Condusiv
Technologies

Condusiv® Technologies
V-locity® I/O Reduction Software

Certification of Microsoft® SQL Server I/O Reliability Program

Introduction

This document describes the full compliance of Condusiv Technologies' V-locity product against the Microsoft® SQL Server® I/O Reliability Program Review Requirements.

This applies to the following editions of SQL Server:

- SQL Server 2008 (all editions)

- SQL Server 2012 (all editions)

- SQL Server 2014 (all editions)

- SQL Server 2016 (all editions)

More information about the SQL Server I/O Reliability Program Review Requirements are at SQL Server I/O Reliability Program Review Requirements.

Overview

Microsoft developed the SQL Server I/O Reliability Program to ensure the reliability, integrity, and availability of vendor products with SQL Server. The program includes a set of requirements that, when complied with, ensure the product is fully reliable and highly available for SQL Server systems. The program does not require or show performance characteristics of products, but it does require some I/O testing (Core 1.08) to exhibit the reliability and integrity of the product.

Condusiv Technologies' V-locity is the product that is being documented for compliance with the SQL Server I/O Reliability Program. V-locity is a transparent, "set it and forget it" software-only solution that solves two big I/O inefficiencies. First, it enforces large, clean, contiguous writes and reads, so more payload is delivered with every I/O operation, reducing the number of I/Os to perform the same workload. In addition, V-locity further reduces I/O to storage by caching hot reads from idle, available DRAM. Nothing has to be allocated for cache since V-locity dynamically adjusts to only what is otherwise unused. If a system is memory constrained, V-locity's caching engine backs off entirely.

More information about V-locity can be found here.

Program Requirements and Compliance

This section documents each of the program requirements, along with a summary of how V-locity is in compliance with each. Many of the below requirements are intended for new Storage Device Platforms created by vendors to ensure the device provides and supports the needed I/O functionality. V-locity is a software-only product that uses existing technology on Windows OS and NTFS to enhance I/O performance. All the existing APIs and I/O functionality of existing storage solutions on the system are retained and are fully functional.

Core Requirements

Core 1.00: Windows Logo Certification

Requirement:

Microsoft Windows logo certification helps ensure the safety of Microsoft SQL Server data by testing various aspects. To be compliant with the SQL Server I/O Reliability Program Review Program, solutions must pass and maintain the latest certifications for Windows logos.

Compliance:

V-locity passed all the Windows Server 2016 Logo tests.

Core 1.01: Core Windows API Support (Required)

Requirement:

SQL Server utilizes several APIs to enable secure data storage. A storage solution must ensure that a system supports specific API properties throughout the various layers and implementations of the I/O solution.

- CreateFile

- DeviceIoControl

- FlushFileBuffers

- GetVolumePathName

- GetVolumeInformation

- GetVolumeNameForVolumeMountPoint

- WriteFile

- WriteFileGather

- ReadFile

- ReadFileScatter

Compliance:

All APIs of existing storage solutions on the system are fully retained and fully functional through V-locity. V-locity supports all Core Windows APIs throughout all layers to ensure data integrity, reliability, and availability. This is also shown in the successful SQLIOSim and TPC testing documented in requirement Core 1.08.

Core 1.02: Stable Media (Required)

Requirement:

SQL Server relies on the Write-Ahead Logging (WAL) protocol to maintain the Atomicity, Consistency, Isolation, and Durability (ACID) properties of the database. WAL relies on stable media capabilities. A solution must comply with this stable media intention.

Compliance:

All APIs of existing storage solutions on the system are fully retained and fully functional through V-locity. This includes the Write-Ahead Logging (WAL) protocol.

Core 1.03: Forced Unit Access (FUA) and Write-Through (Required)

Requirement:

To support Write-Ahead Logging (WAL), SQL Server uses FILE_FLAG_WRITETHROUGH when opening database files. SQL Server also uses FlushFileBuffers during various operations. Write-through and flushing to stable media must be supported by storage solutions.

All components in a solution must honor the write-to-stable media intent. This includes, but is not limited to, caching components.

Compliance:

All APIs of existing storage solutions on the system are fully retained and fully functional through V-locity. This includes supporting FILE_FLAG_WRITETHROUGH and FlushFileBuffer protocol.

Core 1.04: Asynchronous Capabilities

Requirement:

SQL Server performs most of its I/O using asynchronous capabilities. If a request specifies asynchronous operation, no API call should cause a synchronous condition. Synchronous I/O can cause unexpected scheduler and concurrency issues. Therefore, a SQL Server solution must provide asynchronous I/O capabilities.

Compliance:

All APIs of existing storage solutions on the system are fully retained and fully functional through V-locity. V-locity supports asynchronous capabilities and does not create API calls that create a synchronous condition.

Core 1.05: Write Ordering

Requirement:

A tenet of the WAL protocol is write ordering preservation. Any SQL Server solution must provide write ordering preservation.

Compliance:

All APIs of existing storage solutions on the system are fully retained and fully functional through V-locity. V-locity does not change the write ordering, so it is preserved.

Core 1.06: Torn I/O Protection

Requirement:

A SQL Server I/O Reliability solution must provide sector alignment and sizing in a way that prevents torn I/O including splitting I/Os across various I/O entities in the I/O path.

Compliance:

All APIs of existing storage solutions on the system are fully retained and fully functional through V-locity. This includes any sector alignment or sizing already provided by the existing storage solutions. V-locity uses standard operating system interfaces and does not require additional configuration to meet this requirement.

