Education

NAS and iSCSI Technology Overview

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References to other SNIA Tutorials

Education SNIA

Check out SNIA Tutorial:

Storage Consolidation with IP Storage
The Storage Evolution
iSCSI and Fibre Channel
High Availability and Disaster Recovery for NAS
IP Storage Protocols – iSCSI

Target Audience

- CIO/CTO
- Consultants
- Systems Architects and Technologists
- Systems Administrators
- Technical Specialists

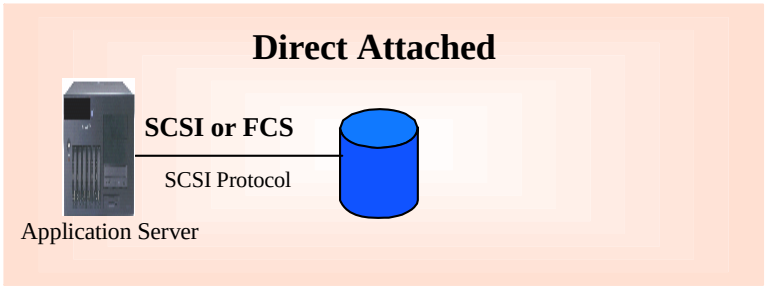
Abstract

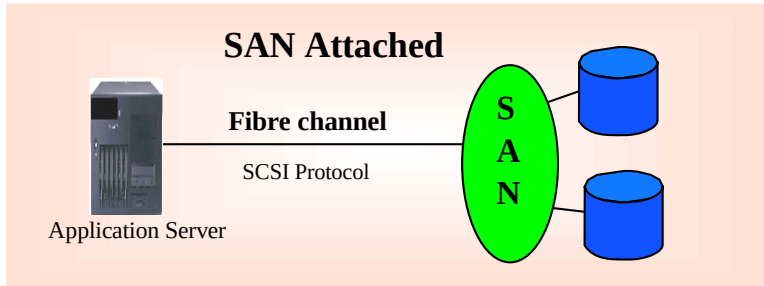
- Marketplace Directions
- General Differences of DAS, SAN, NAS, iSCSI
- Uses of NAS
- NAS Gateway/Head Architecture and Solutions
- iSCSI Status and Future

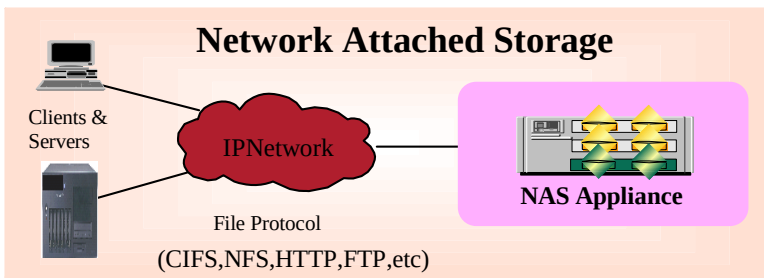
Marketplace Directions

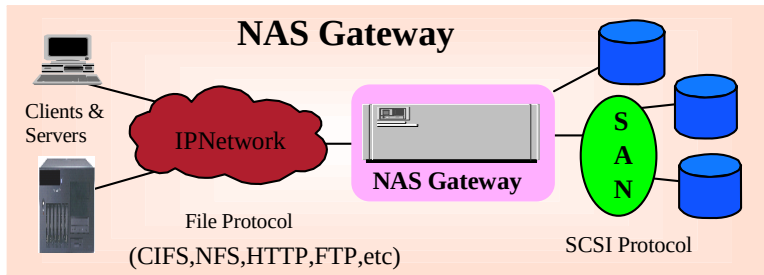
- **Trends**
  - Storage growth 20-150% per year
  - Lack of skilled personnel
- **Industry Directions**
  - Pool storage for flexibility
  - Intelligent storage to reduce administrative costs
    - Simpler (less skills required)
    - Automation (less effort)
  - Continuous availability

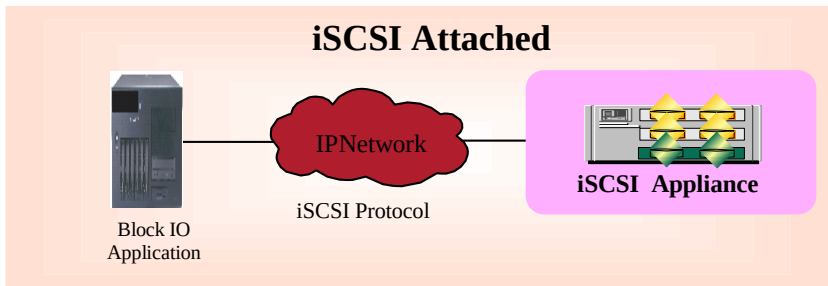
Connectivity for Storing Data







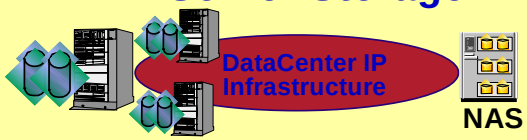




Uses of NAS

"Storage"

1. Server Storage



Shared Pooled Intelligent Storage

Business Problem:
Cost, skills, downtime for adding storage to servers

2. Client Storage

Shared Pooled Intelligent Storage

Business Problem:
Backup/Recovery, adding storage, sharing files

"File Server"

