IBM Storwize family products and the Microsoft SQL Server I/O Reliability program

David West

IBM Systems and Technology Group ISV Enablement
October 2013

@IBMSysmsISVs
# Table of contents

Abstract........................................................................................................................................... 1  
Introduction ...................................................................................................................................... 1  
Core requirements......................................................................................................................... 1  
  Core 1.00 Windows logo certification ......................................................................................... 1  
  Core 1.01 Core Windows API support ......................................................................................... 2  
  Core 1.02 Stable media ................................................................................................................. 2  
  Core 1.03 Forced Unit Access (FUA) and write-through ............................................................ 2  
  Core 1.04 Asynchronous capabilities ......................................................................................... 3  
  Core 1.05 Write ordering ............................................................................................................. 3  
  Core 1.06 Torn I/O protection ..................................................................................................... 3  
  Core 1.07 NTFS support ............................................................................................................. 3  
  Core 1.08 Testing ......................................................................................................................... 3  
Advanced requirements.................................................................................................................. 4  
  Advanced 2.01 Write ordering – remote storage systems .......................................................... 4  
     Synchronous replication – IBM Metro Mirror ............................................................................ 4  
     Asynchronous replication – IBM Global Mirror .................................................................... 4  
  Advanced 2.02 Transactional sector / block rewrites ............................................................... 4  
  Advanced 2.03 Virtual device interface ...................................................................................... 5  
  Advanced 2.04 Clustering ........................................................................................................... 5  
  Advanced 2.05 File streams ....................................................................................................... 5  
  Advanced 2.06 Protection ........................................................................................................... 5  
  Advanced 2.07 Hardware virtualization ..................................................................................... 5  
Conclusion..................................................................................................................................... 6  
Resources...................................................................................................................................... 7  
Trademark and special notices ..................................................................................................... 8
Abstract

This white paper covers the IBM Storwize family products in the Microsoft SQL Server I/O Reliability program. The program provides a framework for the required behaviors an I/O subsystem must provide to fully support Microsoft SQL Server. The storage system reliability is tested with the Microsoft SQLIOSim utility, and the results are verified by the Microsoft SQL team.


Introduction

To ensure Microsoft® SQL Server reliability, integrity, and availability, Microsoft has developed a set of requirements for storage vendors to analyze and validate systems compatibility with SQL Server storage technologies and standards. Each requirement is included in this analysis report, with a general summary of specific compliance and any additional detailed information, where applicable.

The IBM® Storwize® family products all run the same code base, hardware architecture and feature sets, with all systems equally compliant with the program requirements. The Storwize family currently includes the following storage systems:

- IBM Storwize V7000
- IBM Storwize V3500 and Storwize V3700
- IBM Storwize V5000

All required tests were run on the Storwize V7000, as a well-known and reliable representation of the related Storwize family systems, using the latest 7.01 Storwize software.

You can find more detailed information about the Storwize family systems at:

ibm.com/systems/storage/storwize/

Core requirements

This section provides information about each of the core compliance requirements from Microsoft for the IBM Storwize family products and SQL Server 2012. Full compliance with these standards is required for membership in the SQL Server I/O Reliability program.

Core 1.00 Windows logo certification

Each of the IBM Storwize family products are Microsoft Windows® Server logo certified. IBM certifies all storage systems for the Windows Server platform.
The specific logo certifications for the Storwize family can be viewed at the following pages on the Microsoft Windows Server catalog website:

- IBM Storwize V7000
  
  http://www.windowsservercatalog.com/item.aspx?idItem=f2b9709b-a0ae-1a88-8397-bcf950a36a7b&bCatID=1282

- IBM Storwize V3500 (China only)
  
  http://www.windowsservercatalog.com/item.aspx?idItem=0994ab39-1c41-4dfd-5cc6-78cb0c48d9a7&bCatID=1282

- IBM Storwize V3700
  
  http://www.windowsservercatalog.com/item.aspx?idItem=780b1fc5-97c1-d605-ec1a-893277c4056b&bCatID=1282

- IBM Storwize V5000
  
  http://www.windowsservercatalog.com/item.aspx?idItem=b9595231-3df6-3715-b3f5-d05087be6410&bCatID=1282

### Core 1.01 Core Windows API support

Microsoft has identified several APIs that are required by SQL server to provide secure data storage. The IBM Storwize family systems support these APIs. The following APIs are required.

