



NETWORLD INTEROP 2001

AN INTEROP[™] EVENT

Strategic Interop Key Emerging Technology: Networked Storage

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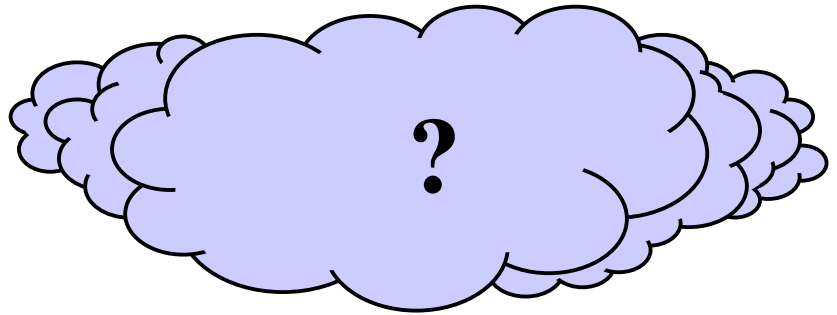
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Networked Storage

- **Networked Storage Environment**
- **Information Flow & Networks**
- **NAS & SAN**
- **Myths**
- **Physical Transport Technologies**
- **Futures**



Environment

- **Information processing shifts over time**
 - Mainframe-based centralized computing
 - Distributed departmental computing
 - Desktop computing
 - Client/Server computing
- **Computing paradigm shifts**
 - Processors are faster
 - Processing power cost less
- **Storage shifts**
 - Greater storage capacity at less cost
 - Storage device speed has increased
 - More information is online

Storage

- **Enterprise applications growing**
 - Enterprise Resource Planning, Data Warehouse
 - Electronic Commerce, B2B
- **Data is distributed across many systems and servers**
 - Data is privately held, not accessible to other systems
 - Distributed data management is difficult
 - Backup is time consuming and difficult
 - Storage space is a fixed allocation

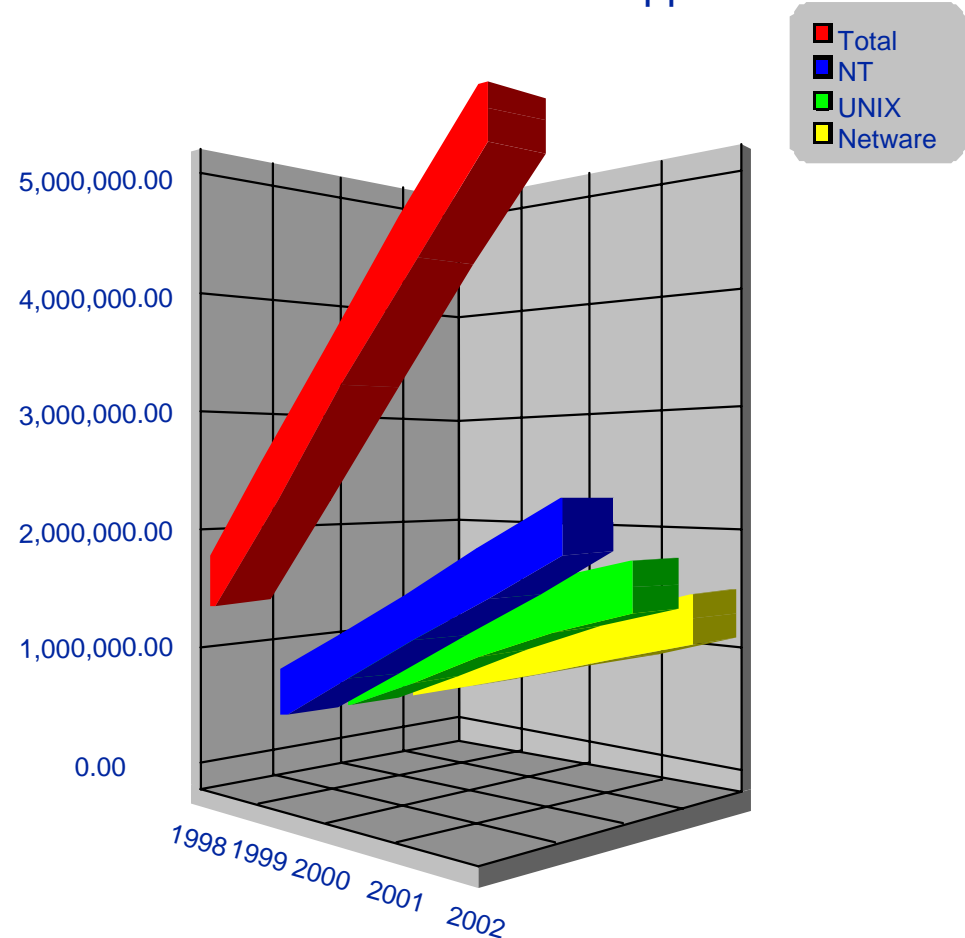
I/O Directions

- **Faster I/O interfaces are needed to keep pace with systems and devices**
- **Longer distances are needed**
 - Data consolidation for more efficient utilization and management
 - Remote copy and mirroring
 - Remote disaster recovery and backup
- **More connectivity required**
 - More systems access consolidated data
 - Larger I/O subsystems provide capacity
- **High availability is a must**

Constant Server Growth

- **Heterogeneous systems**
 - Operating systems
 - Distributed applications and databases
 - Shrinking management windows

Worldwide Servers Shipped

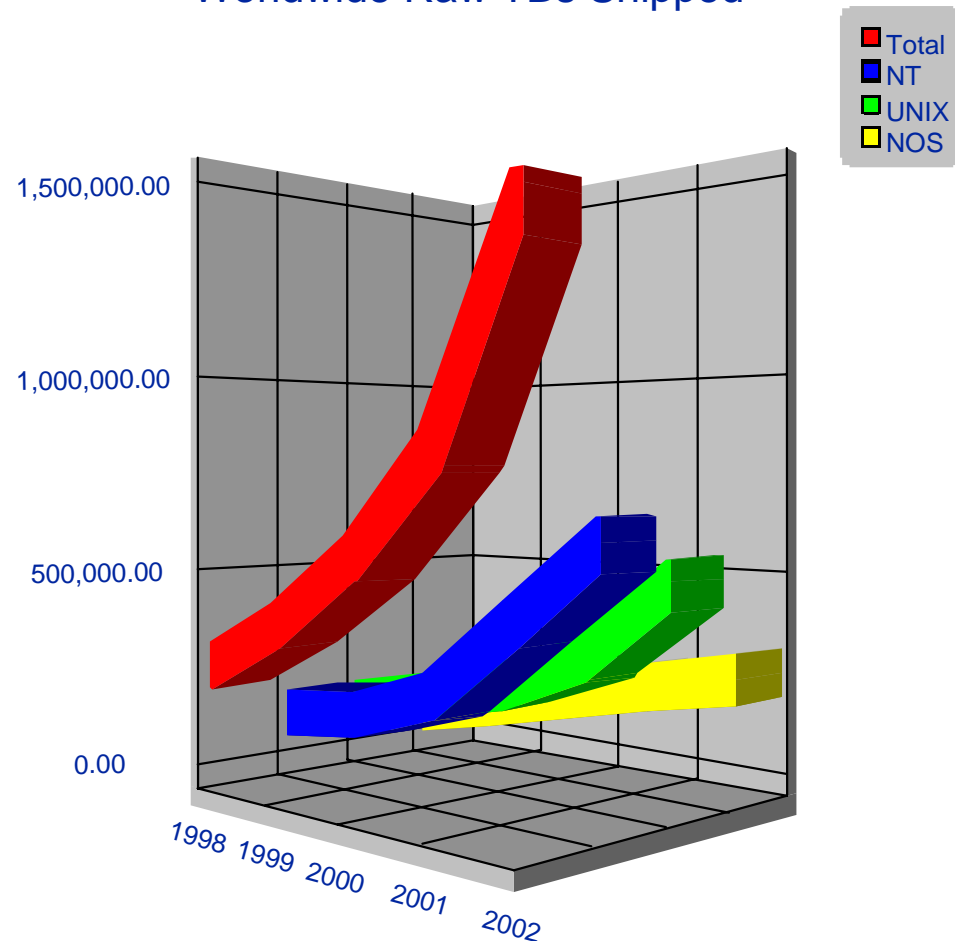


Constant Storage Growth

Worldwide Raw TBs Shipped

- **Storage**

- Increasing amounts of data
- Worldwide operations and Internet and Intranet connectivity



Enterprise Issues & Concerns

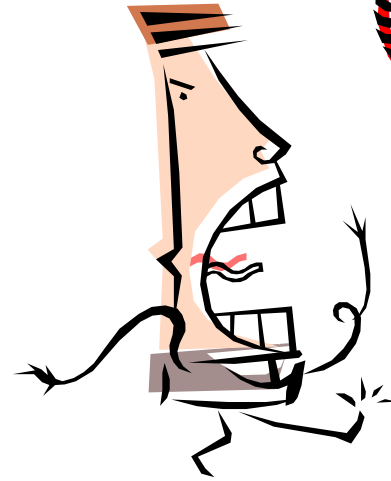
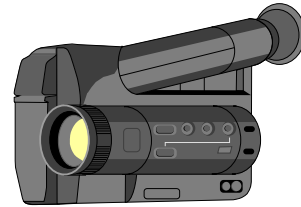
- **Information access and availability**
- **Impacts of downtime costs**
- **24x7 operations limit scheduled downtime**
- **Distributed management of servers and storage**
- **Heterogeneous system-storage needs**
- **Need to share data with multiple servers and storage**
- **Backup and recovery**
- **Reduce and eliminate wasted information assets**