3. File Server Appliance

CIFS, NFS, HTTP, HTML, XML, RFC 1852, Multi-Media

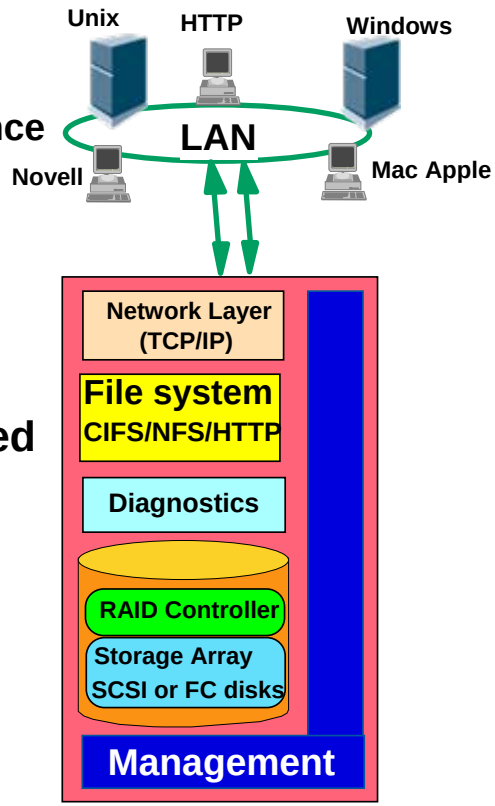
Business Problem:
Availability, performance, skills for serving files

What is Network Attached Storage?

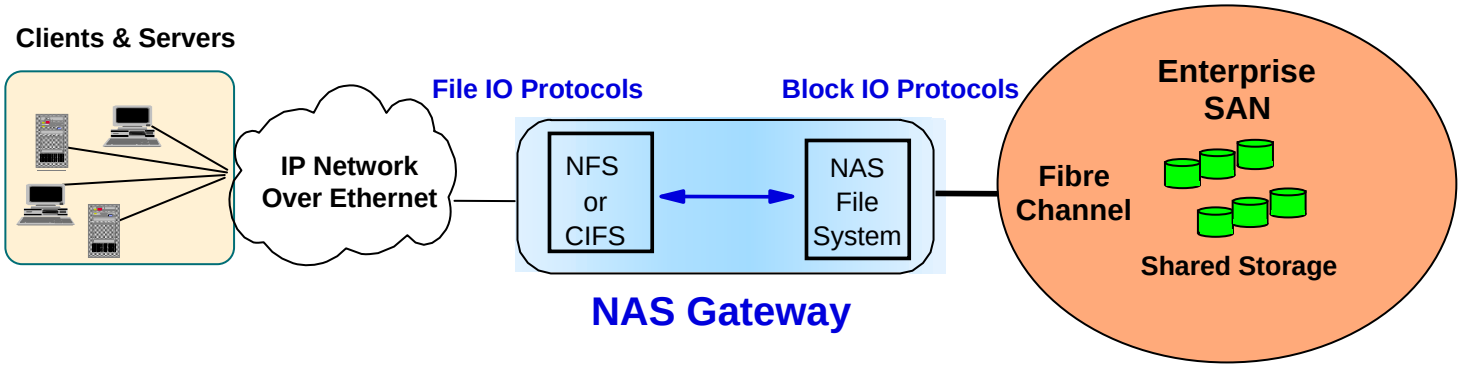
Task-optimized, high performance storage appliance directly attached to IP networks, providing "File Serving" to clients and servers in a heterogeneous environment

- **Preloaded file system that provides heterogeneous file sharing**
  - **Windows (CIFS), UNIX (NFS), Web (HTTP), Novell, FTP, Apple FP**
- **Installation/Configuration of software for Clients/Appliance**
  - **Requires minimum IT skills to maintain / install**
- **Scales from GBs to TBs**
- **Connects to IP network, mainly running over Ethernet**
- **Management software**
  - **Manage & Setup from remote location**
- **Diagnostic software**
  - **Predictive Failure Analysis, Alerts**
- **Fault Tolerant Features**
  - **Dual, Redundant, Hot Swap Components**
- **Data Protection Technology**
  - **Data Protection with RAID, & Backup to Disk & Tape**

- **Preloaded**
- **Preconfigured**
- **Pre-Tuned**
- **Pre-Tested**



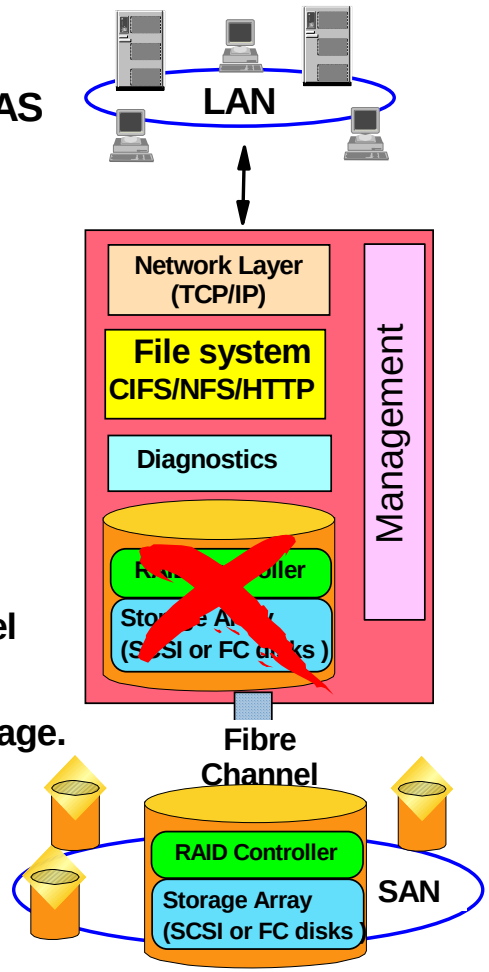
NAS Gateway/Head Configuration



- **Gives the combined benefits of NAS and SAN**
  - NAS flexibility and ease of use
  - SAN scalability on the IP network
- **Increases the reach of Fibre Channel storage devices**
  - Extends beyond topology limitations of Fibre channel
  - Allows FC devices to be used on the IP network
  - Connectivity to switches, directors, RAID controllers and disk arrays
- **Leverages the value of Fibre Channel investment**
  - Reduces access costs to Fibre devices
  - Allows access to underutilized SAN storage
  - Enables heterogeneous file serving on SAN storage devices

