

Virtual Storage Device Emulator

Technical Description

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1. Introduction

Virtual Storage Device Emulator emulates virtual storage controller, virtual storage devices, and virtual media on Windows operating system platforms. Virtual Storage Device Emulator supports iSCSI transport protocol through network interfaces.

Virtual Storage Device Emulator emulates the direct access block devices, sequential access devices, optical memory devices, and media changer devices. Virtual devices store the data in the files located in local file system. Virtual devices can be configured as having either fixed or removable medium. Virtual media can be loaded to and unloaded from virtual devices manually or in automated way.

Virtual Storage Device Emulator emulates the virtual storage controller device for the operating system and other software to access the virtual storage devices. The virtual storage devices that are emulated through virtual storage controller are visible only on the computer the Virtual Storage Device Emulator is running on.

Virtual storage devices that are emulated through iSCSI transport protocol are visible to initiators running on the other computer systems. Local computer system can access virtual devices through iSCSI transport protocol as well.

Virtual Storage Device Emulator provides GUI management console for managing the virtual hardware and virtual media configuration.

Virtual Storage Device Emulator is intended for being used in the following scenarios.

- Development and testing of storage management solutions. Virtual Storage Device Emulator allows the user to configure large number of storage devices and media of different models, types, and capacities.
- Emulation of the storage type that is required for particular application client – disk storage, tape storage, optical memory storage, and automated storage.
- Emulation of old storage devices that are no longer manufactured.

2. Supported operating system platforms

The following Windows operating system platforms are supported:

- Windows Server 2019
- Windows Server 2016
- Windows 10 32-bit and 64-bit
- Windows 8.1 32-bit and 64-bit
- Windows Server 2012 64-bit
- Windows 8 32-bit and 64-bit
- Windows 7 32-bit and 64-bit
- Windows Server 2008 32-bit and 64-bit
- Windows Vista 32-bit and 64-bit

NOTE: 64-bit operating system platforms are supported only for AMD64 (x64) processor architecture.

NOTE: Service Pack 1 or higher should be installed on Windows Vista OS platform.

3. System requirements

Hardware requirements:

- Computer system must meet the minimal hardware requirements for supported Windows operating system.
- Sufficient disk space for virtual media storage.

Software requirements:

- Supported Windows operating system with the necessary service pack installed.

NOTE: It is recommended to install all system patches from Windows Update site.

4. Product features

4.1. Emulation of virtual storage controller

The virtual storage controller is the communication endpoint for the operating system and other software to access the virtual storage devices.

Virtual storage controller accepts the command and other requests from the system and passes them to core Virtual Storage Device Emulator component for processing. Virtual storage controller handles requests for multiple virtual devices in parallel.

Virtual storage controller driver is implemented according to Virtual Storport model.

4.2. Support of iSCSI transport protocol

Virtual storage devices that are emulated through iSCSI transport protocol are visible to initiators running on the other computer systems. Local computer system can access virtual devices through iSCSI transport protocol as well.

The iSCSI transport protocol implementation supports Internet Protocol version 4 (IPv4).

4.3. Emulation of direct access block device

Virtual Storage Device Emulator emulates the direct access block (disks) devices. Virtual disk devices can be configured as having either fixed or removable medium.

4.4. Emulation of sequential access device

Virtual Storage Device Emulator emulates the sequential access (tape drive) devices. Virtual tape drive devices can be configured as having only removable medium.

The virtual tape drive device supports multiple partitions on the tape and is capable for storing the Linear Tape File System (LTFS).

4.5. Emulation of optical memory device

Virtual Storage Device Emulator emulates the optical memory (magneto optical disks) devices. Virtual optical memory devices can be configured as having only removable medium.

4.6. Emulation of media changer device

Virtual Storage Device Emulator emulates the media changer (jukebox) devices. Virtual media changer devices can be configured as having only removable medium.

It is possible to configure the media changer device with any supported general media type (disk, tape, and optical memory).

4.7. Enabling and disabling interfaces

If interface is in enabled state all connected SCSI targets and logical units are visible to initiators. If interface is in disabled state the initiator does not see the SCSI targets and logical units connected to interface buses.

Enabled/disabled interface state is persistent and is kept between system restarts.

4.8. Enabling and disabling virtual devices

Enabling and disabling virtual devices emulates the physical powering on and off of the devices. If virtual device is enabled, it is visible to the host and is available for command processing. If virtual device is disabled, it is not visible to the host and is not available for command processing. Disabled virtual device state remains in virtual hardware configuration. It is possible to enable/disable virtual devices on the fly. Enabled/disabled device state is persistent and is kept between system restarts.

