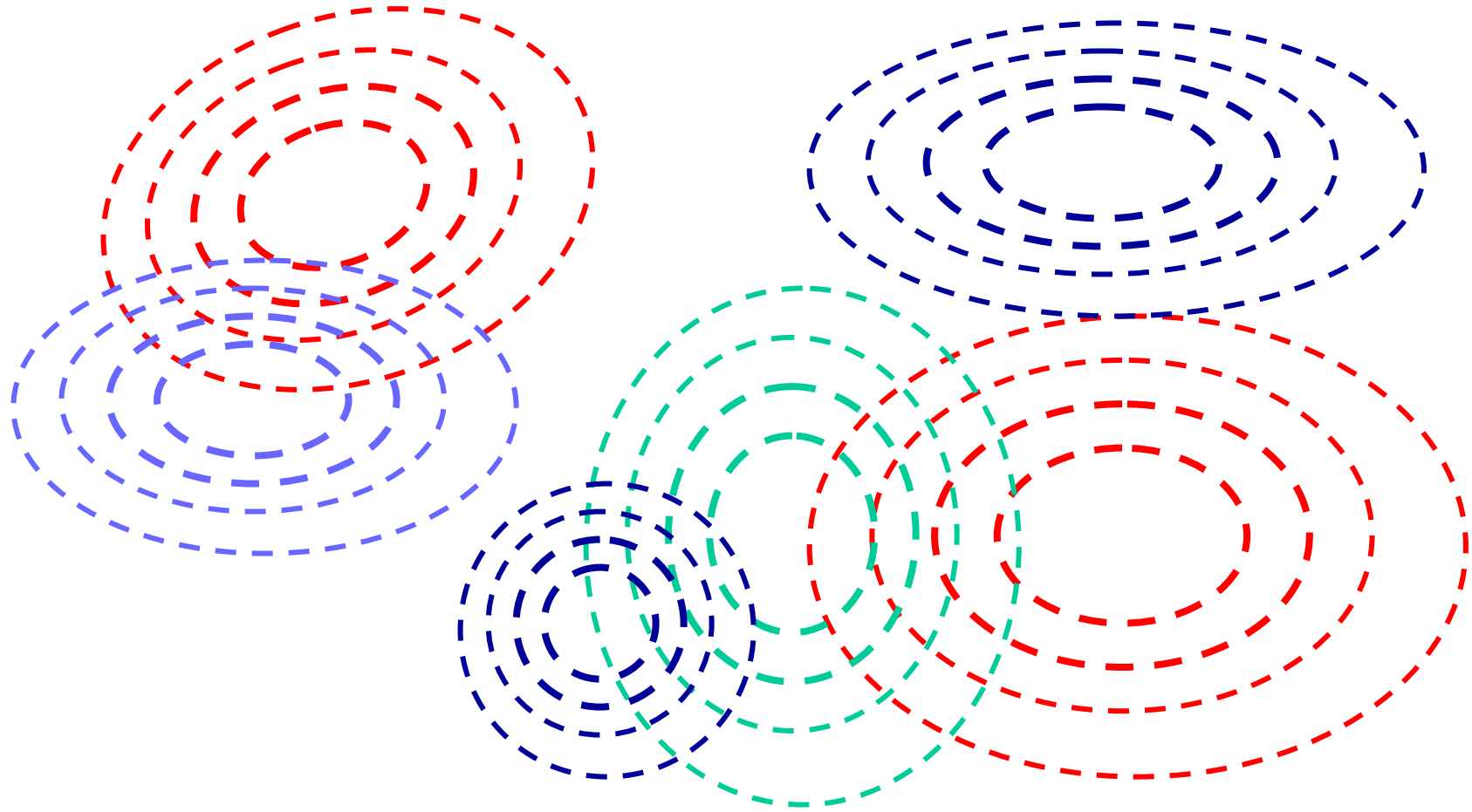


NSF Middleware Initiative



Cyberinfrastructure: SensorNets

The Network of Things



Observations for the Future

- **The pace of change will accelerate**
 - (incredible - in light of changes over the past decade, but true)
- **“IT Does Not Matter”**
 - but middleware does ... and architecture does – watch the response to Wal-Mart initiated RFID technology disruption (dispersion of the pack)
- **Look for a new network paradigm: wireless, RFID ...**
 - Pending revolution in manufacturing and supply chain