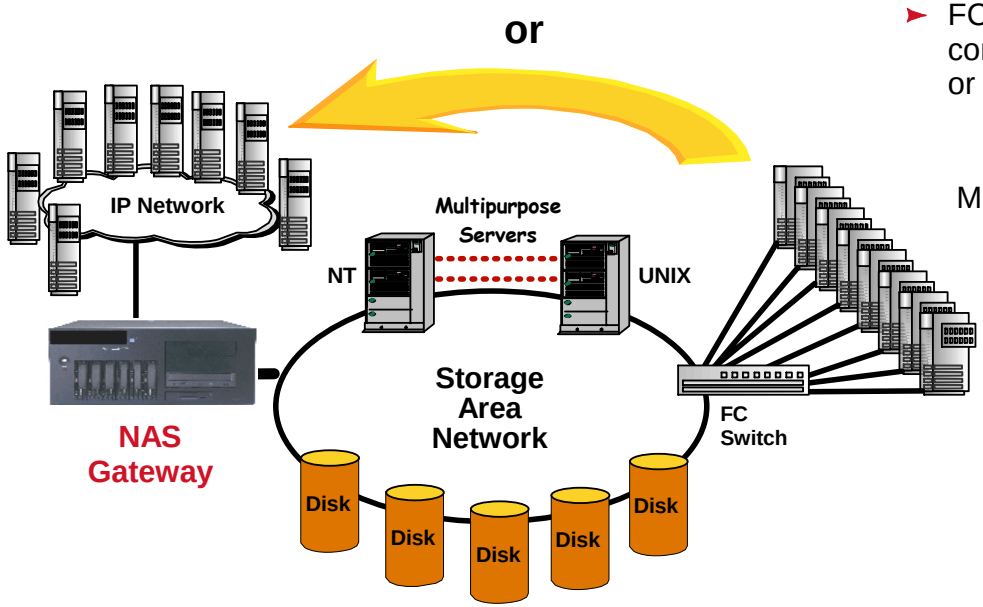
NAS Gateway/Head Architecture

- NAS Gateway offers benefits and characteristics of NAS
  - Connects to IP networks
  - Performs as a file server
  - Heterogeneous file sharing
  - Data protection
  - Clustering and failover features
- NAS Gateway is a NAS Appliance with one exception
  - NAS Gateway supports direct attachment to Fibre Channel storage or connection to a storage device across a SAN.
  - NAS Gateways do not have integrated disks for data storage.



NAS Gateway/Head Solution

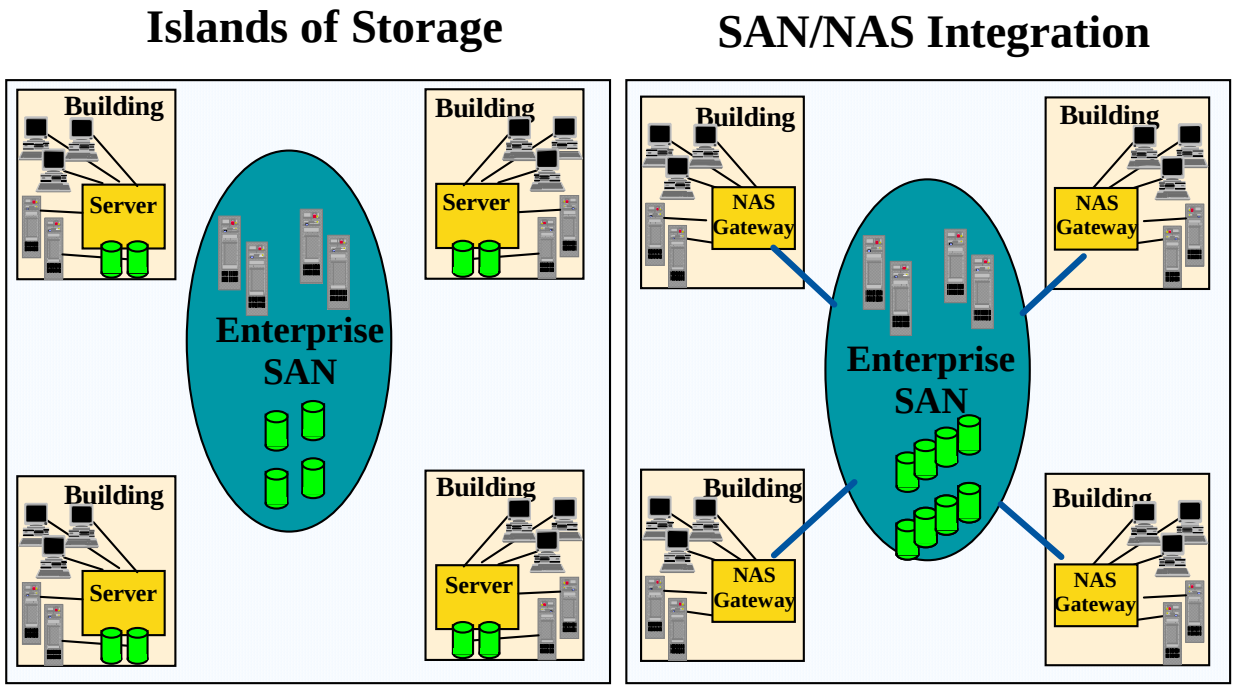
- Why purchase additional integrated NAS storage when you already have SAN storage
- Capitalize on your storage investment and purchase NAS functionality without the cost of additional NAS storage