- CreateFile
- DeviceIoControl
- FlushFileBuffers
- GetVolumePathName
- GetVolumeInformation
- GetVolumeNameForVolumeMountPoint

### Core 1.02 Stable media

The Storwize family systems support the SQL storage requirements for Write-Ahead Logging (WAL). The WAL protocol provides the Atomicity, Consistency, Isolation, and Durability (ACID) database properties that SQL relies on for data integrity.

You can find further information on this can at: http://technet.microsoft.com/en-us/library/cc917726.aspx

### Core 1.03 Forced Unit Access (FUA) and write-through

SQL Server uses FILE_FLAG_WRITETHROUGH and FlushFileBuffers to process files without data loss. In order to fully support Write-Ahead Logging and write-to-stable media intent, both of these must be supported.

All IBM Storwize family systems comply with this requirement. The systems also use battery-backed mirrored cache. The battery backup system takes over in the event of a power interruption, ensuring all
cached data is protected. A write is not considered complete until it resides on the stable media. In the event of a prolonged power outage, the system properly destages all I/O to disk before cleanly shutting down.

**Core 1.04 Asynchronous capabilities**

Microsoft SQL Server handles most of its I/O using asynchronous operations. If a request specifies an asynchronous process, nothing within the storage system should result in a synchronous condition. Unexpected synchronous I/O can result in SQL scheduler and concurrency issues.

All Storwize family systems maintain asynchronous I/O processes, and fully support this requirement.

**Core 1.05 Write ordering**

The Storwize systems support the Write-Ahead Logging protocol, as mentioned previously, to prevent database corruption and have implemented the write ordering or order preservation to ensure consistency, including during mirrored-replication operations.

**Core 1.06 Torn I/O protection**

The Storwize family supports standard NTFS sector sizing to meet torn I/O protection requirements. No specific storage system configuration is needed to meet this requirement. Specific sector alignment is no longer needed on Windows Server 2008 and later versions.

**Core 1.07 NTFS support**

All stated NTFS requirements are fully supported by the Storwize family systems including:

- Sparse files
- File streams
- Encryption
- Compression
- Security properties

**Core 1.08 Testing**

Testing was completed using the latest version of the Microsoft SQLIOSim tool to validate performance and reliability for 24 hours. All required tests passed.

The tests were run based on the SQLIOSim configuration file provided by the SQL I/O Reliability program.
The following storage configuration was used:
- One dual-controller IBM Storwize V7000, 7.1 firmware, one expansion enclosure
- Forty-two 600 GB 10k SAS disks

**Advanced requirements**

This section provides information about each of the advanced compliance requirements from Microsoft for the IBM Storwize family products and SQL Server 2012.

### Advanced 2.01 Write ordering – remote storage systems

The Storwize family products meet Microsoft’s requirements for remote data mirroring, maintaining accurate write ordering, and making use of consistency groups. Remote copy services are supported with IBM Global Mirror asynchronous replication for remote storage systems across large distances. IBM Metro Mirror synchronous replication is used for remote copy between metropolitan area network distances.

#### Synchronous replication – IBM Metro Mirror

Metro Mirror creates a synchronous copy of data from a primary volume to a secondary volume. With synchronous copy, a host application writes to the primary volume but does not receive confirmation that the operation has completed until data is written to the secondary volume. This ensures that both volumes have identical data when the copy operation completes.

After the initial copy operation, Metro Mirror maintains a fully synchronized copy of the source data at the secondary location. Metro Mirror supports replication between volumes that are separated by distances up to 300 km.

#### Asynchronous replication – IBM Global Mirror

Global Mirror provides an asynchronous copy process. When a host writes to the primary volume, confirmation of I/O completion is received before the write operation has completed for the copy on the secondary volume. The secondary volume is not an exact match of the primary volume at every point in time.

### Advanced 2.02 Transactional sector / block rewrites

The Storwize family systems meet all of the SQL I/O Reliability program requirements for transactional sector and block rewrites. IBM Storwize systems use a virtual storage pool concept consisting of extents. Transactional safety is maintained during any extent movement.

