High-Availability Storage Area Network

with Adaptec FS4500 Storage Array and Emulex LP1050

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Introduction: The Business Continuance Challenge
As companies become ever more reliant on server-based applications and data, any event that interrupts access to that data—even for a few hours—threatens productivity and profitability. To ensure uninterrupted business activity, IT managers need flexible storage solutions that enable them to create high-availability environments that help prevent outages to ensure business continuance under all conditions.

The Solution: High-Availability Fibre Channel SAN
Storage Area Networks (SANs) are ideal for facilitating such a high-availability environment. A SAN interconnects multiple shared storage environments and servers into a storage network, with all storage resources available to any server, regardless of physical location. SANs offer the advantages of built-in redundancy, dynamic failover protection and automatic traffic rerouting. A high-availability SAN can also be tuned to enable load sharing to significantly improve overall performance.

Creating a high-availability SAN with Adaptec FS4500 storage array, Emulex LP1050 Fibre Channel Host Bus Adapter and Vixel InSpeed 355 loop switch
The Adaptec FS4500 is a high-performance, high-density Fibre Channel storage solution that delivers the performance, price and availability to meet today’s real-world enterprise requirements. Based on Serial ATA disk technology, RAID disk array technology, and Fibre Channel interface technology, the Adaptec FS4500 storage array offers exceptional price/performance and flexibility.

The Adaptec FS4500 helps ensure data availability with RAID storage arrays and highly reliable Serial ATA disks. And it is highly scalable, permitting rapid, cost-effective scaling of both capacity and performance. The FS4500 reduces management cost and complexity through simple, centralized management of all storage resources.

The configurations described and tested in this Solution Report combine the Adaptec FS4500 Storage Array with Emulex LP1050 Fibre Channel Host Bus Adapter and Vixel InSpeed 355 loop switch in a Fibre Channel SAN environment. Three SAN configurations were tested:

1. Fabric SAN Configuration
2. Windows 2003 2-node Cluster Configuration
3. Microsoft Exchange 2003 LoadSim Performance Configuration

Configuration Details
Note: Various Fibre Channel peripheral devices were tested randomly in different configurations from those listed below.

1. Fibre Channel Disk Array information
   Brand and Model: Adaptec FS4500
   Disk Array Firmware Level: 3.31
   Number of Disk Drives: 12

2. Fibre Channel Switch information
   Brand and Model: Vixel InSpeed 355
   Switch Type: Loop Switch
   Firmware Level: 2.04

3. SFP information
   Brand and Model: Finisar FTRJ-8519-3-2-5
   Brand and Model: IBM SFF-PGG-200-M5-SN-1
   Brand and Model: Stratos MPLC-20-8-1-8L
   Brand and Model: Agilent HFBR-5720L

4. Fibre Channel HBA information
   Brand and Model: Emulex LP1050
   Firmware Level: 1.90a4
   BIOS Version: 1.63A2
   Driver Version: 5-5.10a10
   PCI/PCI-X: PCI-X

5. Application information
   Backup application: Computer Associate ARCserve v11.1 for Windows
   Server Application: Microsoft Exchange 2003 Server

6. Operating system information
   Windows 2003 (Enterprise Server)
   Windows 2000 SP4 (Advance Server)

7. Management Software
   Spheras RAID Watcher v1.53
   HBAnywhere v.2.0a13

8. Test Tools
   NTstress v4.3
   NTFileCopy v1.0
   Microsoft LoadSim 2003
Test Configurations

Topology 1 Information
Transparent Failover Configuration (Active/Passive)

Server 1
Make and Model: Supermicro X5DPL
CPU: P4 / 3.0GHz Xeon
BIOS: Phoenix
Chipset: Intel E7501
Operating System: Windows 2003
HBA: LP1050
SFP: Stratos
Storage: LV0–RAID10;150GB(128K stripe size); Primary Controller Port 0