- FC has distance limitations
- FC is costly to deploy when compared to cost of departmental or workgroup class servers

Mix of UNIX & NT Servers

Customer Example

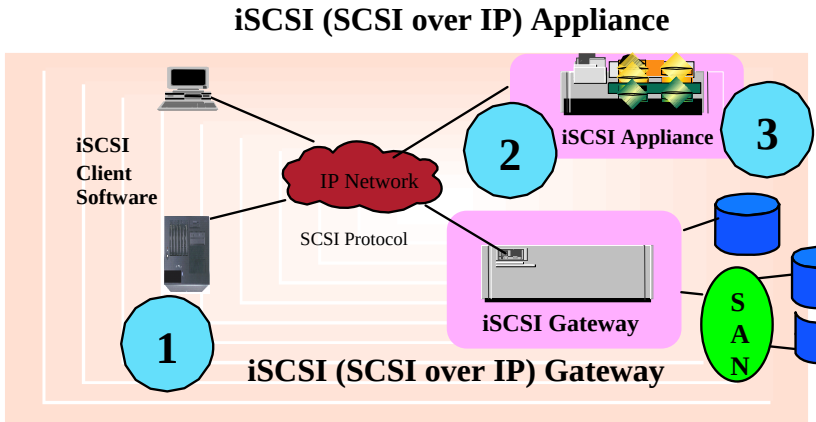


Benefits

- Storage Consolidation
- Cost effective connection to SAN capacity

iSCSI - An Alternative Technology

SCSI over IP Networks
"SAN" with IP fabric



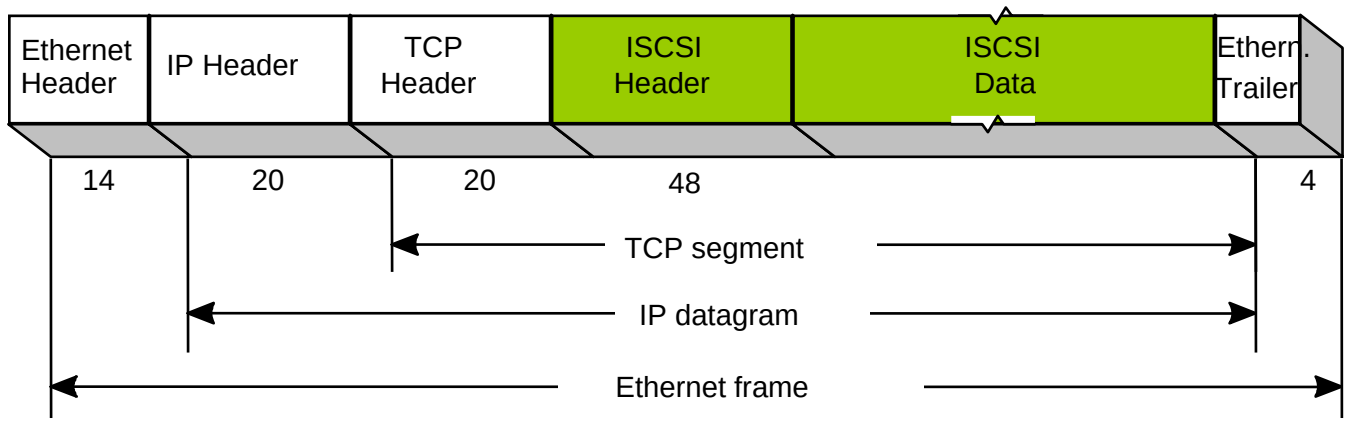
Two industry Approaches:

iSCSI Appliance (Native iSCSI w/ embedded storage)
iSCSI Gateway (Implemented on Fibrechannel Switch or Standalone Appliance, w/o embedded storage)

1. iClient (initiator) code reroutes SCSI commands over IP network
2. iSCSI target code receives SCSI commands from IP network.
3. SCSI commands then either routed directly to embedded storage (iSCSI Appliance) or routed to FC SAN (iSCSI Gateway)

What is iSCSI ?

- **Enables the transport of Block I/O data over IP Networks**
- **Operates on top of TCP through encapsulation of SCSI commands in a TCP/IP data stream**
- **Transport of iSCSI mainly over Ethernet (LAN/Metro); WAN Protocols (PPP, Frame Relay..) possible as well**