4.9. Removable device storage

Virtual Storage Device Emulator emulates removable device medium. The virtual media are located in media pool. The GUI management console provides the means for managing the virtual media.

It is possible to insert and remove the virtual media on the fly either manually or in automated way. If virtual medium has been loaded to the drive, it remains in permanent loaded state through the system reboot cycles until it is unloaded.

4.10. Virtual hardware management console

Virtual Storage Device Emulator provides GUI management console for managing the virtual hardware configuration. User can view and change the configuration of virtual hardware and manage virtual media.

Main window of management console includes the following general purpose areas:

- Virtual hardware configuration pane that reflects the current configuration of virtual hardware. The virtual hardware configuration is shown as a tree of items. The items represent the following virtual hardware objects: storage interfaces, interface buses, SCSI targets, logical units, media pool, and pseudo SCSI analyzer.
- Virtual hardware properties pane that indicates the properties of virtual hardware object that is selected in virtual hardware configuration pane.

4.11. Large CDB support

Virtual Storage Device Emulator supports 32-byte commands for direct block and optical memory devices on Windows 8/2012 and later operating system platforms. Applications and drivers can execute large commands by means of storage request block request or extended SCSI pass through request.

4.12. SCSI-3 command and parameter support

Virtual Storage Device Emulator supports the SCSI commands and the device parameters as described in the SCSI-3 standards documents. The implementation is based on the following standards documents.

- SCSI Architecture Model - 3 (SAM-3)
- SCSI Primary Commands - 3 (SPC-3)
- SCSI Block Commands - 3 (SBC-3)
- SCSI Stream Commands - 4 (SSC-4)
- SCSI Media Changer Commands - 3 (SMC-3)

Some features from the latest standards documents are also implemented. Virtual Storage Device Emulator supports mandatory SCSI commands and device parameters, and subset of optional commands and device parameters.

4.13. Primary commands and parameters support

The following commands from the primary command set are supported.

- Inquiry (12h)
- Log Select (4Ch)
- Log Sense (4Dh)
- Mode Select (6) (15h)
- Mode Select (10) (55h)
- Mode Sense (6) (1Ah)
- Mode Sense (10) (5Ah)
- Persistent Reserve In (5Eh)
- Persistent Reserve Out (5Fh)
- Read Attribute (8Ch)
- Read Buffer (10) (3Ch)
- Report LUNs (A0h)
- Request Sense (03h)
- Security Protocol In (A2h)
- Security Protocol Out (B5h)
- Send Diagnostic (1Dh)

- Test Unit Ready (00h)
- Write Attribute (8Dh)
- Write Buffer (3Bh)

The following shared vital product data parameters are supported.

- Device Identification (83h)
- Supported VPD Pages (00h)
- Unit Serial Number (80h)

The following shared log parameters are supported.

- Read Error Counter (03h)
- Supported Log Pages (00h)
- Write Error Counter (02h)

The following shared mode parameters are supported.

- Power Condition (1Ah)

4.14. Disk commands and parameters support

The following commands from the direct access device command set are supported.

- Format Unit (04h)
- Pre-Fetch (10) (34h)
- Pre-Fetch (16) (90h)
- Prevent Allow Medium Removal (1Eh)
- Read (6) (08h)
- Read (10) (28h)
- Read (12) (A8h)
- Read (16) (88h)
- Read (32) (7Fh/0009h)
- Read Capacity (10) (25h)
- Read Capacity (16) (9Eh/10h)
- Read Defect Data (10) (37h)
- Read Defect Data (12) (B7h)
- Start Stop Unit (1Bh)
- Synchronize Cache (10) (35h)
- Synchronize Cache (16) (91h)
- Verify (10) (2Fh)
- Verify (12) (AFh)
- Verify (16) (8Fh)
- Verify (32) (7Fh/000Ah)
- Write (6) (0Ah)
- Write (10) (2Ah)
- Write (12) (AAh)
- Write (16) (8Ah)
- Write (32) (7Fh/000Bh)

The following additional commands for the optical disk devices are supported.

- Erase (10) (2Ch)
- Erase (12) (ACh)

The following direct access device mode parameters are supported.

- Caching (08h)
- Flexible Disk (05h)

- Format Device (03h)
- Rigid Disk Device Geometry (04h)

4.15. Tape commands and parameters support

The following commands from the sequential access device command set are supported.