Core 1.07: NTFS Support

Requirement:

You must support NTFS capabilities. This includes but not limited to the following:

- Sparse Files

- File Streams

- Encryption

- Compression

- All Security Properties

The solution must support sparse files on NTFS based file systems. Microsoft SQL Server 2005 and newer versions use sparse files in support of DBCC CHECK commands and snapshot databases.

Compliance:

All capabilities of existing storage solutions on the system are fully retained and fully functional through V-locity. This includes all supported NTFS existing capabilities, including NTFS sparse files, file streams, encryption, compression, and all security properties.

Core 1.08: Testing

Requirement:

The SQL Server I/O Reliability Review Program requires successful execution of the following data durability and integrity test suites.

1. The latest SQLIOSim.exe (installed in BINN directory during SQL Server installation) for data durability and integrity testing.

2. Common benchmark suites such as (TPC-E, TPC-C, TPC-H).

Compliance:

1. Data durability and integrity testing with V-locity was successfully completed on a Windows Server 2016 system with 4 cores and 4GB. The latest SQLIOSim.exe was executed with the Alwayson.sqliosim.cfg.ini configuration referenced in this program requirement. The 24-hour test passed with no errors or warnings. The log file for the 24-hour test is available upon request.

2. Benchmark testing on a Windows SQL Server 2016 system using the HammerDB load and benchmarking tool was performed and passed. HammerDB uses the TPC-C as part of its benchmarking methods. Test Report: Performance Testing V-locity and MS-SQL.

3. Also, there are many of customer case studies showing V-locity and SQL Server running successfully and with great performance gains. Here are references to some of these cases:

• University of Illinois (Read the Case Study).

• Creative Office Pavilion (Read the Case Study).

• Alvernia University (Read the Case Study).

Advanced Requirements

Advanced 2.01: Write Ordering (Required – Remote Storage Solution)

Requirements:

For remote and mirrored I/O destinations, all the paths must honor write ordering across the database files. A SQL Server I/O Reliability solution white paper must include information about the configuration requirements needed for the solution to meet the write ordering requirement.

Compliance:

V-locity is not a Remote Storage Solution. In any case, V-locity does not alter any write ordering, so it is honored and maintained.

Advanced 2.02: Transactional Sector / Block Rewrites (Required)

Requirement:

Solutions involving movement of sectors or blocks must provide transactional safety while maintaining asynchronous capabilities. Sectors or blocks cannot be rewritten or changed unless transactional safety can be guaranteed

Compliance:

V-locity does not move sectors or blocks of data. It can move logical clusters of data on the Windows File system level for defragmentation but ONLY through the use of the Windows FSCTL_MOVE_FILE control code.

Advanced 2.03: VDI (Required)

Requirement:

VDI solutions must meet the requirements outlined in the SQL Server 2005 Virtual Backup Device Interface (VDI) Specification.

Compliance:

V-locity is not a VDI solution.

Advanced 2.04: Clustering (Required)

Requirement:

For clustering solutions, the shared disk should be part of the Hardware Compatibility List for Windows Server.

Compliance:

V-locity is not a clustering solution, but fully supports clustered infrastructures.

Advanced 2.05: File Streams (Required)

Requirement:

The SQL Server file streams feature requires NTFS transactional guarantees. Compliance of SQL Server file stream requires the following:

- File system must report NTFS.

- File system must support the NTFS mini-filter stack including support of the filter manager contexts FSRTL_FLAG2_SUPPORTS_FILTER_CONTEXTS in FCBs.

- Support for Extended Attributes.

Metadata changes on the same volume must maintain ordering. For example, a metadata change of File A followed by a metadata change of File B will maintain order, even after a crash recovery.

Directory scan enumeration returns the current state of the directory. For example, if a directory contains files A and C when the scan is started but during the scan file B is added; then A and C should be returned and B is optional. The file system must not look at the count of files at scan startup as an absolute. In the example, the count would be two (2). The scan should not return A and B only. The enumeration behavior of B is undefined but A and C were present at the start of the scan and unaltered during the scan, so they should be returned in the scan.

It is recommended that the solution participates in Microsoft Plug Fest Interop testing.

File stream access does not support OpLocks.

Compliance:

All capabilities of existing file systems and storage solutions on the system are fully retained and fully functional through V-locity. V-locity natively supports NTFS transactional guarantees.

Note: We attended the first Plug Fest (~ 2000) and have been active attendees since then (only missed one or two).

Advanced 2.06: Protection (Recommended)

Requirement:

Data durability compromises can frequently be predicted or avoided. This is frequently referred under initiatives such as S.M.A.R.T. Solutions are encouraged to provide advanced data protection features.

Solution:

V-locity is not a storage device platform. V-locity is software-only solution that enhances I/O performance on the Windows OS. There is no storage hardware in V-locity, so this requirement does not apply.

Advanced 2.07: Hardware Virtualization

Requirement:

Solutions involving virtualized environments must comply with Windows SVVP program as outlined in the SQL Server virtualization support policy.

Compliance:

V-locity is not a storage device platform. V-locity is software-only solution that enhances I/O performance on the Windows OS. There is no hardware virtualization creation in V-locity, so this requirement does not apply.

Conclusion

This document shows that Condusiv Technologies' V-locity product is in full compliance with all the requirements in the Microsoft SQL Server I/O Reliability Program for Microsoft SQL Server 2016. Further supporting this are the successful completion of the Microsoft SQLIOSim and HammerDB(TPC-C) tests plus documented user case studies of V-locity running successfully on SQL Server systems. This clearly shows the reliability, integrity, availability, and high performance that V-locity provides to SQL Server systems.