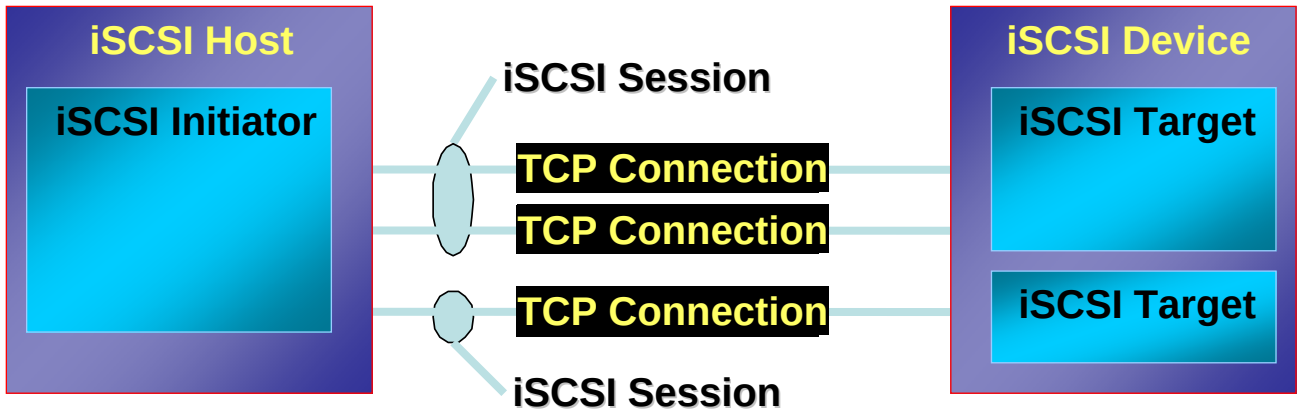
What is iSCSI ? - cont.

- Transport for SCSI Commands
- End to End protocol (between Initiator and Target)
- Can be implemented on Desktops, Laptops and Servers
- Can be implemented with current TCP/IP Stacks
- Can be implemented completely in a HBA
- Can use existing routers/switches without changes
- Transport includes Security as a base concept
  - Initiator and Target (RADIUS) authentication
  - Uses CHAP, SRP, Kerberos, SPKM
  - Enabled for IPSec Encryption, Digests and anti-Replay
- Defines Discovery as a basic element
- Defines process for Remote Boot, as a basic element
- Excellent SAN solution for servers with less thruput demand today

Benefits of Ethernet in Storage

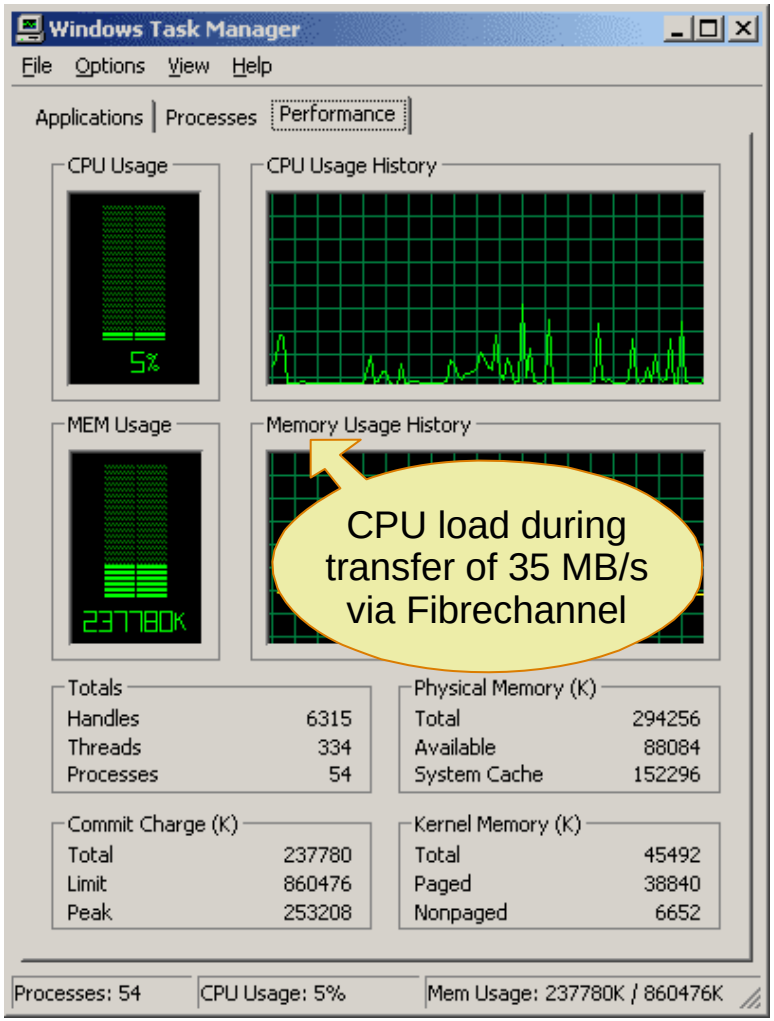
- **Ethernet is a widely deployed and dominant in the TCP/IP area**
  - Not just the Fortune 1000 (as is Fibre Channel)
  - Well understood technology
  - Low acquisition cost
  - Unlimited distance
  - Companies do not have to retrain for TCP/IP networks
- **Ethernet is a scalable technology, with 10/100/1000/10000 Mbps**
  - 100 Gbps is on the roadmap
- **Allows the creation of a single physical network using familiar standards**
- **VLAN's maybe used for separating storage traffic from intranet traffic**
- **Brings Interoperability & Ethernet economics to storage**
- **Enables remote data replication and disaster recovery**
- **Faster implementation than with FC**