Information Flow

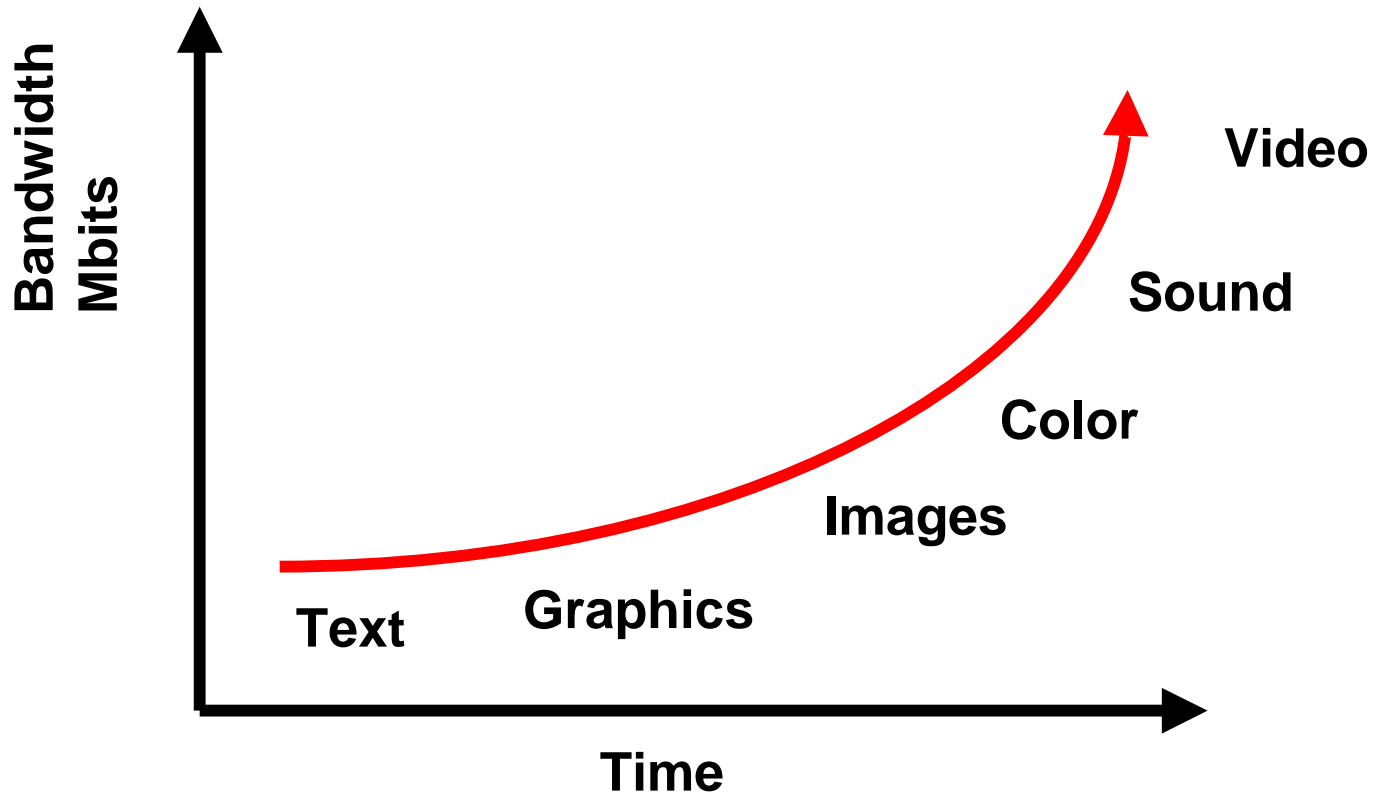
- **Information flow between systems**
 - Where its needed
 - When its needed
 - In the form needed
 - At the right price
- **Computer systems represent information using stored data**
 - Files, Databases
 - » Email, Web Pages, Programs
 - » Text, Images, Sounds, Videos
- **Storage systems move information using**
 - Commands, Data, Status

The Requirements of Networking

- **Why Networking?**
 - Facilitate information sharing
- **Move information from SOURCE system to a DESTINATION system**
- **Demands are growing!**
 - More, Faster, Further

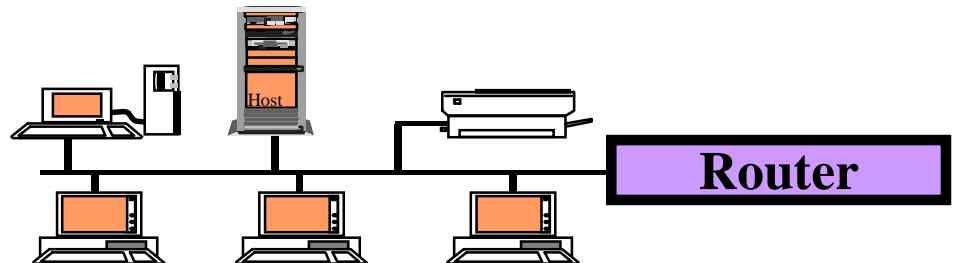


Increased Capacity Requirements



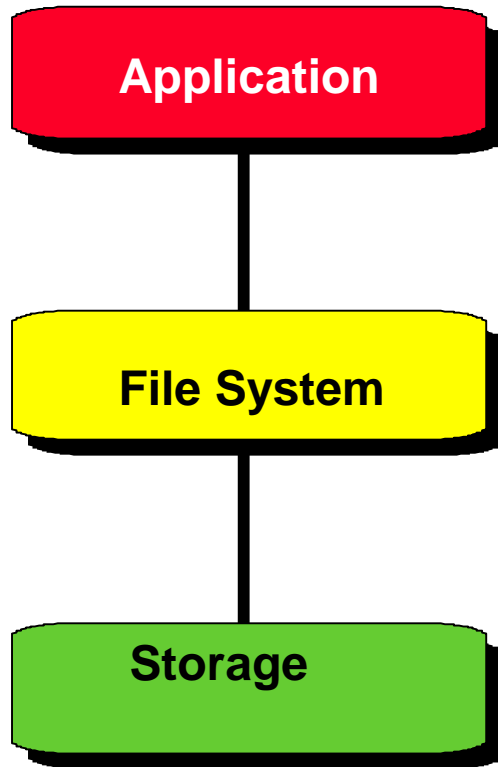
What is a Network?

- **A group of connected systems - at least two!**
 - Host, Node, Computer, Server, Workstation, Printer, Router, Storage Device
- **A connection medium or the “appearance of” a connection medium**
 - Unshielded Twisted Pair (UTP), Coaxial Cable, Multi-Mode Fiber, Leased Line
- **A connection protocol or method**
 - Ethernet, Token Ring, PPP, Frame Relay, ATM, Fibre Channel

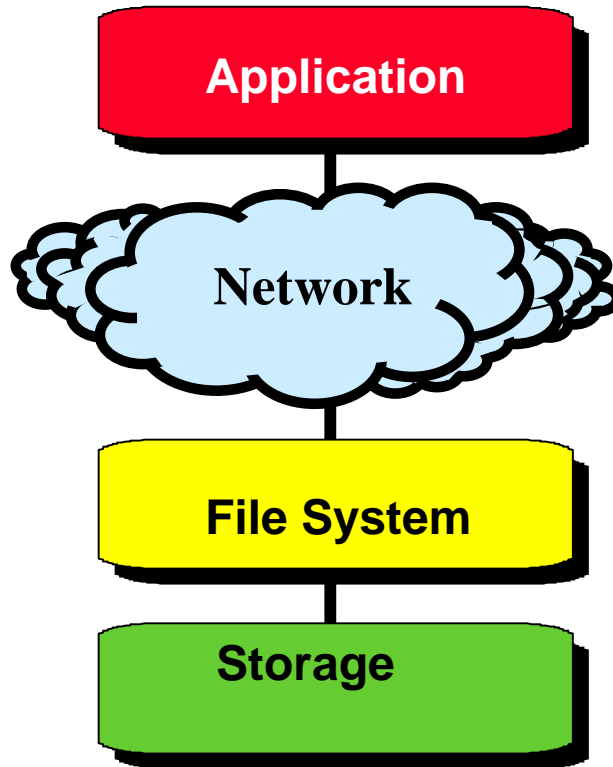


DAS, NAS, SAN

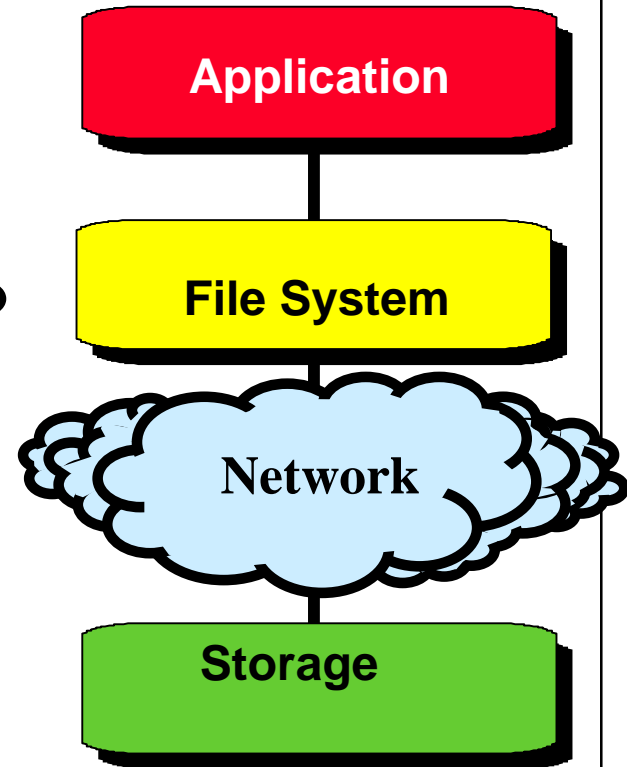
Direct-Attached Storage (DAS)



Network-Attached Storage (NAS)



Storage Area Network (SAN)



