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Veritas Storage Foundation for Windows

Dynamic Multi-pathing Competetive Comparisons

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Introduction

Multi-pathing software provides the intelligence necessary to manage multiple I/O paths between a server and a storage subsystem. Without multi-pathing software, the server operating system presents applications with multiple images of a disk or LUN (one for each I/O path discovered), which can result in data corruption.

At its most basic, multi-pathing software has two main modes of operation. When configured for redundancy, a single path is dedicated to I/O transfer, while other paths are in standby mode. The software manages failover between the I/O paths, thus eliminating the potential for a single point of failure. If connectivity along one path to a storage device is interrupted, the multi-pathing software dynamically switches I/Os to a surviving path, allowing application access to continue unimpeded. The other mode of operation allows for all paths to be utilized for I/O transfer. This can improve performance by leveraging the presence of these multiple paths, increasing the available bandwidth for I/O traffic.

Veritas Storage Foundation Dynamic Multi-pathing Option

Most multi-pathing solutions are developed by storage vendors for their specific brand of storage and, as such, generally cannot service the many various types of storage that exist in many of today's heterogeneous SAN environments. Unlike these mostly proprietary solutions, Veritas Storage Foundation for Windows Dynamic Multi-pathing is a truly heterogeneous solution which fully integrates with the Microsoft® Multipath I/O (MPIO) architecture, including several Device Specific Modules (DSMs) which provide support for a wide variety of the most popular array families available today from the leading storage vendors. In addition to the benefits of heterogeneity, Veritas Dynamic Multi-pathing offers several advantages over other multi-pathing solutions, such as:

- GUI/CLI management for heterogeneous storage from a common user interface
- Array visualization from the GUI
- SNMP alerts for path failure and recovery
- Path performance statistics
- Microsoft WHQL logo qualification
- Fibre Channel and iSCSI support

Defining multi-pathing and load balancing

Dynamic Multi-pathing operates in two basic modes: Active/Passive mode, where a single path is dedicated to data transfer, while other paths act as failover targets to provide fault tolerance should the primary path fail; and Active/Active mode, where multiple paths are utilized for I/O transfer to provide improved performance through I/O load balancing.

Active/Passive

In its simplest form, Active/Passive multi-pathing is just that: one active path for I/O traffic, with other paths being passive. However, through special configuration, environments using Active/Passive multi-pathing can also be made to concurrently utilize multiple paths. This is known as Active/Passive Concurrent multi-pathing (also referred to as Dual-Active multi-pathing), and is important in cluster environments that use SCSI-2 protocols. This is accomplished through multi-pathing software that allows for configuring at the device (LUN) level instead of (or in addition to) at the array level. By configuring the preferred path for data transfer at the device level, specific paths can be dedicated to specific LUNs. This allows multiple paths, each configured as the preferred path for its specific LUN, to be used for data transfer. Note that the array also must support this.

Active/Active

Active/Active multi-pathing has more variations than Active/Passive. There are several different load-balancing algorithms available today. Although some of these algorithms may be referred to by different names, their functionality is the same. Table 1 describes some of these algorithms, along with some of their various other acronyms.

Table 1 Load-Balancing Algorithm

Algorithm	Other Names	Description	Comments
Round Robin		Equally distributes I/O among the paths in round-robin sequence	
Dynamic Least Queue Depth	Least I/O; Minimum Queue; Smart; Shortest Queue Requests (HP)	Schedules I/O through the path with the least number of I/Os pending.	Useful with JBOD configurations
Balanced Path		Uses an algorithm to balance random I/Os across all available paths.	Good for a wide variety of applications; optimizes built-in cache in the RAID controllers or disk drives
Adaptive (EMC)	Adaptive Load Balance (HP)	Paths selected based on an algorithm that takes into account the load and priority.	Adaptive load balance works in conjunction with load balancing policy.
StreamIO (EMC)	Load balancing sequential (IBM)	Uses the same path for I/O to a volume/LUN as was previously used until the pending number of I/Os exceeds the threshold value set for the volume, after which a new path is selected based in the adaptive policy algorithm.	StreamIO can improve the performance of small I/Os (for example, an application sending sequential I/Os down the same device) LBS (IBM) provides optimization for sequential I/O.
Round Robin Sequential (IBM)		Round robin with optimization for sequential I/O	
Weighted Paths	Least Bandwidth;	Paths are assigned a user specified weight which designates their priority for data transfer. Lower weights have higher ptiority.	Good for I/O loads that can vary over time; e.g., a database can have both long transfers (table scans) and short transfers (random look-ups).
Round Robin with Subset	Priority	Uses a subset of paths in turn, in round-robin fashion. The user specifies the paths for data transfer that make up the subset. The remaining paths are in standby mode.	
Least Blocks		Load balancing is based on the number of blocks in pending I/Os. I/O requests are routed to the path with the fewest queued blocks.	
Shortest Queue Bytes		Selects the path with least outstanding I/O bytes.	HP
Shortest Queue Service Time		Chooses the path with the least outstanding I/O service time for the incoming I/O request.	HP
Subset based load balancing		Implements subset based load balancing algorithms that allow only a selected set of paths to be used for I/O requests.	The subset setting is supported on a per logical unit basis and works in conjunction with the load balancing policies supported by the DSM.
Extended round robin Extended Least I/O Extended Least Blocks		Distributes I/Os to paths depending on the type of I/O; sequential access or random access. For sequential access, I/ Os are issued to a single path. For random access, I/Os will be distributed to multiple paths based on the load-balancing policy.	HDLM

