NAS and iSCSI Technology Overview

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References to other SNIA Tutorials

Check out SNIA Tutorial:

IP Storage
Storage for Networking Professionals
Networking for Storage Professionals
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
• Clustering Architectures
• NAS Gateway/Head Architecture and Solutions
• iSCSI Status and Future
Marketplace Directions

• Trends
  – Storage growth 20-150% CAGR
  – In 1999 more storage was sold than in all previous years together
  – 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

Direct Attached
- SCSI or FCS
- SCSI Protocol
- Application Server

SAN Attached
- Fibre channel
- SCSI Protocol
- Application Server

Network Attached Storage
- IPNetwork
- File Protocol (CIFS, NFS, HTTP, FTP, etc)
- NAS Appliance

NAS Gateway
- IPNetwork
- File Protocol (CIFS, NFS, HTTP, FTP, etc)
- NAS Gateway
- SCSI Protocol

iSCSI Attached
- IPNetwork
- iSCSI Protocol
- iSCSI Appliance
Technology Comparison

IP Network

Clients & Servers

File IO Protocol
CIFS, NFS Protocols

Ethernet Connection

NAS
File IO results in Block IO for storage on local disks

NAS Gateway

File IO results in Block IO for storage on SAN Network

SAN

Fibre Channel Connection

File IO Protocol

iSCSI Protocols

Ethernet Connection

iSCSI Storage Appliance

Only Block IO execution required (no File IO)
Uses of NAS

1. Server Storage
   - DataCenter IP Infrastructure
   - Shared Pooled Intelligent Storage
   - Business Problem: Cost, skills, downtime for adding storage to servers

2. Client Storage
   - Internet Intranet
   - Shared Pooled Intelligent Storage
   - Business Problem: Backup/Recovery, adding storage, sharing files

3. File Server Appliance
   - CIFS, NFS, HTTP, HTML, XML, RFC 1852, Multi-Media
   - Business Problem: Availability, performance, skills for serving files
Clustering Architectures

- **Shared Null**
  - No failover
  - No clustering
  - No load balancing

  ![Shared Null Diagram](image)

  Each node accesses storage separately.

- **Shared Nothing**
  - Clustered failover
  - No load balancing

  ![Shared Nothing Diagram](image)

  Any node can read or write to any piece of data... NOT Concurrently.

- **Shared Everything**
  - Clustering and immediate failover
  - Load balancing
  - Multinode access to large file systems

  ![Shared Everything Diagram](image)

  Any node can read or write to any piece of data... CONCURRENTLY.
What is Network Attached Storage (NAS)?

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**
  - PFA, LPD, Alerts

- **Fault Tolerant Features**
  - Dual, Redundant, Hot Swap Components

- **Data Protection Technology**
  - Data Protection with RAID, & Backup to Disk & Tape
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

Islands of Storage

SAN/NAS Integration

Benefits

- Storage Consolidation
- Cost effective connection to SAN capacity
Improving NAS Performance

• TCP/IP Off-load Engines (TOEs), key to Gigabit wire speed NICs
  – Required to be competitive with Fibre Channel
  – 1Gigabit 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
  – 1Gbps 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
  – 10Gbps NIC’s available in 2004
    • Full integrated ASIC Chips required here
iSCSI - An emerging 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.

- iSCSI is a Transport for SCSI Commands
  - iSCSI is an End to End protocol
  - iSCSI can be implemented on Desktops, Laptops and Servers
  - iSCSI can be implemented with current TCP/IP Stacks
  - iSCSI can be implemented completely in a HBA
  - iSCSI has the concept of Human readable SCSI Device (Node) naming
  - iSCSI can use existing routers/switches without changes
- iSCSI Transport includes Security as a base concept
  - Authentication (at the Node Level)
  - Enabled for IPSec and other Security Techniques
- iSCSI defines Discovery as a basic element
- iSCSI define process for remote Boot, as a basic element
- iSCSI defines MIB standards as a basic element
Benefits of Ethernet in Storage

• Ethernet is a widely deployed and dominant in the TCP/IP area
  • Not just the Fortune 200 (as is Fibre Channel)
  • Well understood technology
  • Companies do not have to retrain for TCP/IP networks
• Ethernet is a scalable technology, supporting 10/100/1000/10000 Mbps
• 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, any server to any storage access
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 require Gigabitethernet and TOE
iSCSI Working Group

• The working group will cover:
  – Issues new to iSCSI (a result of using an IP transport)
  – Management, including MIB definition(s)
• The working group will not cover
  – Extensions to existing protocols (SCSI, TCP, IP, …).
  – File system protocols.
  – Environments where high data loss rates are acceptable.
    • That is, protocols assume a reliable transport (TCP)
iSCSI Deployments

Same HW Configurations as NAS
Workgroup, Departmental, & Enterprise
(Appliances and Gateways)

Independent iSCSI Deployment

Extending the SAN

In Combination with NAS
Transporting Application Data

DAS
- Computer System
  - Application
    - OS File System
    - Database System
    - LVM
    - Raw Partition
    - SCSI Device Driver
    - SCSI Bus Adapter
- Block I/O
  - SCSI Bus Adapter

SAN
- Computer System
  - Application
    - OS File System
    - Database System
    - LVM
    - Raw Partition
    - SCSI Device Driver
    - FC Host Bus Adapter
- IP Network
  - SAN
- SAN Appliance
  - NIC
  - TCP/IP Stack
  - File System + LVM
  - Device Driver
- Block I/O
  - FC Host Bus Adapter

iSCSI
- Computer System
  - Application
    - OS File System
    - Database System
    - LVM
    - Raw Partition
    - iSCSI layer
    - TCP/IP stack
    - NIC
- iSCSI Appliance
  - NIC
  - TCP/IP stack
  - iSCSI layer
  - I/O Bus/Adapter
- Block I/O
  - SAN

NAS
- Computer System
  - Application
    - OS File System
    - I/O Redirector
    - NFS / CIFS
    - TCP/IP Stack
    - NIC
    - TCP/IP Stack
    - file system + LVM
    - Device Driver
- NAS Appliance
  - NIC
  - TCP/IP Stack
  - File System + LVM
  - Device Driver
- NAS Gateway
  - NIC
  - TCP/IP Stack
  - File System + LVM
  - Device Driver
- Block I/O
  - SAN

NAS and iSCSI Technology Overview
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Up and coming Features

- Key Enhancements
  - Security
  - 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
      - (e.g. Shark, Symmetrix)
      - IBM, Sun, HPQ servers
    - “Dual Dialect” - NAS and iSCSI support on one Box
    - 10 Gb Ethernet for iSCSI Appliance/Gateway
## Events and Imminent Releases

- **First iSCSI Plugfest in July 2001**
- **Promontory Summit iSCSI demo in September 2001**
  - iSCSI data transfer between east- and westcoast
    - Adaptec, Dell, Hitachi, IBM, Intel, Nishan, Qlogic, Quest
- **First Generation iSCSI SNICs**
  - Q3-Q4 2001
    - Emulex, Platys, Qlogic, Intel
- **2004 Year of iSCSI**
  - Lots of new products, lots of vendors (e.g. Cisco, Sanrad)
  - Many locations will begin to install in many areas
  - 10 Gig products introduced
- **2004/5 Year of 1Gig 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: tut-nas-chair@snia.org

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