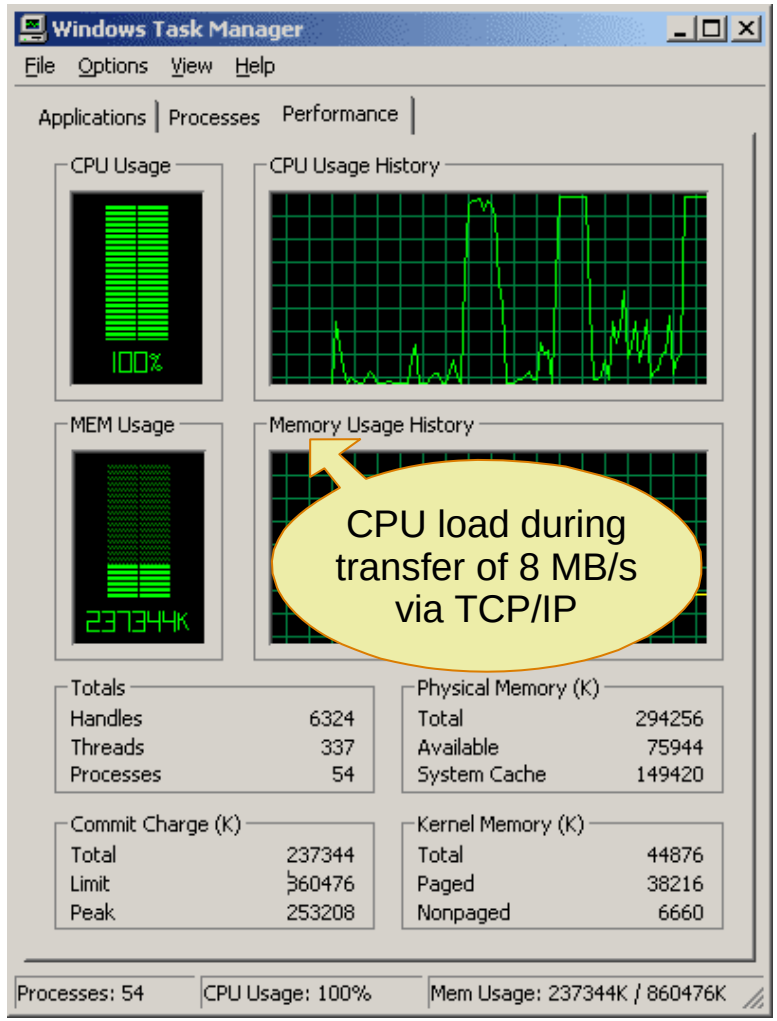
iSCSI Connectivity



- Initiators and targets can be implemented in H/W or S/W
- Session between initiator and target
  - One or more TCP connections per session
  - Login phase begins each connection
- Services (e.g., authentication, security) negotiated during login
- TCP Protocol provides
  - Delivery of SCSI commands in order
  - Recovery from lost connections