Algorithm	Other Names	Description	Comments
Active/Passive (no load-balancing)	Failover; Failback	No load balancing done. The path designated as the "Preferred Path" or "Primary Path" is always active and the other path or paths act as backups (standby paths) that are called into service if the current operating path fails.	Failover: I/O requests use the primary path; standby paths are used in decreasing order of preference if the primary path fails. Failback: Preferred path used for I/O requests; alternate paths used if it fails, but I/O automatically moves back to the preferred path when it is restored .

Competitive comparisons

As already mentioned, in addition to Veritas Dynamic Mult-pathing, there are several other multi-pathing solutions available from hardware vendors, some of which also provide support for other vendors' storage. Veritas Dynamic Mult-pathing is truly heterogeneous, meaning that it has no hardware agenda; see the Veritas Dynamic Multi-pathing HCL for a complete listing of supported hardware. Most of the other multi-pathing solutions are provided by hardware vendors, and are specific to the arrays manufactured by those vendors. Among the most popular are applications from EMC (PowerPath), HP (MPIO DSM), Hitachi (HDLM), and IBM (SDDDSM). These applications also enable many different features and offer a variety of load-balancing algorithms, as defined above. This paper will compare solutions from Symantec and some of the other vendors.

Table 2 gives a side-by-side comparison of the available features and load-balancing options available with these applications.

Table 3 gives a side-by-side comparison of the hardware arrays supported by each of these applications.

Table 2 Multi-pathing Feature Comparisons

Product	Veritas SFW 5.1 SP1 DDI-1 DMP	Microsoft MPIO DSM (W2K8 R2)	EMC PowerPath 5.3	HP MPIO DSM[1]	Hitachi HDLM 6.4	IBM SDDDSM 2.4.2.1-2
System Management						
GUI Multi-pathing Management	•	•	•	•	•	
CLI Multi-pathing Management	•	•	•	•	•	•
GUI Visualization of Array	•		•		•	
SNMP Alerts for Path Failures	•		•		•	
Path Performance Statistics	•	•	•		•	
Proactive Path Checking	•	•	•	•	•	•
Intermittent error monitoring[2]		•			•	
SNMP Alerts for Path Recovery	•		•		•	
Multi-pathing						
Automatic I/O Path Failover Detection	•	•	•	•	•	•
Dynamic Reconfiguration & Recovery	•	•	•	•	•	•
Auto Failback	•	•	•	•	•	•
Dynamic Path Recognition	•	•	•	•	•	•
Maintenance Mode Support	•			•	•	•
Encryption with RSA[3]			•			
Load Balancing						
Active/Passive (Failover Only)	•	•	•	•		•
Round Robin	•	•	•	•	•	•
Dynamic Least Queue Depth	•	•	•	•	•	•
Least Blocks	•		•		•	
Weighted Path	•	•	•			
Balanced Path	•					
Round Robin with Subset	•	•		•		
Adaptive			•	•		

[1] v4.01.00 for SAN Virtualization Services, XP and EVA; v3.02.00 for MSA
[2] An intermittent error means an error that occurs irregularly because of some reason such as a loose cable connection. I/O performance might decrease when an intermittent error occurs while automatic failback is used, because automatic failback is performed repeatedly. To prevent this phenomenon, HDLM can automatically remove the path where an intermittent error is occurring from those paths subject to automatic failback. This process is called intermittent error monitoring.
[3] PowerPath Encryption ensures the confidentiality of data on a disk drive that is physically removed from a data center and prevents unauthorized reading or using of the data on that device by using strong encryption protocols to safeguard sensitive data on the disk devices. It transparently encrypts data written to a disk device and decrypts data read from it.

