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Information technology – Small computer system interface-3 (SCSI-3) – Part 351: Medium changer commands (SMC)



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Information technology – Small computer system interface-3 (SCSI-3) – Part 351: Medium changer commands (SMC)

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CONTENTS

FOREWORD	5
INTRODUCTION	6
1 Scope	8
2 Normative References	8
3 Definitions, symbols and abbreviations	8
3.1 Definitions	8
3.2 Symbols and abbreviations	13
3.3 Keywords	13
3.4 Conventions	14
4 Overview	14
5 Medium changer models	16
5.1 Independent medium changer	16
5.2 Attached medium changer	16
5.3 Medium changer elements	16
5.4 Medium transport element	17
5.5 Storage element	18
5.6 Import/export element	18
5.7 Data transfer element	18
5.8 Element status maintenance requirements	18
5.9 Volume tag information	19
5.10 Primary and alternate volume tag information	19
5.11 Volume tag information format	19
6 Commands for medium changer logical units	21
6.1 Commands for independent medium changers	21
6.2 Commands for attached medium changers	22
6.3 EXCHANGE MEDIUM command	22
6.4 INITIALIZE ELEMENT STATUS command	24
6.5 MOVE MEDIUM command	25
6.6 POSITION TO ELEMENT command	26
6.7 READ ELEMENT STATUS command	27
6.7.0 General	27
6.7.1 Element status data	28
6.7.2 Element status page	29
6.7.3 Medium transport element descriptor	30
6.7.4 Storage element descriptor	32
6.7.5 Import/export element descriptor	33
6.7.6 Data transfer element descriptor	35
6.7.7 Identification descriptor	36
6.8 RELEASE ELEMENT (6) command	37
6.8.0 General	37
6.8.1 Logical unit release (mandatory)	37
6.8.2 Element release (optional)	37
6.9 RELEASE ELEMENT (10) command	37

6.9.1	RELEASE ELEMENT (10) overview.....	37
6.9.2	Third-party release (Mandatory)	38
6.10	REQUEST VOLUME ELEMENT ADDRESS command	39
6.11	RESERVE ELEMENT (6) command	41
6.11.0	General	41
6.11.1	Logical unit reservation (mandatory).....	42
6.11.2	Element reservation (optional).....	42
6.12	RESERVE ELEMENT (10) command	43
6.12.0	General	43
6.12.1	Third-party reservation (mandatory)	44
6.12.2	Superseding reservations.....	44
6.13	SEND VOLUME TAG command	45
7	Parameters.....	48
7.0	General	48
7.1	Diagnostic parameters	48
7.2	Log parameters	48
7.3	Mode parameters.....	48
7.3.0	General	48
7.3.1	Device capabilities page.....	49
7.3.2	Element address assignment page.....	51
7.3.3	Transport geometry parameters page.....	52
	Bibliography	54
	Figure 1 – General structure of SCSI standards.....	6
	Figure 2 – Example independent medium changer device	15

Table 1 – Volume tag information format	20
Table 2 – Commands for independent medium changers	21
Table 3 – Commands for attached medium changers	22
Table 4 – EXCHANGE MEDIUM command	23
Table 5 – INITIALIZE ELEMENT STATUS command	24
Table 6 – MOVE MEDIUM command	25
Table 7 – POSITION TO ELEMENT command	26
Table 8 – READ ELEMENT STATUS command	27
Table 9 – Element type code	28
Table 10 – Element status data	28
Table 11 – Element status page	29
Table 12 – Medium transport element descriptor	30
Table 13 – Storage element descriptor	32
Table 14 – Import/export element descriptor	33
Table 15 – Data transfer element descriptor	35
Table 16 – Identification descriptor fields	36
Table 17 – RELEASE ELEMENT (6) command	37
Table 18 – RELEASE ELEMENT (10) command	38
Table 19 – RELEASE ELEMENT (10) parameter list	39
Table 20 – REQUEST VOLUME ELEMENT ADDRESS command	40
Table 21 – Volume element address header	41
Table 22 – RESERVE ELEMENT (6) command	41
Table 23 – Data format of element list descriptors	43
Table 24 – RESERVE ELEMENT (10) command	43
Table 25 – RESERVE ELEMENT (10) ID and elements parameter list	45
Table 26 – SEND VOLUME TAG command	45
Table 27 – Send action codes	46
Table 28 – Send volume tag parameters format	47
Table 29 – Diagnostic page codes	48
Table 30 – Log page codes	48
Table 31 – Mode page codes	49
Table 32 – Device capabilities page	50
Table 33 – Element address assignment page	51
Table 34 – Transport geometry parameters page	52
Table 35 – Transport geometry descriptor	53

INFORMATION TECHNOLOGY – SMALL COMPUTER SYSTEM INTERFACE-3 (SCSI-3) –

Part 351: Medium changer commands (SMC)

FOREWORD

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- 2) In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.
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International Standard ISO/IEC 14776-351 was prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology.

The list of all parts of ISO/IEC 14776 series, under the general title *Information technology – Small computer system interface (SCSI)*, can be found on the IEC web site.

This International Standard has been approved by vote of the member bodies, and the voting results may be obtained from the address given on the title page.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

INTRODUCTION

This International Standard defines the SCSI commands and model for independent medium changer devices and attached medium changer functions integrated into other SCSI devices.

The SCSI-3 Medium Changer Commands (SMC) standard specifies the commands and external behavioural characteristics of a device server that declares itself a medium changer in the device type field of the INQUIRY command response data. This standard also specifies the behaviour of the attached medium changer commands available when the medium changer MCHNGR bit is set to one in INQUIRY command response data.

SMC is specified independent of any service delivery subsystem used to carry commands, command parameter data, command response data and status. The SMC standard conforms to the requirements specified in the SCSI-3 Architecture Model (SAM) standard.