### Advanced 2.03 Virtual device interface

The Storwize family systems meet all of the requirements for the SQL Server virtual device interface, as outlined in the SQL Server Virtual Backup Device Interface (VDI) specification.
IBM also offers a Volume Shadow Copy Service (VSS) provider for the Storwize systems. The provider coordinates with the SQL Server VSS writer and a compatible VSS requester such as IBM Tivoli® Storage Manager backup solutions. IBM Tivoli Storage FlashCopy® Manager fully supports the VSS framework specification and is the hardware-based snapshot feature included with the Storwize family products.

**Advanced 2.04 Clustering**

The Storwize family systems are all certified through the Windows Server Logo program. As such, they have passed Windows clustering tests and fully support the clustering requirements of the SQL Server I/O Reliability program.

**Advanced 2.05 File streams**

The Storwize family systems meet all of the program requirements to support file streams.

**Advanced 2.06 Protection**

The Storwize Family systems comply with the requirements for advanced protection and data durability as outlined in the SQL I/O Reliability program.

**Advanced 2.07 Hardware virtualization**

The Storwize family systems use a virtual storage design that is compatible with the Windows Server Virtualization Validation Program (SVVP). You can find more information about SVVP at: http://windowsservercatalog.com/svvp.aspx?svvppage=svvp.htm

You can find additional requirements details in the SQL Server virtualization support policy at: http://support.microsoft.com/KB/956893
**Conclusion**

This paper summarizes the Storwize family systems SQL I/O Reliability program test results and compliance with all of the program’s core and advanced requirements. The Storwize family systems have a proven track record as a robust, enterprise-class, SQL Server storage platform. IBM has partnered with Microsoft on several SQL Server FastTrack reference architectures and configuration guides, providing customers with proven configurations that demonstrate Storwize family systems reliability and high performance.

Refer to the “Resources” section for additional detailed information.
Resources

The following websites provide useful references to supplement the information contained in this paper:

- IBM Systems on PartnerWorld
  ibm.com/partnerworld/systems

- Virtual Loaner Program
  ibm.com/systems/vlp

- IBM Storwize family
  ibm.com/systems/storage/storwize/

- IBM Redbooks
  ibm.com/redbooks

- IBM Publications Center
Trademarks and special notices

© Copyright IBM Corporation 2013.

References in this document to IBM products or services do not imply that IBM intends to make them available in every country.

IBM, the IBM logo, and ibm.com are trademarks or registered trademarks of International Business Machines Corporation in the United States, other countries, or both. If these and other IBM trademarked terms are marked on their first occurrence in this information with a trademark symbol (® or ™), these symbols indicate U.S. registered or common law trademarks owned by IBM at the time this information was published. Such trademarks may also be registered or common law trademarks in other countries. A current list of IBM trademarks is available on the Web at "Copyright and trademark information" at www.ibm.com/legal/copytrade.shtml.

Microsoft, Windows, SQL Server, Windows NT, and the Windows logo are trademarks of Microsoft Corporation in the United States, other countries, or both.

Other company, product, or service names may be trademarks or service marks of others.

Information is provided "AS IS" without warranty of any kind.

All customer examples described are presented as illustrations of how those customers have used IBM products and the results they may have achieved. Actual environmental costs and performance characteristics may vary by customer.

Information concerning non-IBM products was obtained from a supplier of these products, published announcement material, or other publicly available sources and does not constitute an endorsement of such products by IBM. Sources for non-IBM list prices and performance numbers are taken from publicly available information, including vendor announcements and vendor worldwide homepages. IBM has not tested these products and cannot confirm the accuracy of performance, capability, or any other claims related to non-IBM products. Questions on the capability of non-IBM products should be addressed to the supplier of those products.

All statements regarding IBM future direction and intent are subject to change or withdrawal without notice, and represent goals and objectives only. Contact your local IBM office or IBM authorized reseller for the full text of the specific Statement of Direction.

Some information addresses anticipated future capabilities. Such information is not intended as a definitive statement of a commitment to specific levels of performance, function or delivery schedules with respect to any future products. Such commitments are only made in IBM product announcements. The information is presented here to communicate IBM's current investment and development activities as a good faith effort to help with our customers' future planning.

Performance is based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput or performance that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve throughput or performance improvements equivalent to the ratios stated here.

Photographs shown are of engineering prototypes. Changes may be incorporated in production models.
Any references in this information to non-IBM websites are provided for convenience only and do not in any manner serve as an endorsement of those websites. The materials at those websites are not part of the materials for this IBM product and use of those websites is at your own risk.