Product	Veritas SFW 5.1 SP1 DDI-1 DMP	Microsoft MPIO DSM (W2K8 R2)	EMC PowerPath 5.3	HP MPIO DSM[1]	Hitachi HDLM 6.4	IBM SDDDSM 2.4.2.1-2
StreamIO / LBS			•			•
Round Robin Sequential						•
Shortest Queue Service Time				•		
Shortest Queue Bytes				•		
Subset based load balancing				•		
Extended Round Robin					•	
Extended Least I/ O					•	
Extended Least Blocks					•	
ALUA	•	•	•	•	•	•
Active/Active load-balancing with Clustering	•	•	•	•	•	•
Windows OS Support						
Windows Server 2003 (32-bit)	•	•	•	•	•	•
Windows Server 2003 (64-bit Itanium)	•	•			•	•
Windows Server 2003 (64-bit, x64 Opteron or Xeon®)	•	•			•	•
Windows Server 2008 (32-bit)	•		•		•[4]	•
Windows Server 2008 (64-bit Itanium)	•		•		•	•
Windows Server 2008 (64-bit, x64 Opteron/Xeon®)	•		•		•	•
Windows Server 2008 R2 (64-bit Itanium)		•				
Windows Server 2008 R2 (64-bit, x64 Opteron/Xeon®)		•				
Standards Support						
Microsoft MPIO-based	•	•	•	•	•	•
Microsoft WHQL logo qualified	•	•	•			
Fibre Channel SAN Support	•	•	•	•	•	•
iSCSI SAN Support	•	•	•	•	•	
iSCSI Software Initiator	•	•	•	•	•	
SCSI-3 PGR Support	•	•	•	•	•	•

[4] See Hitachi documentation for a complete list of arrays supported with Windows Server 2008.

Table 3 Array Support Comparisons

Product	Veritas SFW 5.1 SP1 DDI1 DMP	Microsoft MPIO DSM (W2K8 R2)	EMC PowerPath 5.2	HP MPIO DSM	Hitachi HDLM 6.4	IBM SDDDSM 2.4.2.1-2
Heterogeneous Array Support	•	•[5]	•		•	
3PAR InServ E200, S400, S800	•					
Compellent Storage Center	•					
Dell Equallogic	•					
EMC CLARiiON AX/CX/CX-3 Ultrascale Series Arrays	•		•		•[6]	
EMC Symmetrix 3000 Series	•		•			
EMC Symmetrix 8000 Series	•		•			
EMC Symmetrix DMX Series	•		•		•[7]	
EMC Symmetrix V-Max	•		•			
EMC Invista Arrays			•			
Fujitsu ETERNUS2000 Series	•					
Fujitsu ETERNUS4000 Series (excludes Models 80 & 100)	•					
Fujitsu ETERNUS6000 Series	•					
Fujitsu ETERNUS8000 Series	•					
Fujitsu ETERNUS DX60/DX80/DX90	•					
Fujitsu ETERNUS DX8000/DX400 Series	•					
Hitachi 9200 Freedom Series					•	
Hitachi 9500 V Thunder Series	•			•	•	
Hitachi 9900 Lightning Series (9900 and 9900 V)	•		•	•	•	
Hitachi SANRISE 2000	•			•	•	
Hitachi SANRISE 9900 V	•			•	•	
Hitachi TagmaStore Universal Storage Platform	•		•	•	•	
Hitachi TagmaStore Network Storage Controller	•					
Hitachi TagmaStore Adaptable Modular Storage	•					
Hitachi TagmaStore Workgroup Modular Storageh	•					
Hitachi USP-V, USP-VM	•		•		•	
Hitachi SMS					•	

[5] You can use the Microsoft DSM if it is also supported by the storage array manufacturer
[6] EMC CLARiiON CX Series only. Windows Server 2008 supported with HDLM v6.4 and later.
[7] Windows Server 2003 32-bit OS platform only. Windows Server 2003 (x64) and Wndows Server 2008 not supported