Server 2
Make and Model: Supermicro 6040 SuperServer
CPU: P3 / 1.0GHz
BIOS: AMI 7.00
Chipset: ServerWorks HE
Operating System: Windows 2000 SP4
HBA: LP1050
SFP: Finisar
Storage: LD0–RAID10;150GB(128K stripe size); Secondary Controller Port 0

Transparent Failover Configuration (Active/Active)

Server 1
Make and Model: Supermicro X5DPL
CPU: P4 / 3.0GHz Xeon
BIOS: Phoenix
Chipset: Intel E7501
Operating System: Windows 2003
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Chipset: ServerWorks HE
Operating System: Windows 2000 SP4
HBA: LP1050
SFP: Finisar
Storage: LD0–RAID10;150GB(128K stripe size); Secondary Controller Port 0

Test Results

<table>
<thead>
<tr>
<th>Test Case Number</th>
<th>Test Title</th>
<th>Storage Path</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1001</td>
<td>LUN zoning or disk assignment with management software to ensure each server has its own storage (Use multiple loop for FC4100 if supported)</td>
<td>S1&gt;(HBA1,FCDA1)-&gt;LV0 S2&gt;(HBA2,FCDA1)-&gt;LD0</td>
<td>PASS</td>
</tr>
<tr>
<td>1002</td>
<td>Disk array LUN Boot with associated OS installation</td>
<td>S1&gt;(HBA1,FCDA1)-&gt;LV0 S2&gt;(HBA2,FCDA1)-&gt;LD0</td>
<td>PASS</td>
</tr>
<tr>
<td>1003</td>
<td>NTStress</td>
<td>S1&gt;(HBA1,FCDA1)-&gt;LV0 S2&gt;(HBA2,FCDA1)-&gt;LD0</td>
<td>PASS</td>
</tr>
<tr>
<td>1004</td>
<td>NTFileTest</td>
<td>S1&gt;(HBA1,FCDA1)-&gt;LV0 S2&gt;(HBA2,FCDA1)-&gt;LD0</td>
<td>PASS</td>
</tr>
<tr>
<td>1005</td>
<td>Dynamic configuration test (cable pull, target power recycle, switch port enable-disable/power recycle, etc.)</td>
<td>S1&gt;(HBA1,FCDA1)-&gt;LV0 S2&gt;(HBA2,FCDA1)-&gt;LD0</td>
<td>PASS</td>
</tr>
<tr>
<td>1006</td>
<td>Transparent RAID controller failover (non multi-path failover)</td>
<td>S1&gt;(HBA1,FCDA1)-&gt;LV0 S2&gt;(HBA2,FCDA1)-&gt;LD0</td>
<td>Active/Passive - PASS Active/Active - PASS</td>
</tr>
<tr>
<td>1007</td>
<td>ARCserve v11.1 for Windows installation and configuration</td>
<td>S1&gt;(HBA1,FCDA1)-&gt;LV0</td>
<td>PASS</td>
</tr>
<tr>
<td>1008</td>
<td>Perform disk-to-disk backup test</td>
<td>S1&gt;(HBA1,FCDA1)-&gt;LV0 S2&gt;(HBA2,FCDA1)-&gt;LD0</td>
<td>PASS</td>
</tr>
</tbody>
</table>
Topologies

Server 1
Make and Model: Supermicro X5DA8
CPU: P4 / 3.2GHz Xeon (x2)
BIOS: Phoenix
Chipset: Intel E7505
Operating System: Windows 2003
HBA: LP1050
SFP: Finisar

Server 2
Make and Model: Supermicro X5DPL
CPU: P4 / 3.0GHz Xeon
BIOS: Phoenix
Chipset: Intel E7501
Operating System: Windows 2003
HBA: LP1050
SFP: Agilent

PDC
Make and Model: Micro Star 649D Pro
CPU: P3 / 700MHz
BIOS: Award
Chipset: VIA 694XDP
Operating System: Windows 2000 SP4
HBA: LP1050

