Artful Intelligence: Creation and Composition of Distributed Storage Services

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Network Storage Tectonic Shifts

- Migration of storage services
  - From the host and subsystems layers
  - To storage fabrics

- Change in the playing field
  - From closed, proprietary hardware architectures
  - To open, standards-based systems
  - Shift most evident in block-based storage
Presentation Topics

- Forces at work
  - Technical and Economic
  - First playing field, then services

- Why they are taking place

- What you need to know for future planning
The IP Storage Access Grant

- **SCSI > FCP (Fibre Channel Protocol)**
  - Enter networked storage
  - Still behind protective walls

- **SCSI > iSCSI (Internet SCSI)**
  - Ubiquitous network storage
  - Protective walls dismantled
Evolution of the Storage Transport

Transport

Serialization

Command Set

Parallel SCSI

SCSI

SCSI N/A

FITP/FCIP

iSCSI

IP Storage (iSCSI)

IP Storage (FC to IP)

Fibre Channel

FC

SCSI

IP
New Storage Transport Placement

- Device Interconnect
  - Host Bus Adapters, Network Interface Cards, Software Initiators
  - Target devices, subsystems

- Storage Area Network
  - Switches, routers, hubs, directors

- SAN/ Remote Interconnect
  - Routers
Areas of IP Storage Deployment

- Device Interconnect
- Storage Area Network
- SAN / Remote Interconnect

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IP Storage Benefits

- Economic
  - Lower equipment cost → IP based
  - Reduced staff training → Familiarity
  - Less expensive bandwidth → Remote

- Technical
  - Advanced features and functionality

- Market Effects
  - Separating device and network dependence
Breaking device and network dependence with IP storage
Fostering Unrestricted Growth

Co-mingling constrains market growth

Unrestricted market growth
Setting the Framework for IP Storage

- Fit new IP storage applications
  - Remote mirroring
  - iSCSI access to Fibre Channel
  - Pure iSCSI storage networks

- Fit additional network storage mechanisms
  - Network-attached storage
  - Object-based storage
The IP Storage Networking Model
Remote Mirroring over IP
IP/iSCSI Access to Fibre Channel
Pure iSCSI Storage Networks

Native IP/iSCSI devices

Native IP/iSCSI devices
IP Storage Application Deployments
Fluidity in the IP Storage Model

Platform Convergence Drivers
(NAS, SAN, Object)

- Ethernet and IP networks, IP Storage protocols
- PCs and Servers
- PCI-X, PCI-Express
- Serial ATA, IDE

Layered Model

- IP Core / Backbone
- Storage Distribution Layer
  - Intelligent Storage Nodes
  - Distributed Services
- Access
  - End Device Aggregation

Intelligent Storage Nodes

Storage Distribution

Access
Distributed Storage Intelligence
From Platforms to Storage Services

- Playing field is now open
  - Enough flexibility in network architectures

- Storage services can freely migrate
  - What to put where and why
## Basic Enterprise Storage Services

<table>
<thead>
<tr>
<th>Management</th>
<th>Capacity</th>
<th>Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAN administration</td>
<td>Volume virtualization</td>
<td>Mirroring and backup</td>
</tr>
<tr>
<td>Performance</td>
<td>Security</td>
<td>Availability</td>
</tr>
<tr>
<td>Network and I/O throughput</td>
<td>Authentication, access, encryption</td>
<td>Clustering and failover</td>
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<tr>
<td></td>
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<td></td>
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</tbody>
</table>
Primary Locations for Storage Services

- **Host based**
  - Servers
  - Mainframes

- **Fabric based**
  - Switches
  - Directors
  - Appliances

- **Device based**
  - Disks/RAIDs/Controllers
  - Filers
  - Tape libraries
Areas of Storage Intelligence

- **IP Core / Backbone**
- **Storage Distribution**
- **Access**

**Layers:**
- Fabric
- Subsystem
- Host
Network Optimization of Fabric Replication

Replication location

Host

Subsystem

Fabric

Network segments used

4

4

3
## Optimal Locations for Storage Services

<table>
<thead>
<tr>
<th>Feature</th>
<th>Implementation</th>
<th>Optimal Location</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manageability</td>
<td>• Application coordination</td>
<td>• Host</td>
<td>• Visibility, access, knowledge, reactive capability</td>
</tr>
<tr>
<td>Capacity</td>
<td>• LUN creation</td>
<td>• Target</td>
<td>• Disk aggregation</td>
</tr>
<tr>
<td>Recoverability</td>
<td>• Packet recovery&lt;br&gt;• Disk error</td>
<td>• Network&lt;br&gt;• Target or network</td>
<td>• Proximity, Recovery speed</td>
</tr>
<tr>
<td>Performance</td>
<td>• RAID 0</td>
<td>• Target</td>
<td>• Balance target throughput with network</td>
</tr>
<tr>
<td>Security</td>
<td>• Access control</td>
<td>• Network</td>
<td>• Knows ingress, egress points</td>
</tr>
<tr>
<td>Availability</td>
<td>• Mirroring</td>
<td>• Depends: network location optimizes bandwidth</td>
<td>• Similar to multicasting</td>
</tr>
</tbody>
</table>
## Benefits of Using an IP Storage Fabric

<table>
<thead>
<tr>
<th>Storage Service</th>
<th>Sample Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management</td>
<td>• Global addressing</td>
</tr>
<tr>
<td></td>
<td>• Address-based zoning</td>
</tr>
<tr>
<td>Availability</td>
<td>• Host-independent failover</td>
</tr>
</tbody>
</table>
Inherent Global Namespace with IP

- IP core
- IP storage distribution
- Access layer
Inherent Zoning of IP Addressing

Zoning through vendor-specific management software

Zoning through subnet assignment – no additional software required
Inherent Failover Capabilities of IP

Advantage of iSCSI Redirect

- Fibre Channel clustering:
  - Host interaction required for failover

- IP storage clustering:
  - Host-independent failover with iSCSI redirect
Services Require Multiple Technologies

- IP core and distribution
  - Global Domain
  - Flexibility

- Access layer
  - Local domain channel efficiency
  - Speed and performance
Quickest Route to An Intelligent Fabric

- Make use of IP networking conventions
- Allow for integration with other technologies
- Prepare for multiple storage platforms
Broad-based IP Storage Consolidation
Other Things to Consider

- Future market battles
- New software/hardware models
- Smarter Storage
Future Network Storage Battles

Long term competition

Short term competition

Host

Fabric

Subsystem
### New software/hardware models

<table>
<thead>
<tr>
<th>Software</th>
<th>Host</th>
<th>Fabric</th>
<th>Subsystem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent</td>
<td>Closed (Independent)</td>
<td>Closed</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Open</th>
<th>Proprietary</th>
<th>Proprietary</th>
</tr>
</thead>
</table>
Smarter Storage

- You can’t buy your data set at the store or on buy.com
  - Keeping storage safe means being smart
- Smart storage offers complete services
  - Manageability, Performance, Capacity
  - Security, Recovery, Availability
- Certain platforms make services easier
Additional Resources

- Coming June 2003
  - IP Storage Networking: Straight to the Core
    - www.straighttothecore.com

- Byte and Switch reports
  - IP SANs: Coming of Age
  - Artful Intelligence
    - www.byteandswitch.com