CPU Load: Fibre Channel vs. TCP/IP





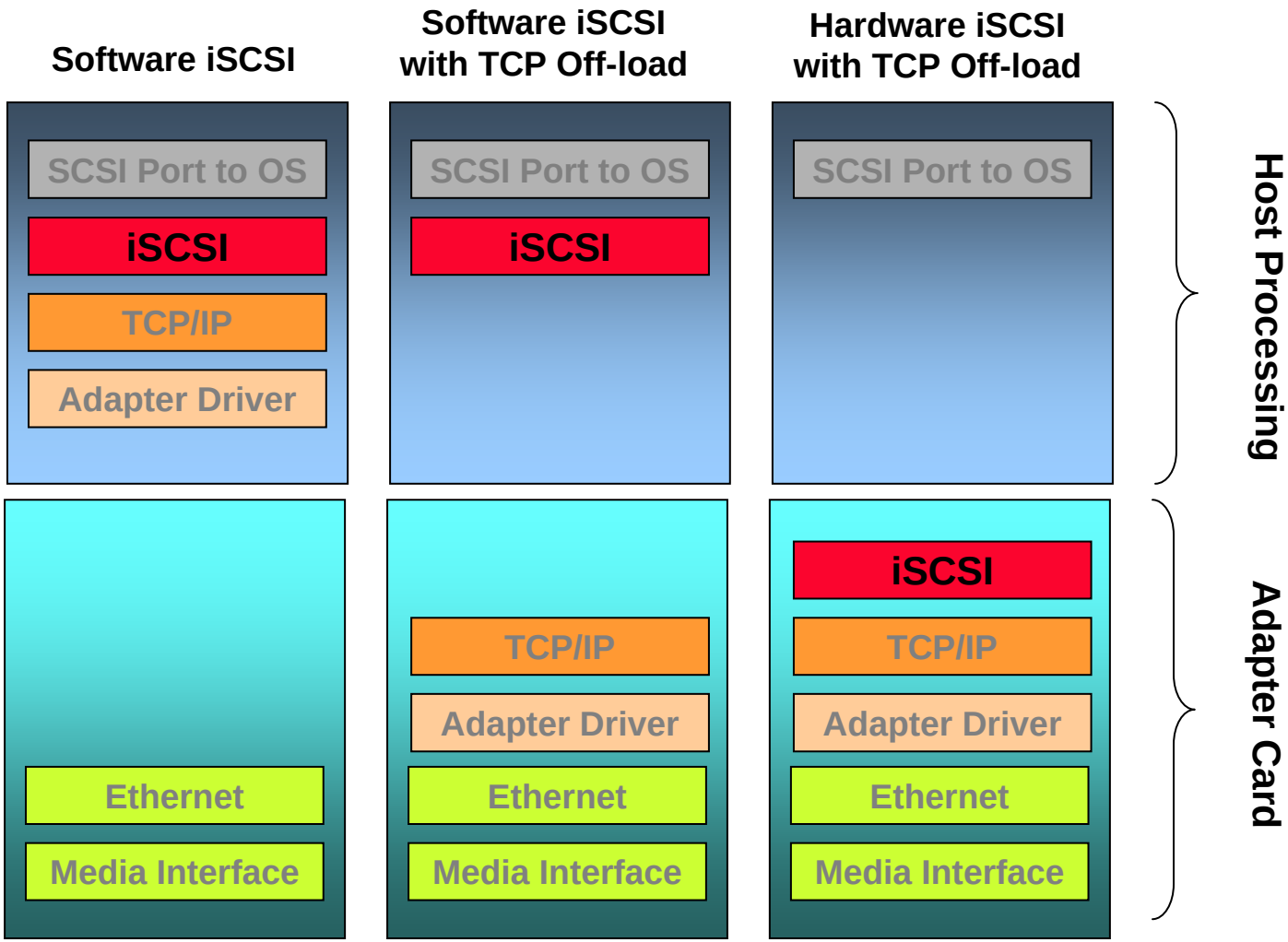
TCP Overhead

- **TCP Processing**
  - Every TCP connection that is part of an iSCSI session has processing overhead potential
    - Connection setup / teardown
    - TCP state machine:
      - Acknowledge, Timeout, Retransmission
      - Window management
      - Congestion Control
    - TCP segmentation
    - IP fragmentation
    - Checksum calculations
  - TOEs help here very much
- **Gigabit Ethernet and TOE not mandatory requirements for iSCSI; Many servers are still 100 Mbps connected**
- **Therefore today, iSCSI mainly used in entry level to mid size servers**
- **High End Servers may require Gigabit Ethernet and TOE**

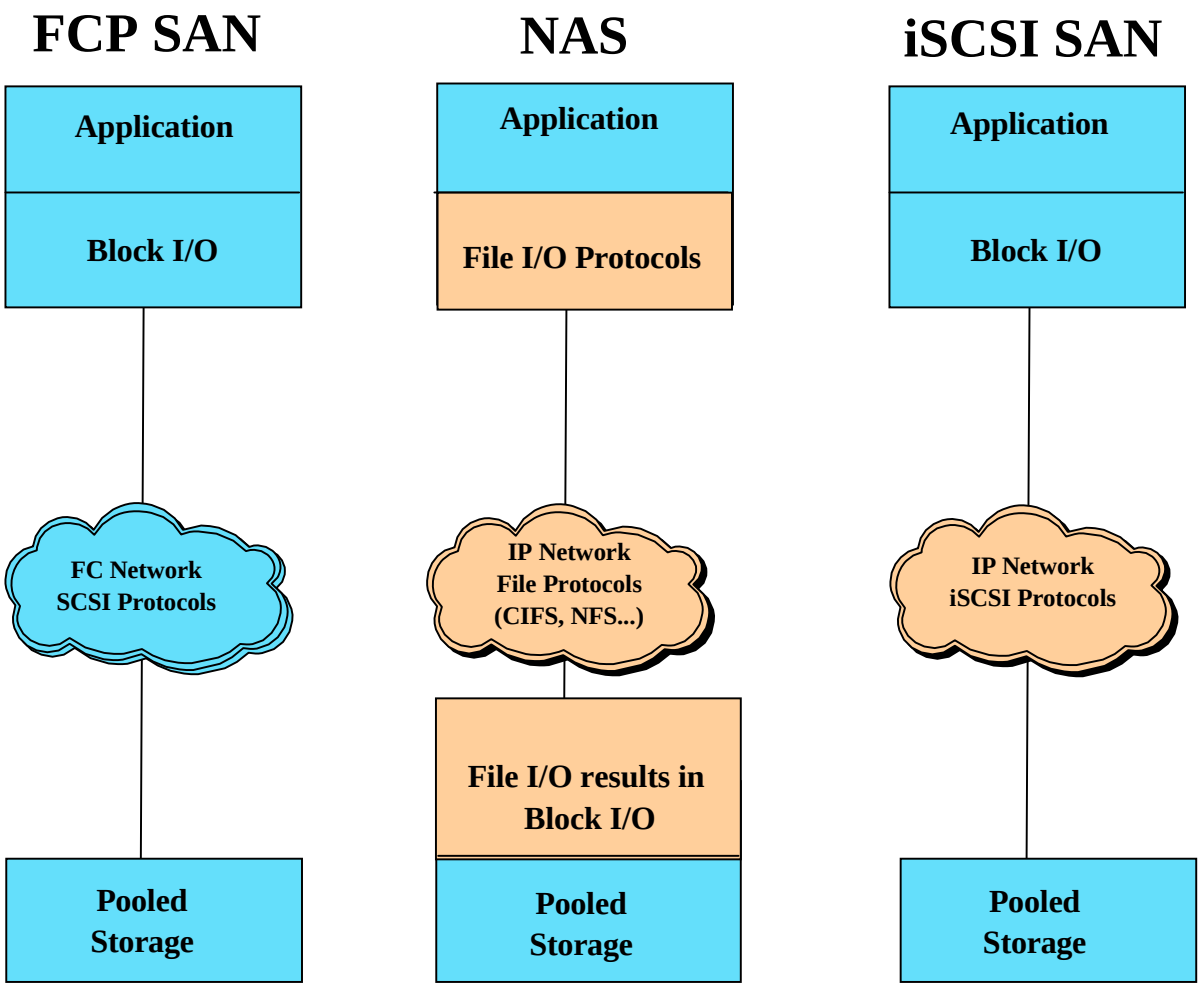
Improving IP Storage Performance

- **TCP/IP Off-load Engines (TOEs), key to Gigabit wire speed NICs**
  - Required to be competitive with Fibre Channel
  - 1 Gbps links will NOT require full integrated ASIC
  - Different Implementations: TCP/IP or TCP/IP and iSCSI offload;
    Full TCP/IP stack versus TCP/IP Data Path only offload
- **Several NAS's already implemented TOEs**
  - 1 Gbps iSCSI NICs available
    - Some with ASIC Chips that includes a TOE and MAC
    - Some with ASIC TOE Chip that include iSCSI and MAC
      - These chips can replace FC chips in Storage Controllers
    - Others just use MIPS or PowerPC processors with SW TCP/IP Stacks
  - 10 Gbps NIC's available
    - Full integrated ASIC Chips required here
- **Use Jumbo Frames** →20-50% performance increase