Wires & Protocols

Wires

Protocols

Block

File

Direct

Direct transfer to memory

Local Attached

SAN Attached

Network

TCP/IP

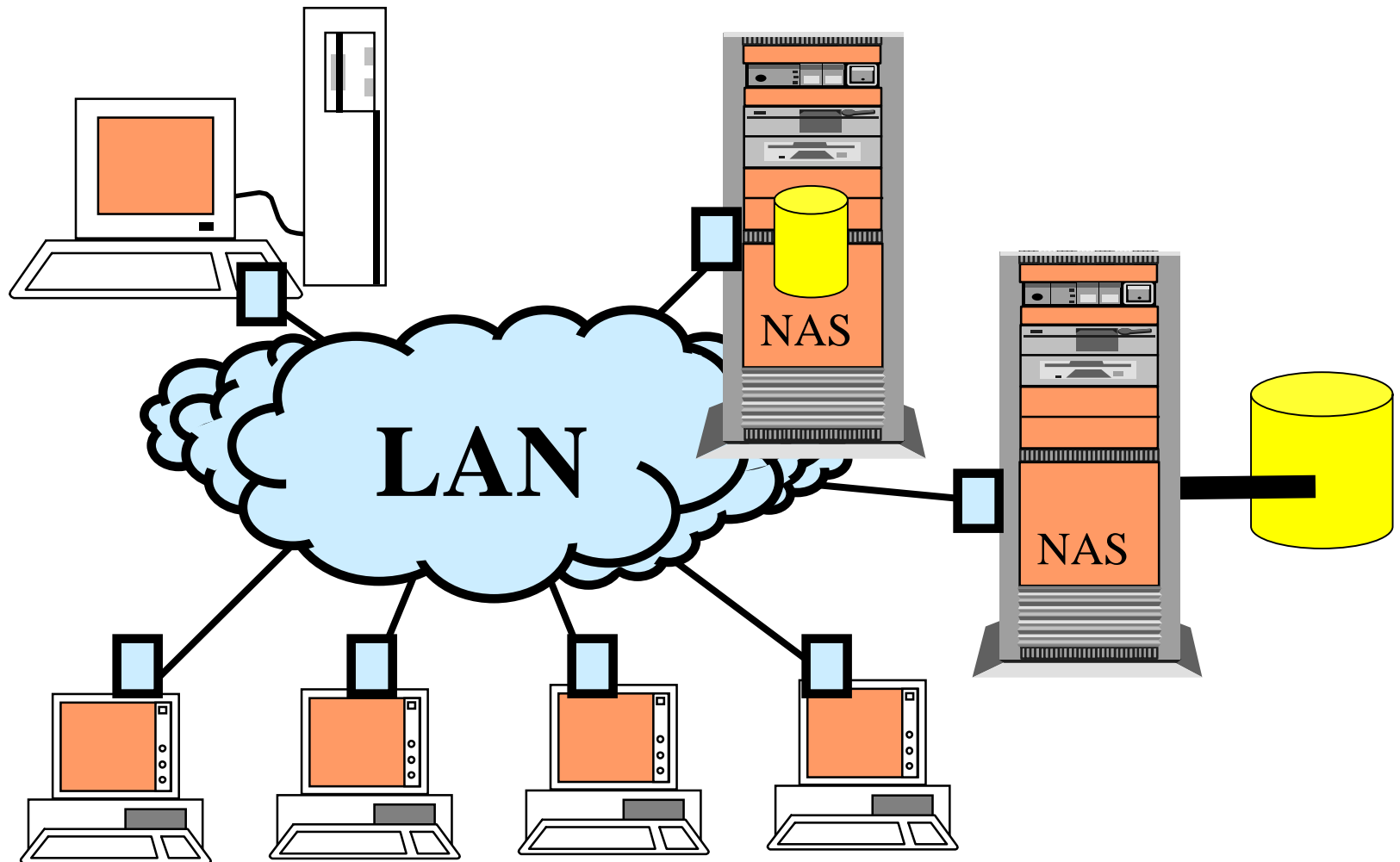
SCSI over IP

File Server

NAS Appliance

Direct Access
File System(DAFS)

Network Attached Storage



NAS Benefits

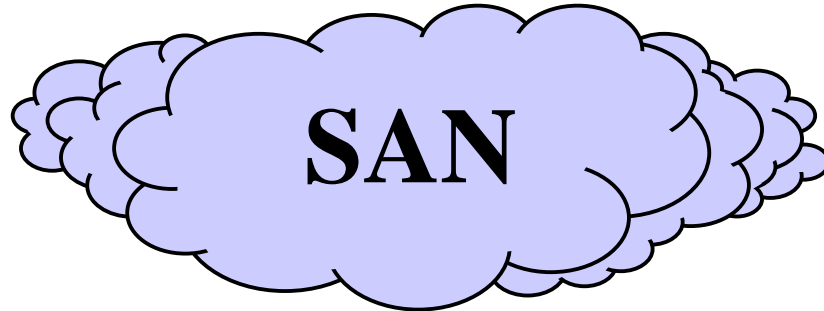
- **NFS, CIFS**
- **Extends client operating system to support shared files across the network**
- **Handles file locking**
- **Cache coherency**
- **Heterogeneous system environment**
- **Name and format conversion**

Network Attached Storage

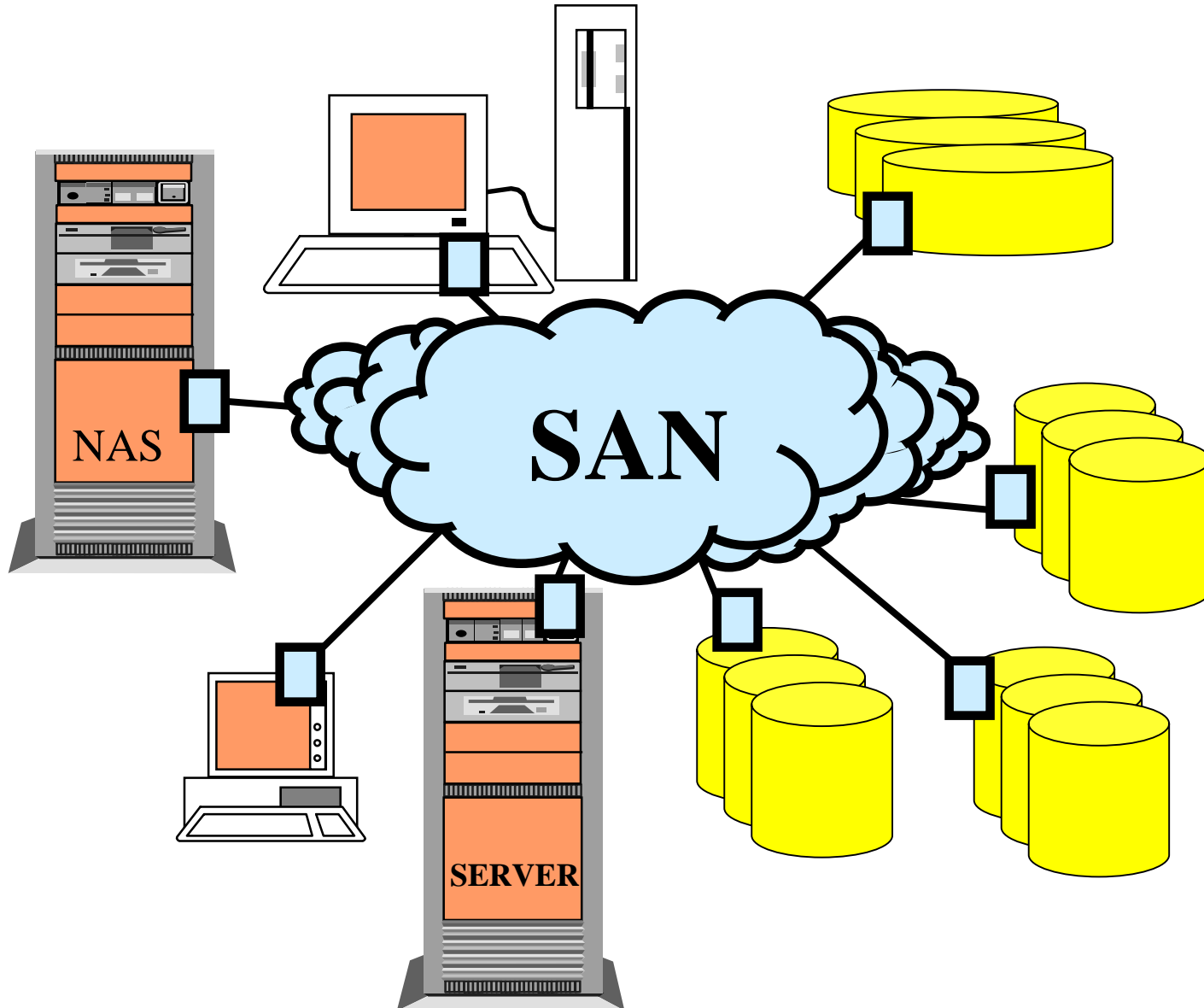
- **Server Attached Storage**
 - Generalized file server function
 - Can be optimized for storage access only
 - Uses I/O interface for storage attachment
- **Network Appliance**
 - Reduced server functionality for storage only
 - Server and storage integrated and often in same device
 - Optimized for file server
- **Network Attached Device**
 - Integrated storage and server function
 - Smaller configurations

What is a SAN?

- **Storage Area Network**
- **Server Area Network**
- **System Area Network**
- **The latest thing to sell!**



Storage Area Network



SAN Benefits

- **Expanded connectivity**
- **Port consolidation**
- **Extended distance**
- **Higher bandwidth**
- **Potential performance improvement**