Test Results

<table>
<thead>
<tr>
<th>Test Case Number</th>
<th>Test Title</th>
<th>Storage Path</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1101</td>
<td>2-Node Cluster Install Test</td>
<td>S1&gt;&gt;(, HBA1, FCDA1)</td>
<td>PASS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S2&gt;&gt;(HBA2, FCDA1)</td>
<td></td>
</tr>
<tr>
<td>1102</td>
<td>Cluster Node Add/Remove Test</td>
<td>S1&gt;&gt;(, HBA1, FCDA1)</td>
<td>PASS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S2&gt;&gt;(HBA2, FCDA1)</td>
<td></td>
</tr>
<tr>
<td>1103</td>
<td>Cluster Node Failure Test</td>
<td>S1&gt;&gt;(, HBA1, FCDA1)</td>
<td>PASS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S2&gt;&gt;(HBA2, FCDA1)</td>
<td></td>
</tr>
<tr>
<td>1104</td>
<td>Cluster SAN Connection Failure Test</td>
<td>S1&gt;&gt;(, HBA1, FCDA1)</td>
<td>PASS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S2&gt;&gt;(HBA2, FCDA1)</td>
<td></td>
</tr>
<tr>
<td>1105</td>
<td>Cluster Node Network Failure Test</td>
<td>S1&gt;&gt;(, HBA1, FCDA1)</td>
<td>PASS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S2&gt;&gt;(HBA2, FCDA1)</td>
<td></td>
</tr>
<tr>
<td>1106</td>
<td>MS Exchange 2003 Cluster with LoadSim Test (50</td>
<td>S1&gt;&gt;(, HBA1, FCDA1)</td>
<td>PASS</td>
</tr>
<tr>
<td></td>
<td>simulated users)</td>
<td>S2&gt;&gt;(HBA2, FCDA1)</td>
<td></td>
</tr>
<tr>
<td>1107</td>
<td>MS Cluster HCT – 2 tests</td>
<td>S1&gt;&gt;(, HBA1, FCDA1)</td>
<td>Move N Node – PASS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S2&gt;&gt;(HBA2, FCDA1)</td>
<td>Crash N Node -PASS</td>
</tr>
</tbody>
</table>
Adaptec FS4500 Storage Array and Emulex LP1050

Topology 3 Information

Server 1
Make and Model: Super Micro X5DA8
CPU: P4 / 3.2GHz Xeon (x2)
BIOS: Phoenix
Chipset: Intel E7505
Operating System: Windows 2003
HBA: LP1050
SFP: Agilent

PDC
Make and Model: Micro Star 649D Pro
CPU: P3 / 700MHz
BIOS: Award
Chipset: VIA 694XDP
Operating System: Windows 2003
Client Load Generators
Make and Model: Super Micro Super Server 5011E
CPU: P3 / 1GHz
BIOS: AMI
Chipset: Intel 815E

Topology 3: Microsoft Exchange 2003 LoadSim Performance Configuration

Test Results

<table>
<thead>
<tr>
<th>Test Case Number</th>
<th>Test Title</th>
<th>Storage Path</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1201</td>
<td>LoadSim performance test</td>
<td>S1=&gt;(, HBA1, FCDA1)</td>
<td>Not Run (See Performance Test Section and FYI section for details)</td>
</tr>
</tbody>
</table>
Performance Testing

For Exchange Server 2003, performance is measured using the MAPI Messaging Benchmark 3 (MMB3) included in the Microsoft LoadSim 2003 utility. The benchmark measures the performance of an Exchange Server and provides the results as a function of response time. In particular, the 95th percentile response means that the vast majority of the clients attached to the Exchange Server under test will experience this response time when accessing the Exchange Server. Microsoft guidelines suggest that the weighted average of LoadSim-measured 95th-percentile responses measure at less than 1 second (expressed as 1000ms).

Please note that LoadSim performance numbers with the LP1050 HBAs and Vixel InSpeed 355 switch are not available due to some issues encountered during testing. In particular, the performance numbers using the LP1050 were very poor due to the fact that the Vixel InSpeed 355 switch was a loop switch. For optimal LoadSim performance numbers, the FS4500 must be set to point-to-point mode and this was not possible when connected to the InSpeed 355 loop switch (please see the Additional Information section below for further details).