- Erase (6) (19h)
- Erase (16) (93h)
- Format Medium (04h)
- Load Unload (1Bh)
- Locate (10) (2Bh)
- Locate (16) (92h)
- Prevent Allow Medium Removal (1Eh)
- Read (6) (08h)
- Read Block Limits (05h)
- Read Position (34h)
- Report Density Support (44h)
- Rewind (01h)
- Space (6) (11h)
- Write (6) (0Ah)
- Write Filemarks (6) (10h)

The following sequential access device vital product data parameters are supported.

- Automation Device Serial Number (B3h)
- Data Transfer Device Element Address (B4h)
- Logical Block Protection VPD page (B5h)
- Manufacturer-assigned Serial Number (B1h)
- Sequential-access Device Capabilities (B0h)
- TapeAlert Supported Flags (B2h)

The following sequential access device log parameters are supported.

- Device Statistics (14h)
- Sequential-Access Device (0Ch)
- Volume Statistics (17h)
- TapeAlert (2Eh)

The following sequential access device mode parameters are supported.

- Control Data Protection (0Ah/F0h)
- Data Compression (0Fh/00h)
- Device Configuration (10h)
- Device Configuration Extension (10h/01h)
- Informational Exceptions Control (1Ch)
- Medium Configuration (1Dh)
- Medium Partition (11h)
- Read-Write Error Recovery (01h)

4.16. Media changer commands and parameters support

The following commands from the media changer device command set are supported.

- Exchange Medium (A6h)
- Initialize Element Status (07h)
- Move Medium (A5h)
- Prevent Allow Medium Removal (1Eh)
- Read Element Status (B8h)

The following media changer device vital product data parameters are supported.

- TapeAlert Supported Flags (B2h)

The following media changer device log parameters are supported.

- Element Statistics (15h)
- Media Changer Diagnostics Data (16h)
- Media Changer Statistics (14h)
- Tape Alert (2Eh)

The following media changer device mode parameters are supported.

- Device Capabilities (1Fh)
- Element Address Assignment (1Dh)
- Extended Device Capabilities (1Fh/41h)
- Transport Geometry Descriptor (1Eh)

4.17. Multiple targets and multiple logical units per target

Virtual Storage Device Emulator supports multiple SCSI targets. Virtual Storage Device Emulator supports multiple logical units per single SCSI target. Logical unit objects are always assigned to the parent SCSI target object.

The configuration of SCSI targets and logical units can be changed dynamically on the fly.

4.18. Pseudo SCSI analyzer

Pseudo SCSI analyzer provides indication of various events that occur in SCSI subsystem and during SCSI command processing. The typical example is arrival of SCSI command from initiator, command processing in target and logical unit, and command completion with SCSI status and sense data.

The content of pseudo SCSI analyzer view can be saved to the text file for later analysis.

4.19. Virtual connections

Virtual connections between interface buses and SCSI targets specify the path of SCSI command routing. When SCSI target is connected to interface bus the SCSI target and assigned logical units are visible to initiators through the interface bus.

Single interface bus can be connected to multiple SCSI targets. Single SCSI target can be connected to multiple interface buses. When SCSI target is connected to multiple interface buses the so-called multi path I/O (MPIO) configuration is used. In MPIO configuration the SCSI target and all assigned logical units are visible to the initiator in multiple instances.

The configuration of virtual connections can be changed dynamically on the fly.

4.20. Artificial not ready device state

Artificial not ready device state provides the means for checking of device state handling in application client software. If not ready device state is enabled all media access commands will be completed with specified error codes.

User can specify additional sense code and additional sense code qualifier values.

4.21. SCSI error emulation

SCSI error emulation provides the means for checking of error handling in application client software. When emulation of SCSI error is enabled the specified SCSI commands are completed with specified error codes.

User can specify SCSI error emulation mode, SCSI commands and operations to fail, SCSI sense data values (sense key, additional sense code, and additional sense code qualifier), and additional error actions.

4.22. TapeAlert flags emulation

Virtual Storage Device Emulator provides the means for emulation of TapeAlert flags. The TapeAlert flags are supported for sequential access and media changer devices.

The user can manage the current values of TapeAlert flags.

4.23. Unit attention condition emulation

Unit attention condition emulation provides the means for generation of any number of unit attentions with specified parameters.

User can specify additional sense code, additional sense code qualifier, and additional sense bytes values.