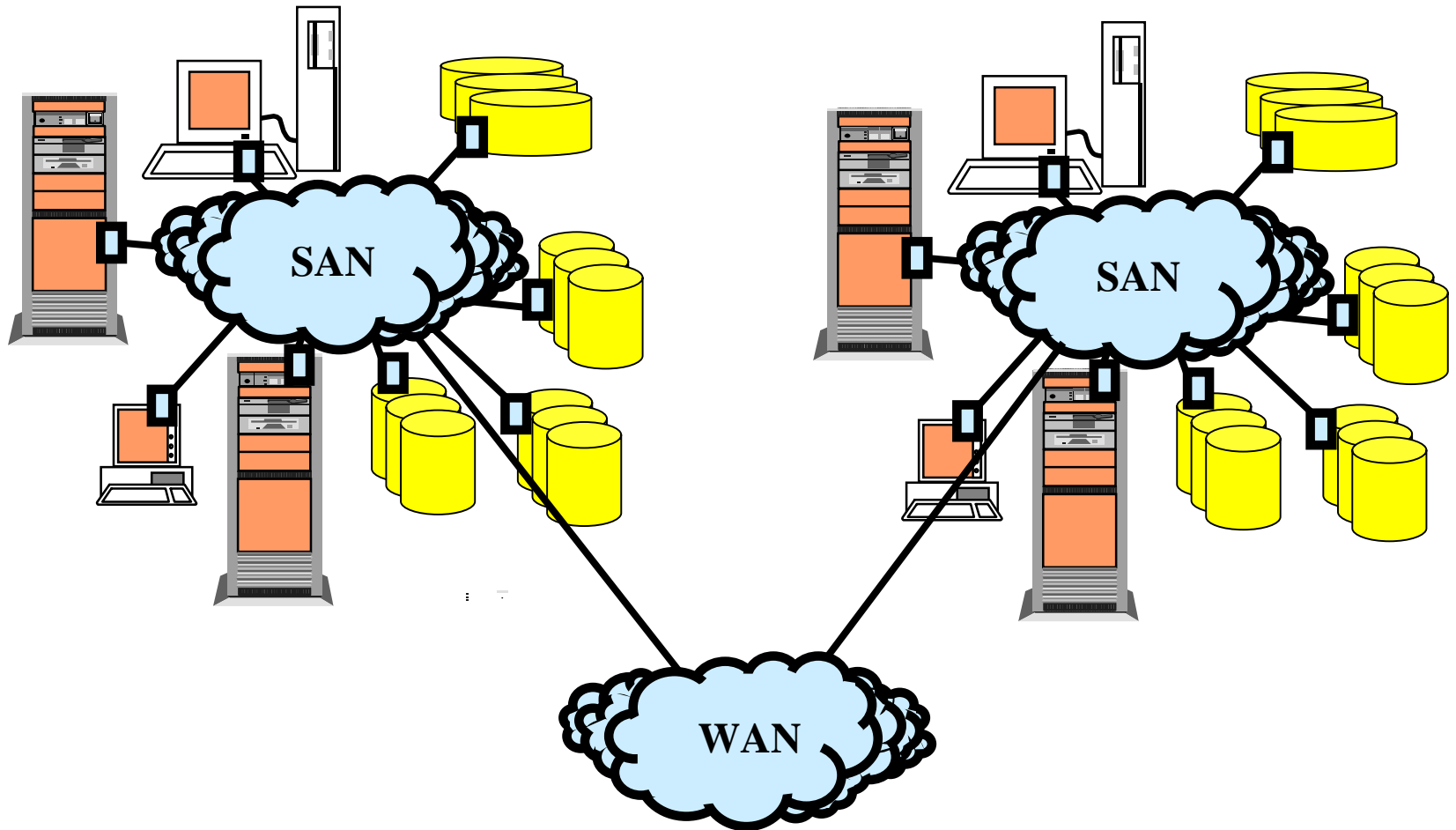


SAN Applications

- High performance storage and workgroups
- Large data bases
- Data warehouse
- Storage backup and recovery
- Server clusters
- Network based storage
- Campus backbones
- Digital audio/visual networks



SAN to SAN over WAN



SAN Myths

- **Software and hardware vendors trumpet their strategies and products**
- **Often the reality of the technologies is overlooked amongst the hype**
- **All technologies have pros and cons**
- **To achieve the full benefits of SAN technologies and to avoid the downside risks it is important to separate:**

Myth from Reality



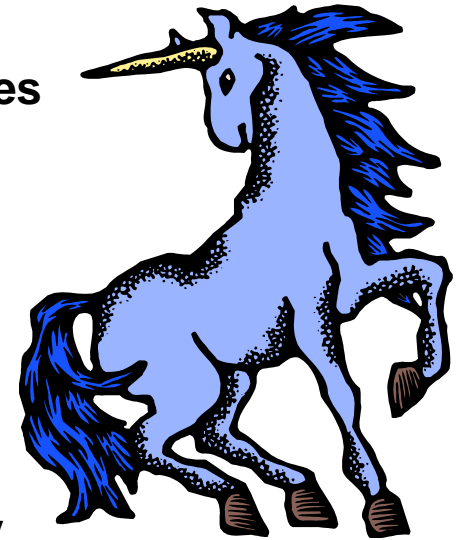
Myth: SAN is a Technology or Product

- **Reality: SAN is a concept, not fully realized**
 - Can enable coordinated sharing of homogeneous storage devices and their data over secure high speed and versatile interconnect topologies
 - Can create a common repository of storage devices available to the associated processors on an any-to-any basis
 - Heterogeneous data and storage sharing is a future



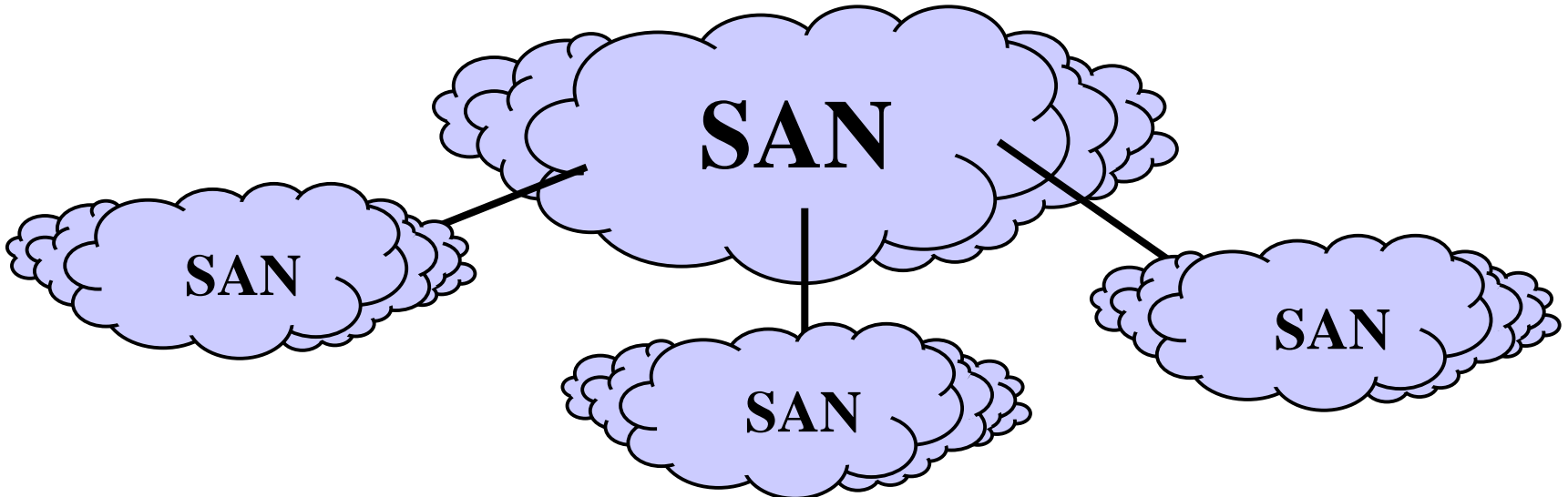
Myth: SANs solve all (most) distributed storage problems

- **Reality: SANs offer advantages and solve some problems**
 - SANs offer any-to-any connectivity
 - SANs can be implemented over great distances
 - High speed channels can reduce bottlenecks
- **Reality: SANs offer disadvantages too!**
 - It's just a virtual SCSI cable
 - It's a new infrastructure
 - It's expensive
 - Not all standards are there for interoperability
 - Enables but does not solve heterogeneous storage and data sharing problems



Myth: SANs are simple to implement

- **Reality: Larger SANs are complex and difficult to implement with today's tools**
 - Requires detailed planning and analysis
 - Great opportunity for companies that offer SAN services
 - Mostly a manual process today

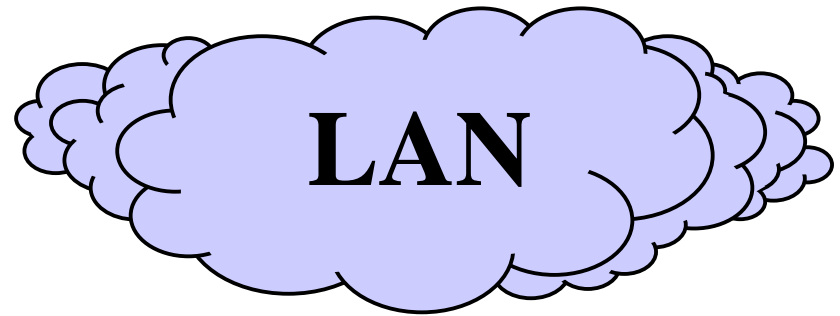


Myth: SANs will replace LANs

LANs will replace SANs

- **Reality**

- Efforts have been underway for over 30 years to combine networks into a single entity without some success
 - » Voice and Data
 - » Centralized and Distributed
 - » TCP/IP and SNA
- There is a hidden cost of Qos systems which require the information flow requestor to ask for the service required



Networked Storage Considerations

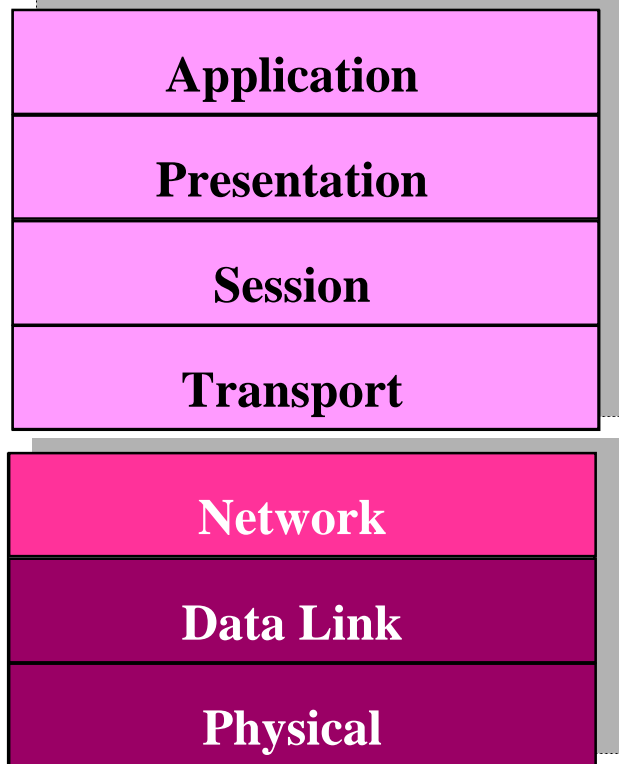
- **New paradigm for connecting storage**
- **New players**
- **Interoperability problems**
- **Volume management**
- **Path Security**
- **Investment brings return over the long terms**

Networked Storage Physical Transport Choices

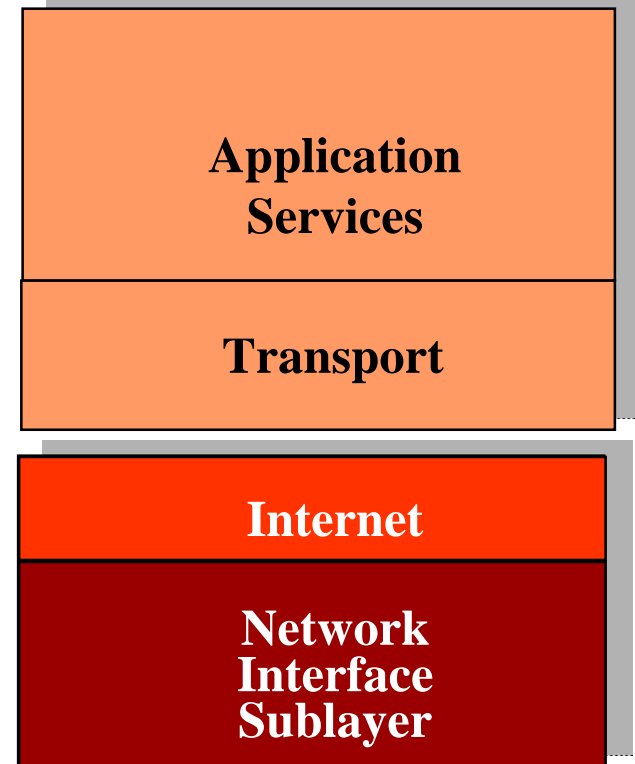
- **Fibre Channel**
- **Storage over IP**
- **Gigabit Ethernet**
- **SCSI Bus**
- **ESCON**
- **Infiniband**
- **iSCSI**
- **Topology Options**