Below are performance results with the LP1050 HBA and a QLogic SANbox 5200 switch. The FS4500 was operating in Point-to-Point mode in the test configuration.

<table>
<thead>
<tr>
<th>95th Percentile Score (in milliseconds)</th>
<th>Emulex LP1050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client 1</td>
<td>977</td>
</tr>
<tr>
<td>Client 2</td>
<td>903</td>
</tr>
<tr>
<td>Client 3</td>
<td>898</td>
</tr>
<tr>
<td>Client 4</td>
<td>1342</td>
</tr>
<tr>
<td>Client 5</td>
<td>1338</td>
</tr>
<tr>
<td>Average</td>
<td>1091</td>
</tr>
</tbody>
</table>

Additional Information

Poor LoadSim Performance Response Times

Running the MS LoadSIM tests on an Exchange setup using the Adaptec FS4500 and an Emulex LP1050 Fibre Channel HBA results in very poor performance numbers. The 95th percentile response time results ranged from 12 seconds to more than 15 seconds. An acceptable result is around 1000ms (1 second) or less.

Also note that previous testing with the Emulex LP1050 and the Adaptec SANBloc 2502 resulted in a 95th percentile response time of ~1000ms.

FS4500: Fabric Loop and Point-to-Point Mode

In testing the FS4500, we’ve observed there are performance differences when setting the FS4500 controller properties to Fabric Loop mode versus Point-to-Point mode.

For optimal performance results in our MS Exchange LoadSim test configuration, the FS4500 must be set to Point-to-Point mode. When setting the FS4500 to Fabric Loop mode, the response times were substantially slower.

Please note that with using the Vixel InSpeed 355 Loop switch, we could not test the FS4500 in Point-to-Point mode to obtain the best possible MS Exchange LoadSim performance results.
## Detailed Test Cases

<table>
<thead>
<tr>
<th>Module/ Test Case No.</th>
<th>Test Suite / Test Title</th>
<th>Test Case Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 General Tests</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 1001                  | LUN zoning or disk assignment with management software to ensure each server has its own storage | - Use associated management software to create LUNs and assign them to different servers  
- For JBODs use multiple loop capability to assign disks to different servers |
| 1002                  | Disk Array LUN Boot with associated OS installation | - Use the assigned FC LUNs or disks to install operating systems  
- Try to boot from these LUNs or disks after OS installation |
| 1003                  | NTStress Test           | - For JBOD, create one or more software RAID 5 disks  
- Run NTStress or LxStress (block IO ) test tools with the FC LUNs or disks |
| 1004                  | NTFileTest Test         | - For JBOD, create one or more software RAID 5 disks  
- Run NTStress or LxStress (file copy/compare) test tools with the FC LUNs or disks |
| 1005 Dynamic configuration test (cable pull, target power recycle, switch port enable-disable/power recycle, etc.) | - Single host join with I/O  
- Configure one to many servers in the SAN, start I/O from all but one of the hosts.  
- While I/O is running join the SAN with the other host, ensure that the I/O recovers and there is no data miscompare.  
- Single host restart with I/O.  
- Configure one to many hosts in a SAN, start I/O from all but one of the servers.  
- While I/O is running restart the server with no I/O, ensure that the I/O on other hosts recovers and there is no data miscompare.  
- Cable pull with I/O  
- Configure two to many hosts in a SAN, start I/O from all of the servers.  
- While I/O is running pull the FC cable from a storage device that has I/O running to it, wait 5 to 20 seconds.  
- Re-insert the FC cable into the storage device, ensure that all I/O to all hosts recovers and there are no data miscompares.  
- Device pull from storage enclosure with I/O.  
- Configure two to many hosts in a SAN, start I/O from all of the servers.  
- While I/O is running pull a device (hard disk, etc) from any storage enclosure that has I/O running to it, wait 5 to 20 seconds.  
- Re-insert the device into the storage enclosure, ensure that all I/O to all hosts recovers and there are no data miscompares.  
- Interconnect restart.  
- Configure two to many hosts in a SAN, start I/O from all of the servers.  
- Unplug the power cord from the hub/switch while I/O is running.  
- Plug the cord backs in and wait for the hub/switch to boot. Ensure that when the hub/switch comes back up all hosts resume I/O without data miscompare |
| 1006 Transparent RAID controller failover (non multi-path failover) | - Configure the disk array to allow transparent failover of controller(if the disk array supports).  
- Connect both controllers to the same switch.  
- Connect the hosts to the switch and run I/Os with their associate LUNs/disks.  
- Fail one controller by pull it out of the enclosure.  
- Verify the I/Os continue on hosts |
| 1007 ARCserve v11.1 for Windows installation and configuration | - Set up and configure the ARCserve 11.1 for Windows server on a Windows 2003/2000 host.  
- Create file system devices with the FC LUNs or disks. |
| 1010 Disk to Disk backup | - Perform “Disk to Disk” backup with scheduled backup & source >= 30GB. |
Adaptec FS4500 Storage Array and Emulex LP1050