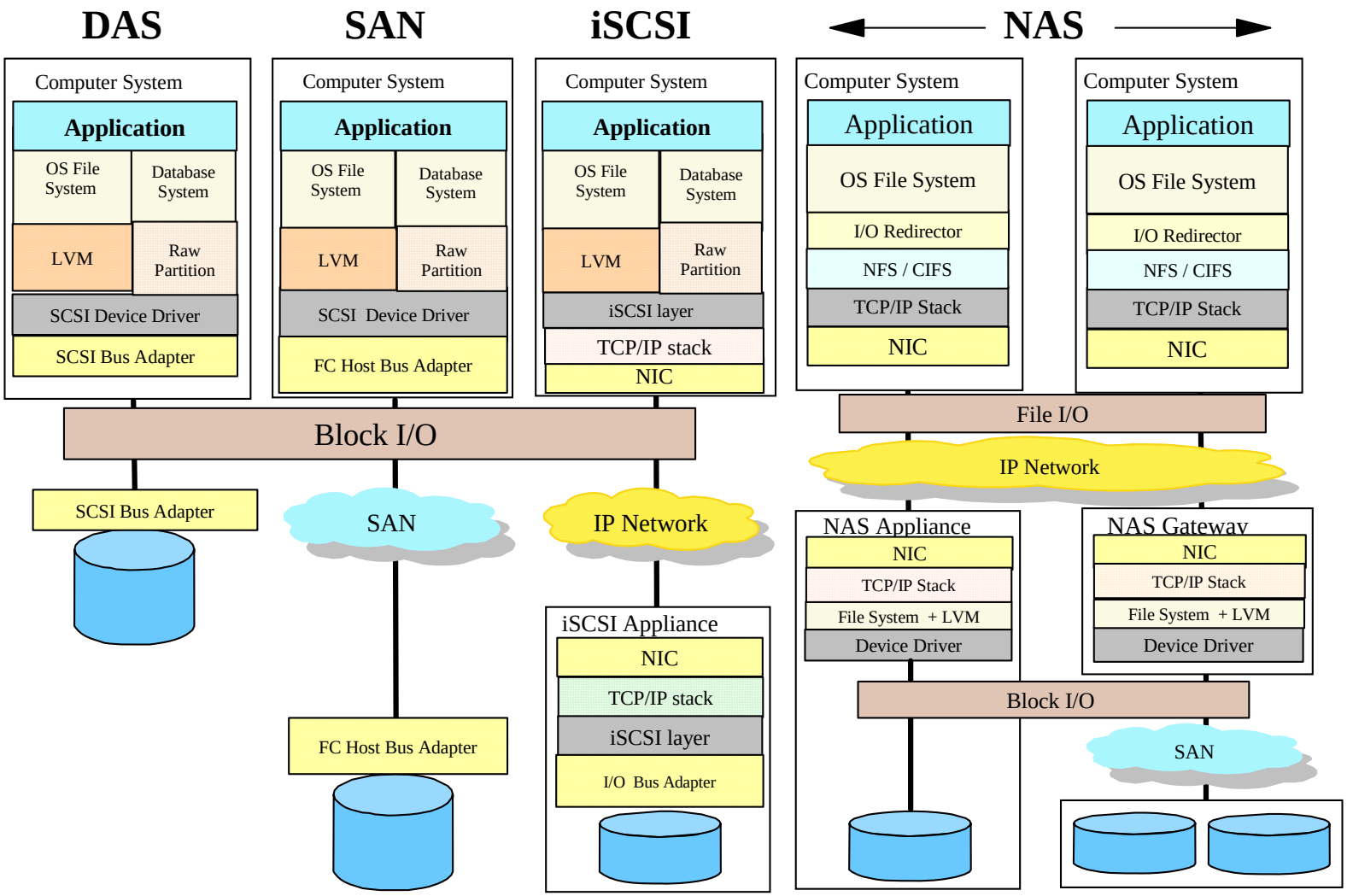
iSCSI & TOE Adapters



Application Protocol Support



Transporting Application Data



Up and coming Features

- **Key Enhancements**
  - **Additional Ease of Use**
    - Automatic Discovery
    - Automatic Configuration
  - **National Language Support**
  - **Enhanced Hardware**
    - iSCSI Native Host Bus Adapter
    - iSCSI “features” on high end storage hardware
    - “Dual Dialect” - NAS and iSCSI support on one Box
    - 10 Gb Ethernet for iSCSI Appliance/Gateway
    - iSER – iSCSI Extension to RDMA

Events and Imminent Releases

- **First iSCSI Plugfest in July 2001**
- **Promontory Summit iSCSI demo in September 2001**
  - iSCSI data transfer between east- and westcoast
    - pioneered by 8 companies
- **iSCSI ratified by IETF in February 2003 (RFC 3720)**
- **Strong increase of iSCSI implementations in 2006**
  - Lots of new products, lots of vendors
  - Many locations will begin to install in many areas
  - 10 Gig products introduced
- **2007 Year of 1 Gbps iSCSI large volume shipments**
  - Also 10 Gigabit Ethernet volume Shipments for Campus Backbones and Host NIC's

Q&A / Feedback

- Please send any questions or comments on this presentation to SNIA: trackstorage@snia.org

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SNIA Education Committee

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