OSI & IPS (TCP/IP)

End User Data

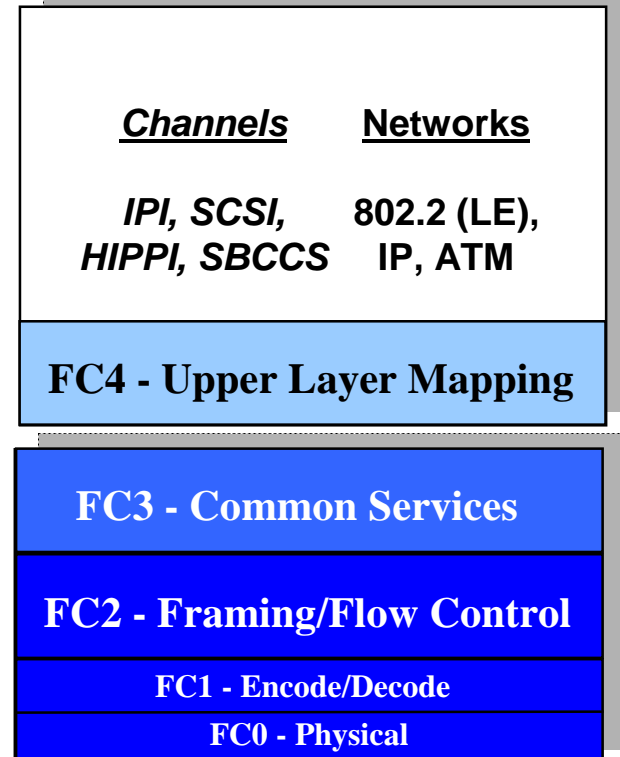
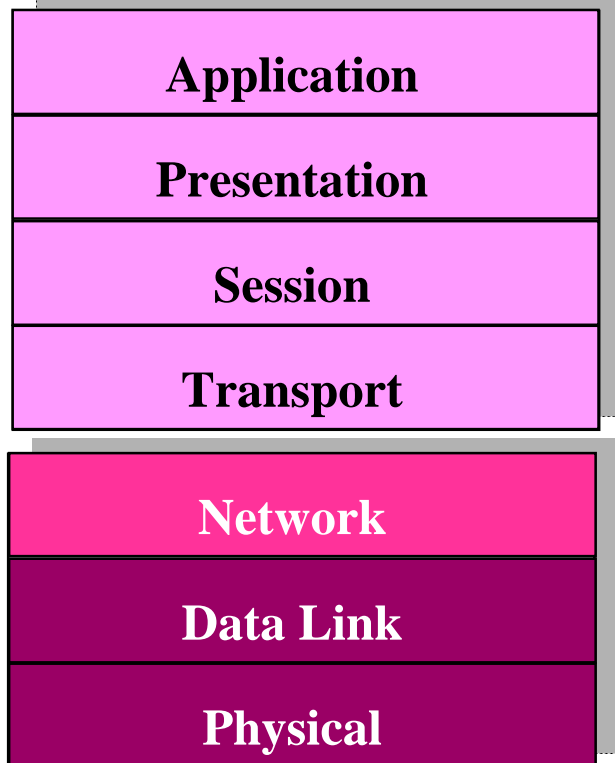


End User Data



OSI & Fibre Channel Architecture

End User Data

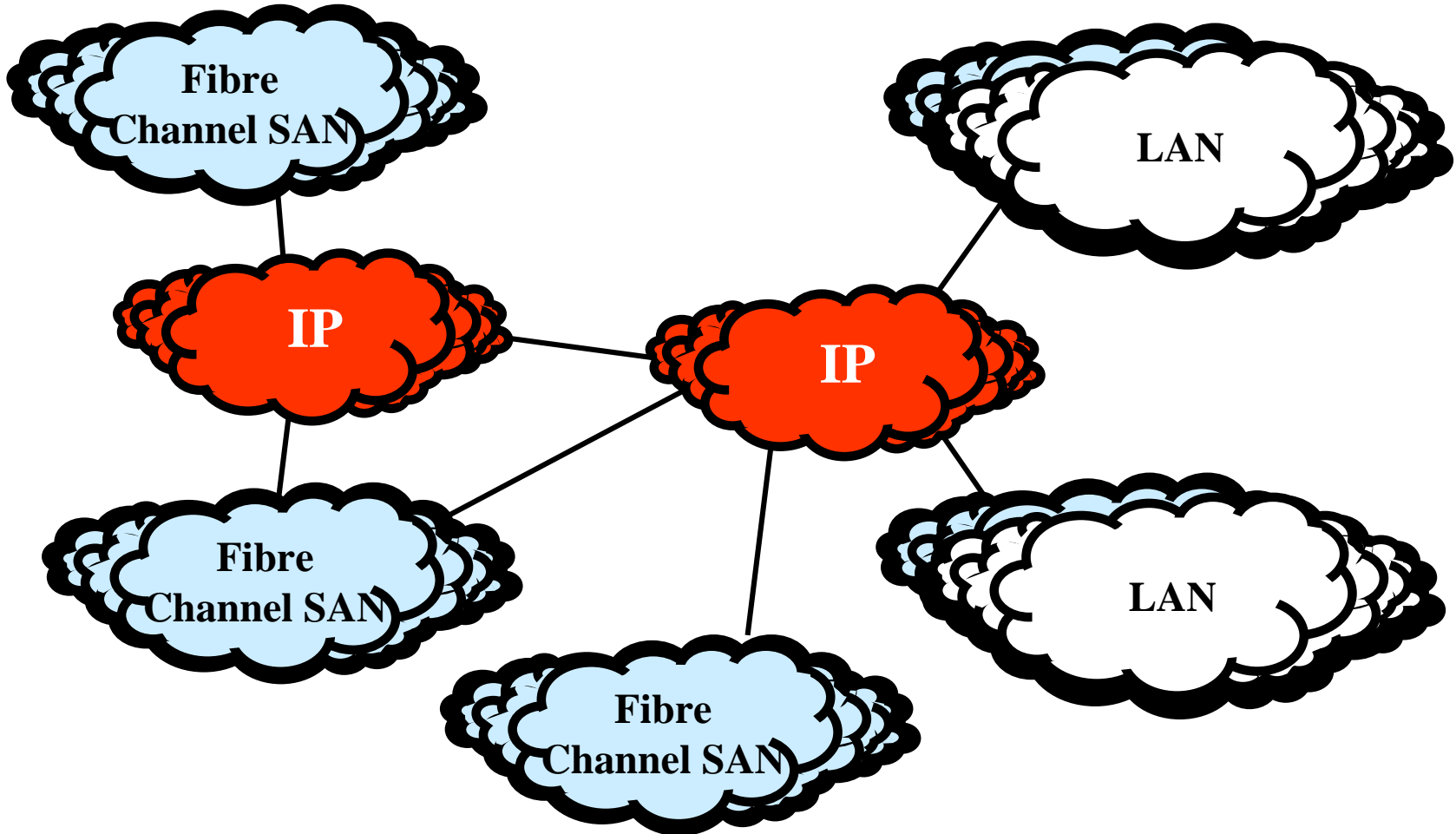


Fibre Channel vs GE

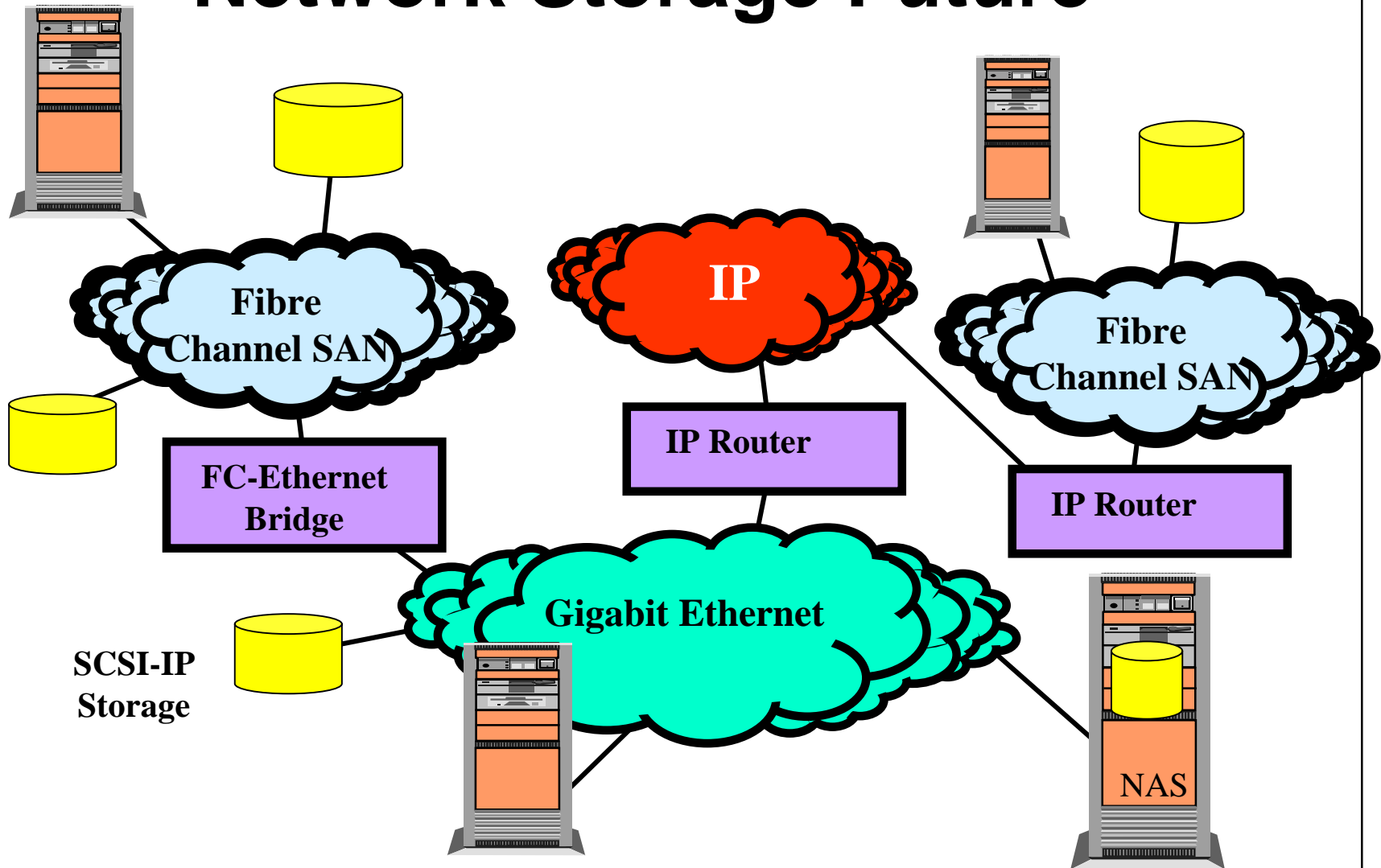
Category	Fibre Channel	Gigabit Ethernet
Bandwidth	100-200 MBps	100-200 MBps
Maximum Addressable Nodes	127 FC-AL 16 Million Fabric	2 ⁴⁸ MAC adresses
Distance	33m Copper 500m MM Fibre 10Km SM Fibre	25m Copper 260m Fiber
Data Loss Due to Congestion	No Class 1, 2, 4, 6 Credit based flow control	Yes, however new standard 802.1 PQ
Throughput	High	High
Mode	Full Duplex Serial	Full Duplex Serial
Protocol	SCSI, IP, Hippi, ESCON, etc.	Multiple Network Layer Protocols