<table>
<thead>
<tr>
<th>Module/Test Case No.</th>
<th>Test Suite/Test Title</th>
<th>Test Case Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1100</td>
<td>Cluster Tests</td>
<td></td>
</tr>
<tr>
<td>1101</td>
<td>2-Node Cluster Install Test</td>
<td>Verify that you can successfully install and setup a 2-Node Cluster and that both Nodes report active in the Cluster Management Utility for the OS you are using.</td>
</tr>
</tbody>
</table>
| 1102                | Cluster Node add/remove Test | Using the Cluster utility for the OS you are testing REMOVE one of the nodes from the Cluster.  
Ensure that the resources, which were running on that Cluster node, migrate to a second node in the Cluster.  
After the resource migrates, re-join the Cluster with the node you removed.  
Migrate the resource back to the joined Cluster and verify its operation. |
| 1103                | Cluster Node Failure Test | While all nodes are in the Cluster, turn off one server and insure its resources migrate to another node.  
Turn the server back on and verify it rejoins the Cluster.  
Verify that the node resources can be migrated back to it |
| 1104                | Cluster SAN Connection Failure Test | While all nodes are in the Cluster, disconnect the SAN connection from one of the nodes in the Cluster.  
Ensure that the Cluster node fails and that all its resources migrate to another node in the Cluster.  
Plug the SAN connection back into the failed node and VERIFY you can re-join the Cluster with that node.  
Ensure you can migrate the node resources back to it |
| 1105                | Cluster Node Network Failure Test | While all nodes are in the cluster, disconnect the private LAN connection from the active node to force it to fail over to the other node.  
Verify the cluster resources migrate over to the other cluster node.  
Reconnect the downed node’s private LAN connection and restart the server.  
Make sure it successfully re-joins the cluster and can the cluster resources fail back to it. |
| 1106                | MS Exchange 2003 Cluster with LoadSim test | Configure an Exchange cluster server to support running LoadSim  
On the client system run LoadSim with 50 users for 4 hours |
| 1200                | MS Exchange 2003 LoadSim Performance test | Setup 3 additional mailbox stores on the Exchange 2003 server. These mailboxes will use the RAID10 Logical Volumes from the FS4500  
Create a topology of 1250 simulated users using LoadSim  
Configure the test parameters so that the test will run for 4 daytime hours  
Initialize the topology from each of the Client Load Generator systems. Verify that 0 errors occur during initialization prior to running the test.  
After performance run has completed, execute the lslog command to obtain performance results from each Client Load Generator system |

Summary

The combination of the Adaptec FS4500 storage array and Emulex LP1050 Fibre Channel HBAs and Vixel InSpeed 355 loop switch provide a flexible, reliable and easily managed solution for deploying high-availability SANs using a variety of configurations. Topologies can be designed to meet specific availability or architecture requirements without compromising ease of management or reliability.