Product	Veritas SFW 5.1 SP1 DDI1 DMP	Microsoft MPIO DSM (W2K8 R2)	EMC PowerPath 5.2	HP MPIO DSM	Hitachi HDLM 6.4	IBM SDDDSM 2.4.2.1-2
HP Proliant DL380 G5 Storage Server	•					
HP StorageWorks EVA4x00/EVA6x00	•				•[8]	
HP StorageWorks EVA8x00	•		•		•[9]	
HP StorageWorks EVA4400, EVA6400, EVA 8400	•				•[10]	
HP StorageWorks EVA3000/EVA5000	•		•	•	•[11]	
HP StorageWorks MSA 1000/MSA 1500	•			•		
HP StorageWorks MSA 2012/2212	•					
HP StorageWorks MSA 2312/2324	•					
HP StorageWorks XP10000/XP12000/XP20000/XP24000	•		•	•	•	
HP SureStore E Disk Array XP128/XP1024	•		•	•	•	
HP SureStore E Disk Array XP48/XP512	•		•	•	•	
HP SAN Virtualization Services				•		
Huawei Symantec S2300	•					
Huawei Symantec S2600F, S2600C	•					
Huawei Symantec S5300/S5500/S5600	•					
Huawei Symantec S6800E	•					
Huawei Symantec VIS6000	•					
IBM® System Storage™ N3000, N5000, N7000 Series	•					•
IBM System Storage™ DS3200	•					•
IBM System Storage N3000/ N5000/N7000 Series	•					•
IBM TotalStorage® ESS 800/ESS 750	•					•
IBM TotalStorage® ESS 2105 F20			•			
IBM System Storage DS3300	•					•
IBM System Storage DS3400	•					•
IBM System Storage DS8000 Series	•					•
IBM System Storage DS6000 Series	•					•
IBM System Storage DS5000 Series	•					•
IBM System Storage DS4000 Series	•					•

[8] Windows Server 2003 OS platform only. Windows Server 2008 not supported
[9] Windows Server 2003 OS platform only. Windows Server 2008 not supported
[10] Windows Server 2003 OS platform only. Windows Server 2008 not supported
[11] Windows Server 2003 OS platform only. Windows Server 2008 not supported

Product	Veritas SFW 5.1 SP1 DDI1 DMP	Microsoft MPIO DSM (W2K8 R2)	EMC PowerPath 5.2	HP MPIO DSM	Hitachi HDLM 6.4	IBM SDDDSM 2.4.2.1-2
IBM System Storage™ SAN Volume Controller	•					•
IBM XIV	•					
Network Appliance FAS2000/FAS900/FAS200 Series	•					
Network Appliance FAS3000/V3000 Series	•					
Network Appliance FAS6000/V6000 Series	•					
Network Appliance V-Series (GF980cm GF960c, GF270c, V3020, V3050, v6030, V6070))	•					
Network Appliance NearStore Series	•					
Nihon Unisys SANArena 2200 Series (2200 & 2800)	•					
Pillar Data Axiom 300/500/600	•					
Sun™ StorageTek 2500 Series	•					
Sun™ StorageTek FlexLine 380	•					
Sun StorEdge™ 6130, 6140, 6540 Array	•					
Sun StorEdge™ 6180	•					
Sun™ StorageTek 6580/6780	•					
Sun StorEdge™ 9900 Series (SE9910 & SE9960)	•					
Sun StorEdge 9900V Series (SE9970V & SE9980V)	•					
Sun StorEdge™ 9990 Series	•					
XioTech	•					

Summary

Veritas Storage Foundation for Windows Dynamic Multi-pathing is the industry's leading SAN storage multi-pathing solution for mission critical Windows servers. Veritas Dynamic Multi-pathing is fully compliant with the Microsoft Windows MPIO Framework, offering several Device Specific Modules (DSM) to provide support for array families from leading vendors such as EMC, HP, Hitachi HDS, IBM and Network Appliance, as well as a providing a feature rich solution unparalleled in the industry. Whether you are looking for an array independent multi-pathing solution for your Windows 'SAN Builds' or a feature-rich solution to improve storage performance and management, Veritas Dynamic Multi-pathing is the ideal choice for your Windows servers.

About Symantec

Symantec is a global leader in infrastructure software, enabling businesses and consumers to have confidence in a connected world. The company helps customers protect their infrastructure, information, and interactions by delivering software and services that address risks to security, availability, compliance, and performance. Headquartered in Cupertino, Calif., Symantec has operations in 40 countries. More information is available at www.symantec.com.

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