Fibre Channel over IP

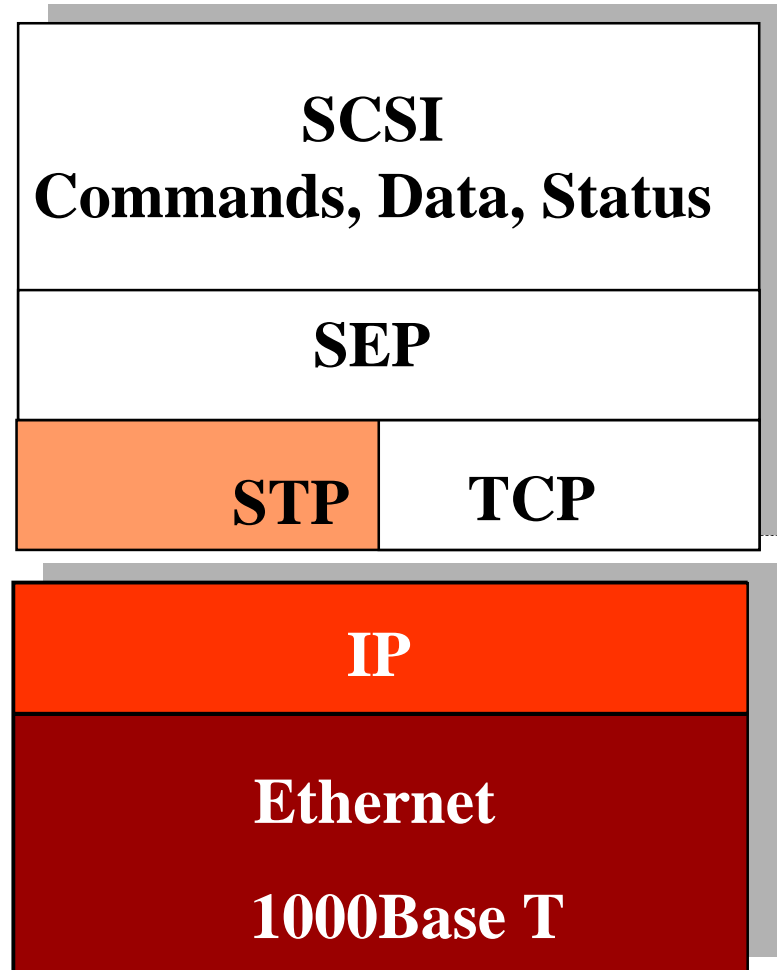
IP over Fibre Channel



Network Storage Future

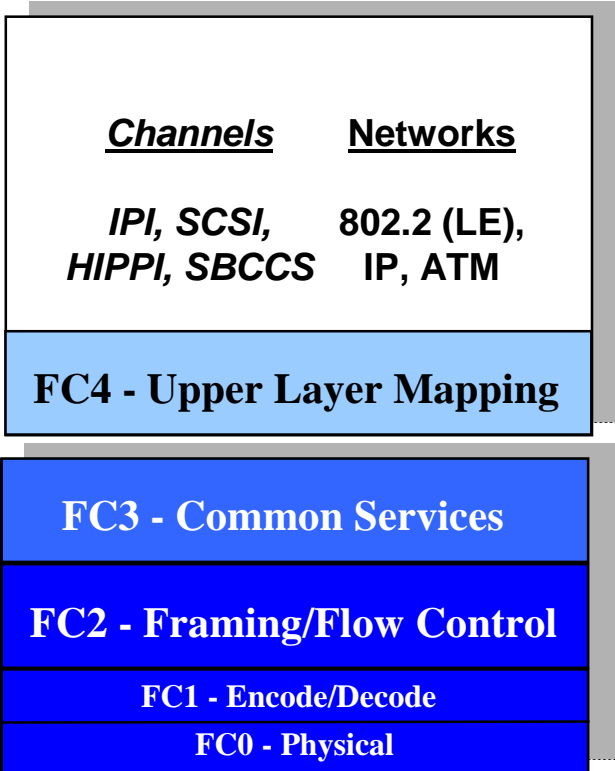


iSCSI and EtherStorage

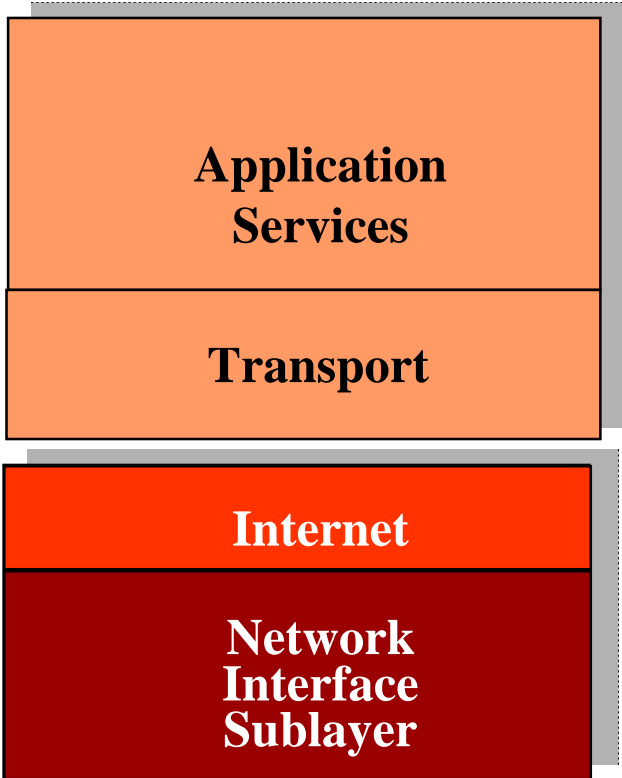


Fibre Channel vs IPS

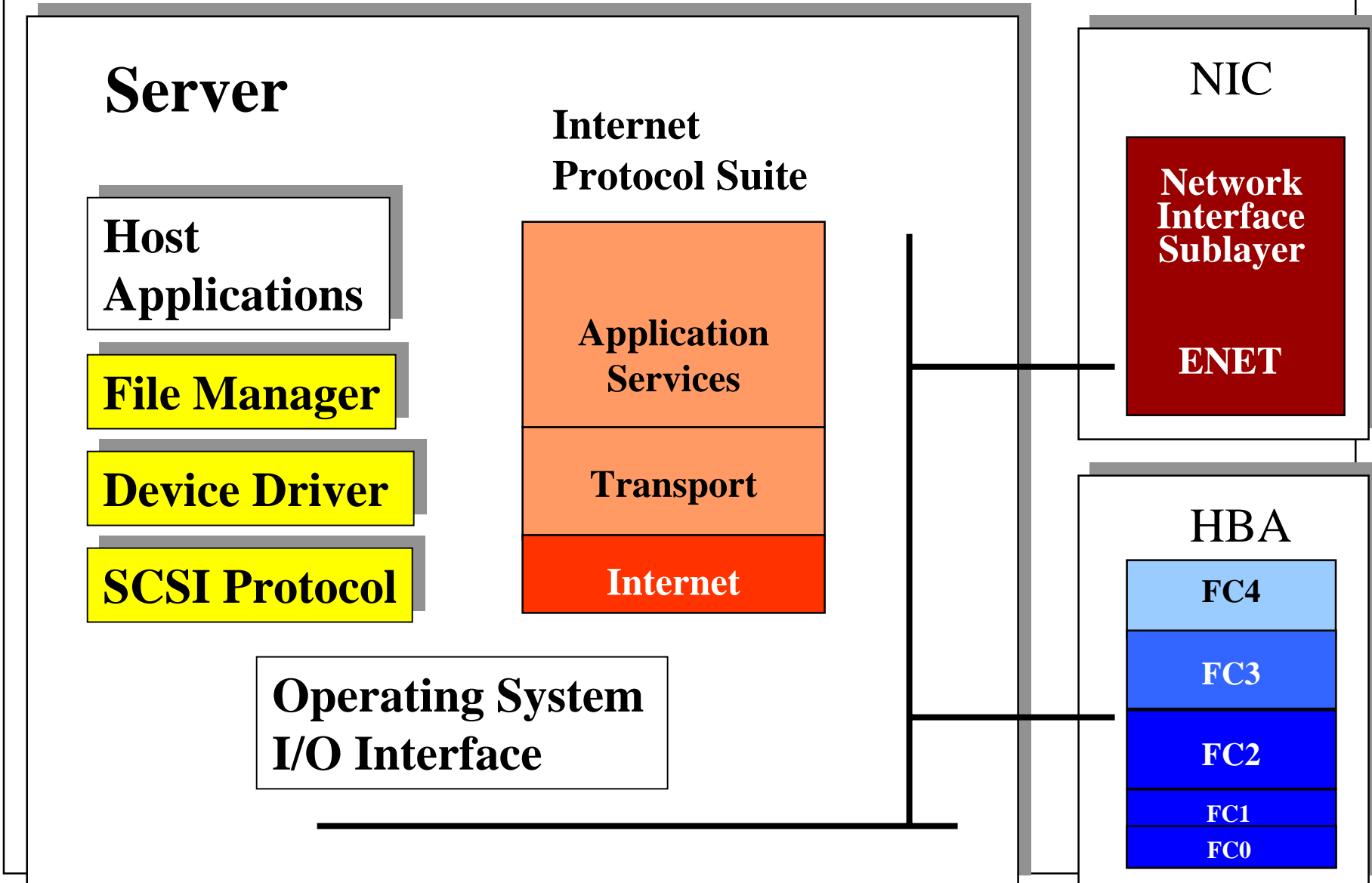
Fibre Channel



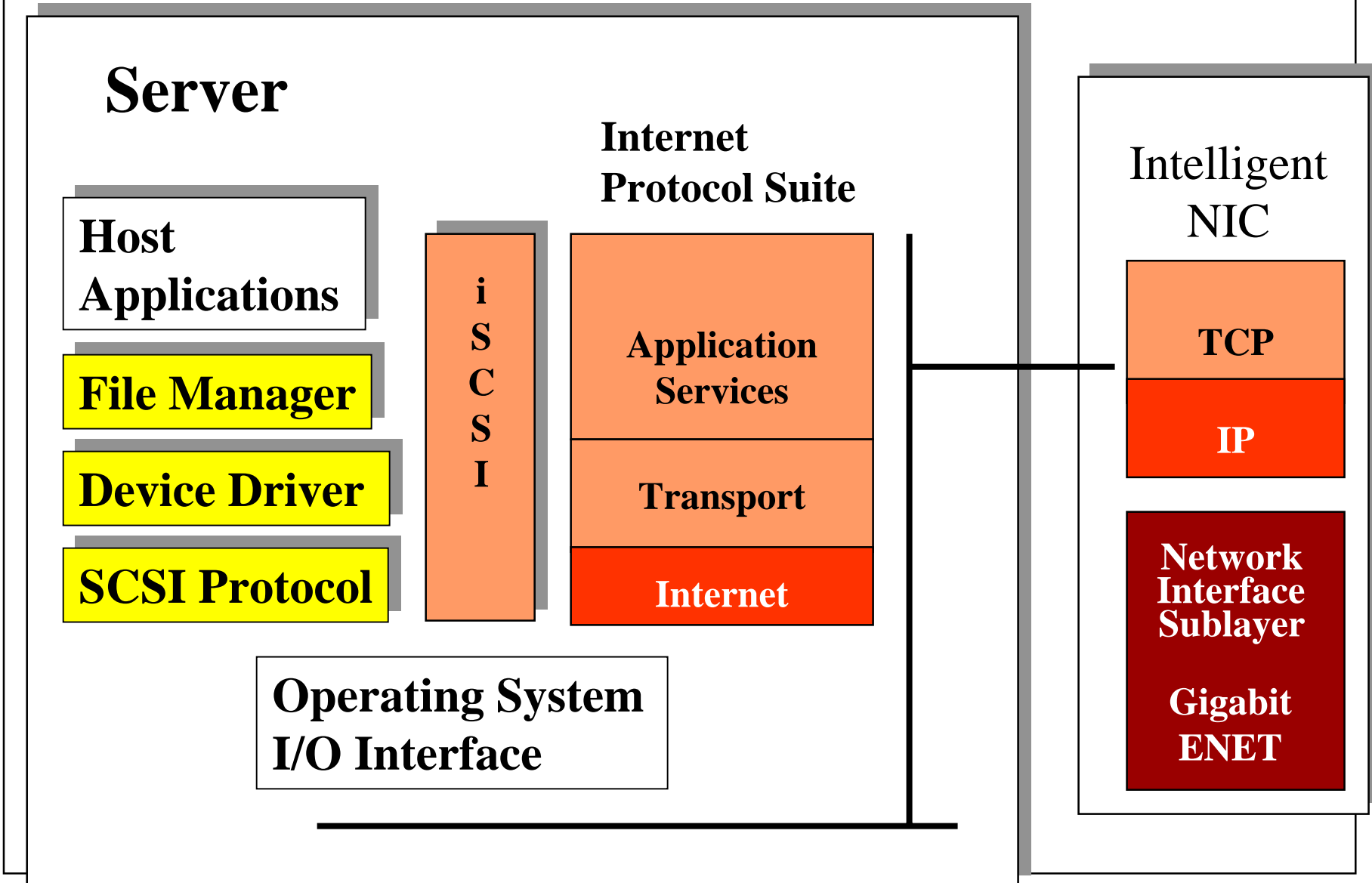
Internet Protocol Suite



Traditional



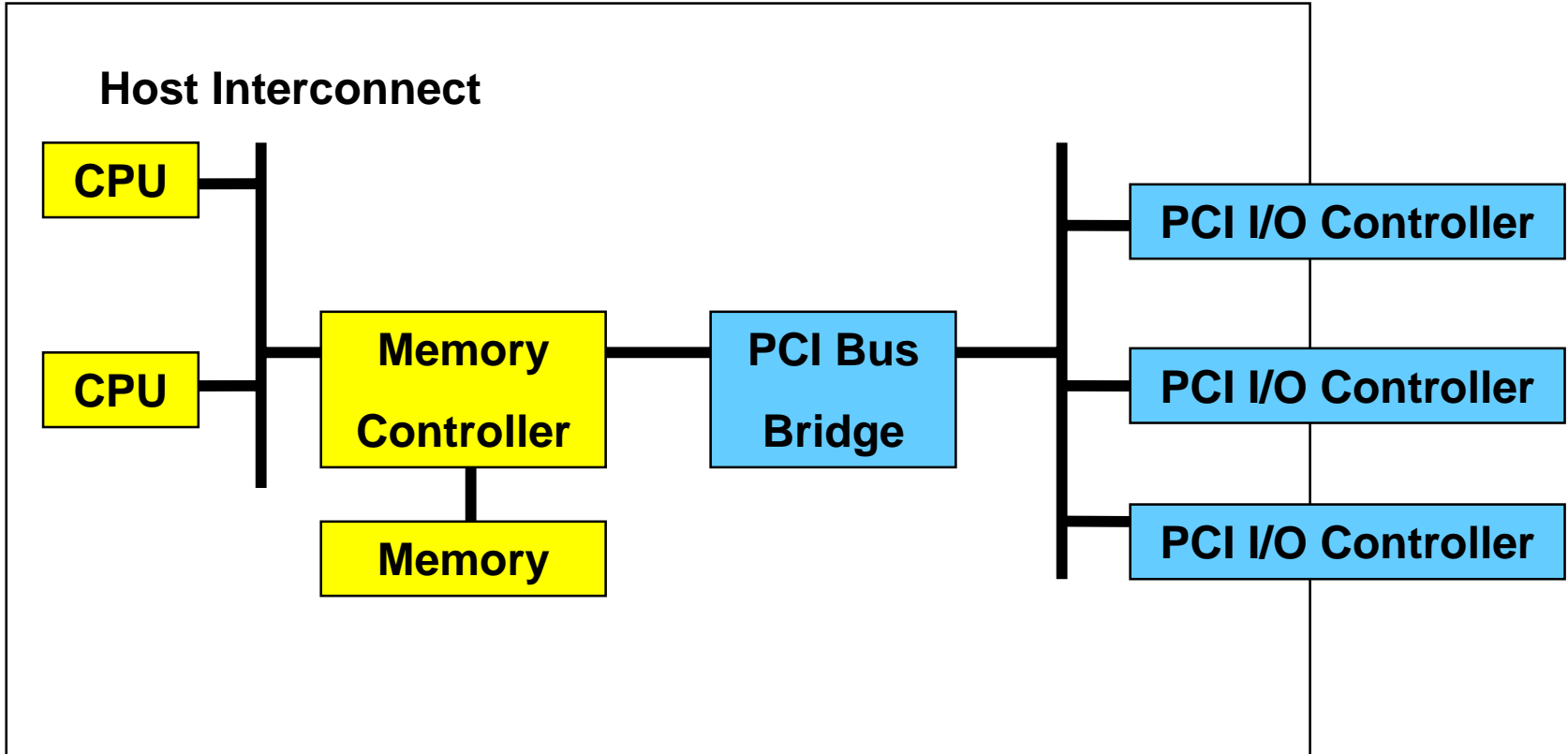
iSCSI



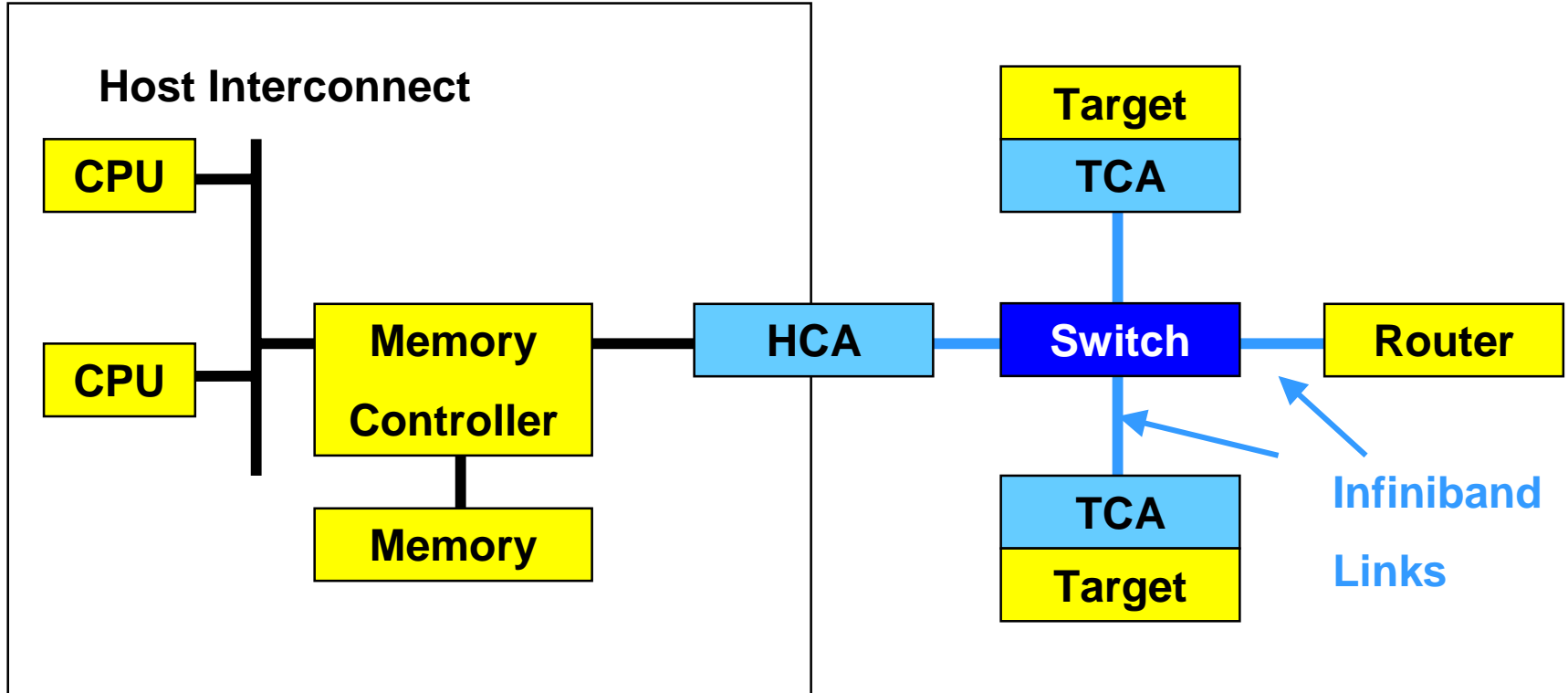
IP Storage Methods

Name	Integration Approach	Legacy Storage Compatibility	IP Network Compatibility	Companies Involved
IP Tunneling	FC frame encapsulation	FC	(Tunneled)	Gadzoox, CNT, Brocade, Cisco
Ether Storage	SCSI mapped to STP (Proprietary L4)	SCSI	Layer 1-3	Adaptec
I-SCSI	SCSI mapped To TCP		Layer 1-4	IBM, HP, EMC, Cisco, others
SoIP	SCSI/FCP adaptation	SCSI & FC	Layer 1-4	Nishan, others

Server I/O PCI Bus

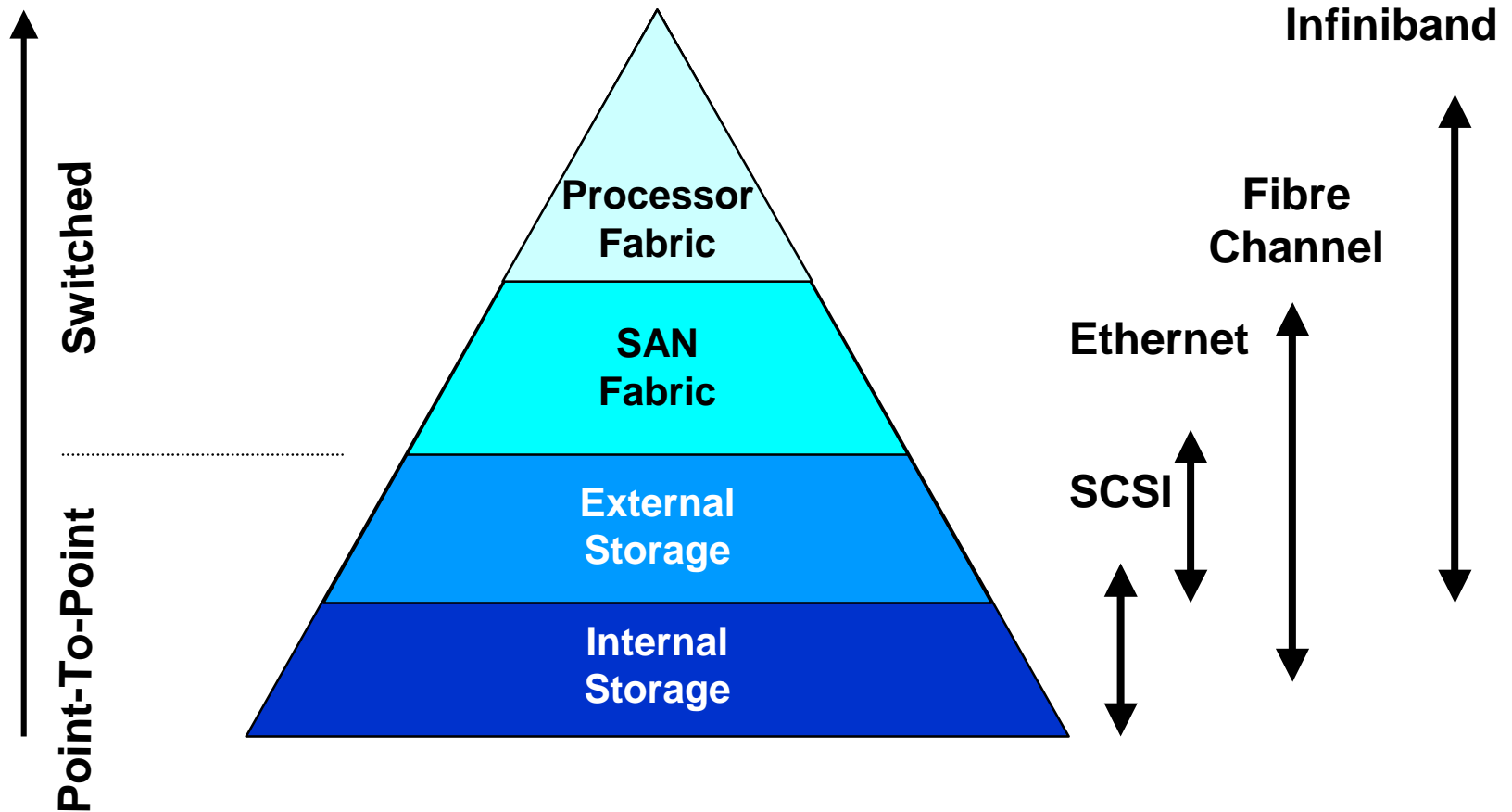


Infiniband Architecture IBA



Targets: SCSI Bus, Fibre Channel, Ethernet

Infiniband Positioning



Networked Storage Futures

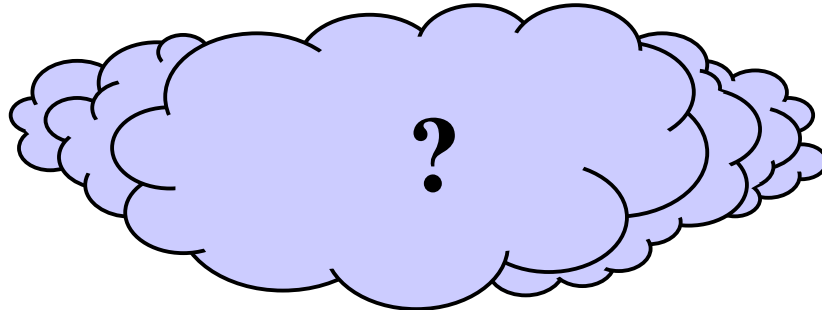
- **Greater process login for multiple upper layer protocols**
- **Class 4 fractional bandwidth**
- **Class 1 dedicated simplex**
- **Stacked connect and buffered class 1**
- **Data compression and encryption**
- **Greater usage**
- **Co-existence with many underlying architectures**
- **Edge routing to and through technologies**

Networked Storage Futures

- **Upper layer protocol changes**
 - Lazy and Hyper reads and writes
 - System SAN awareness
- **Higher bandwidth rates for aggregation and higher speed processors and adapters**
- **SAN Over**
 - Fibre Channel
 - IP
 - GE
 - Infiniband
- **NAS & SAN integration**

Networked Storage

- **Thank you for attending**
- **Good luck with Networked Storage Technologies**



Networked Storage Reading List

<i>Title</i>	<i>Author</i>	<i>ISBN</i>	<i>Date</i>
Fibre Channel Bench Reference	Jeff Stai	ISBN 1-879936-31-3	Jan-95
Fibre Channel : Gigabit Communications and I/O for Computer Networks	Alan F. Benner	ISBN 0-07-005669-2	Jan-96
The Book of SCSI: A Guide for Adventurers	Peter M. Ridge	ISBN 1-88641-02-6	Apr-95
Fibre Channel for Mass Storage	Ralph H. Thornburgh	ISBN 0-13-010222-9	May-99
Designing Storage Area Networks: A Practical Reference for Implementing Fibre Channel SANs	Tom Clark	ISBN 0-201-61584-3	Aug-99
Building Storage Networks	Marc Farley	ISBN 0-07-212050-9	Jan-00
The SCSI Bus & IDE Interface: Protocols, Applications & Programming	Friedhelm Schmidt	ISBN 0-201-17514-2	Oct-98
Making SCSI Work: A Practical Guide	The Paralan Staff	ISBN 0-9657465-0	Jan-99
Fibre Channel: Connection to the Future	Fibre Channel Association	ISBN 1-878707-45-0	Aug-95
Fibre Channel Volume 1: The Basics	Gary R. Stephens - Jan Dudek	ISBN 0-9637439-2-9	Mar-97
What is Fibre Channel? (4th Edition)	Gary R. Stephens	ISBN 0-9637439-5-3	Jan-97
SCSI: An In-Depth Exploration of ...	David A. Deming	ISBN 1-879936-08-9	Jan-98
Understanding I/O Subsystems	W. David Schwaderer - Andrew W. Wilson, Jr.	ISBN 0-9651911-0-9	Jan-96
SCSI Bench Reference	David A. Deming	ISBN 1-879936-07-0	Jan-98
The Fibre Channel Consultant: Arbitrated Loop	Robert W. Kembel		
he Fibre Channel Consultant: A Comprehensive Introduction	Robert W. Kembel		

Networked Storage Links

<i>Website</i>	<i>Description</i>
http://www.t10.org	T10 (SCSI)
http://www.ncits.org/	The NCITS home page
http://www.symbios.com/t10.1/	The (former) T10.1 Task Group (SSA) home page
http://www.t11.org/	The T11 Technical Committee home page (Fibre Channel, HIPPI, IPI, SBCON)
http://www.t13.org	The T13 Technical Committee home page (ATA & ATAPI)
http://www.scsita.org	The SCSI Trade Association (STA)
http://www.fibrechannel.com	Fibre Channel Industry Association (a trade association)
http://www.snia.org	Storage Networking Industry Association (a trade association)
http://www.1394ta.org/	IEEE 1394 Trade Association
http://www.ultra160-SCSI.com/	Information about Ultra160 SCSI