This International Standard forms part of the series of SCSI standards as shown in Figure 1.

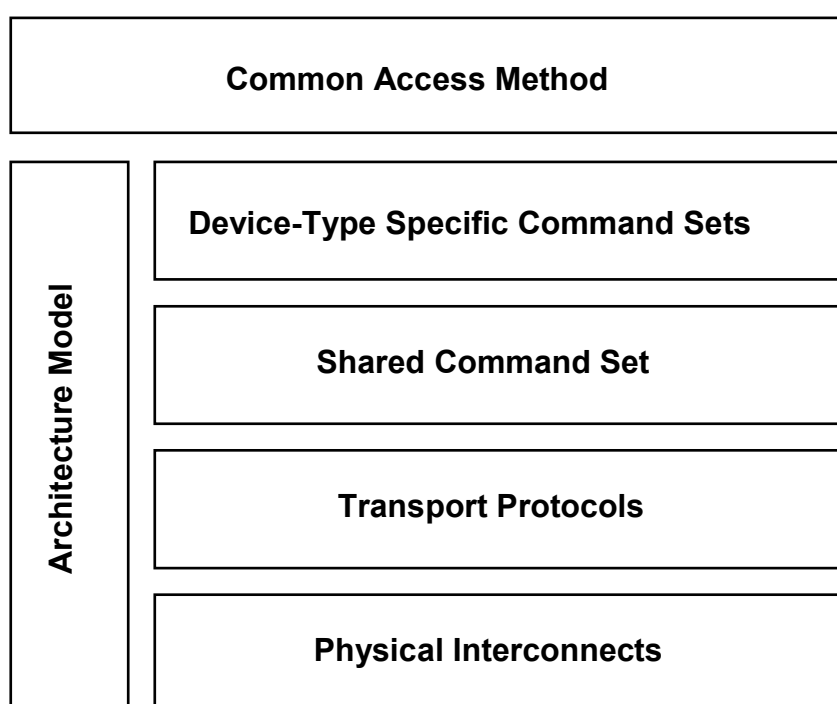


Figure 1 – General structure of SCSI standards

Figure 1 shows the general structure of SCSI-3 standards. The figure is not intended to imply a relationship such as a hierarchy, protocol stack or system architecture.

At the time this standard was generated examples of the SCSI-3 general structure included:

Physical Interconnects

Fibre Channel – Physical and Signalling Interface

SCSI-3 Parallel Interface

SCSI-3 Fast-20 Parallel Interface

SCSI Parallel Interface – 2 [ISO/IEC 14776-112]

Transport Protocols

SCSI-3 Interlocked Protocol [ISO/IEC 14776-211]

SCSI-3 Fibre Channel Protocol Version 3 [ISO/IEC 14776-223]

SCSI Serial Bus Protocol – 2 [ISO/IEC 14776-232]

Shared Command Set

SCSI-3 Primary Commands-2 [ISO/IEC 14776-452]

Device-Type Specific Command Sets

SCSI-3 Block Commands [ISO/IEC 14776-321]

SCSI-3 Enclosure Services [ISO/IEC 14776-371]

SCSI-3 Stream Commands [ISO/IEC 14776-331]

SCSI-3 Medium Changer Commands (this standard)

SCSI-3 Controller Commands [ISO/IEC 14776-341]

SCSI-3 Controller Commands – 2 [ISO/IEC 14776-342]

SCSI-3 Multimedia Command Set

SCSI-3 Multimedia Command Set – 2 [ISO/IEC 14776-362]

Architecture Model

SCSI-3 Architecture Model [ISO/IEC 14776-411]

Common Access Method

SCSI Common Access Method [ISO/IEC 9316-2]

NOTE See bibliography for full references and availability of the documents.

The term SCSI is used wherever it is not necessary to distinguish between the versions of SCSI. The Small Computer System Interface–2 [ISO/IEC 9316:1995] is referred to herein as SCSI–2. The term SCSI-3 in this standard refers to versions of SCSI defined since SCSI–2.

The SCSI-3 Medium Changer Command Set (SMC) standard is divided into seven clauses and a bibliography, as follows.

Clause 1 Scope

Clause 2 enumerates the normative references that apply to this standard.

Clause 3 describes definitions, symbols, abbreviations and conventions used in this standard.

Clause 4 is an overview of this standard.

Clause 5 describes the model for this device class.

Clause 6 describes the commands and responses.

Clause 7 describes the parameters.

Bibliography.

INFORMATION TECHNOLOGY – SMALL COMPUTER SYSTEM INTERFACE-3 (SCSI-3) –

Part 351: Medium changer commands (SMC)

1 Scope

This part of ISO/IEC 14776 defines the command set extensions for operation of SCSI medium changer devices and command set extensions that allow medium changer functions in other types of SCSI devices.

This SCSI-3 Medium Changer Commands standard

- permits an application client to communicate with a logical unit that declares itself to be a medium changer device in the DEVICE TYPE field of the INQUIRY command response data over a SCSI service delivery subsystem,
- permits an application client to access the medium changer functions in a logical unit that sets the MCHNGR bit in INQUIRY command response data,
- defines commands to manage the operation of SCSI medium changer devices.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 14776-411, *Information technology – Small Computer System Interface – Part 411: SCSI-3 Architecture Model (SCSI-3 SAM)*

ISO/IEC 14776-452, *Information technology – Small Computer System Interface (SCSI) – Part 452: Primary Commands-2 (SPC-2)*

3 Definitions, symbols and abbreviations

3.1 Definitions

This clause contains a glossary of special terms used in this standard. These terms apply to SMC and do not constitute a comprehensive glossary for SCSI-3.

3.1.1

additional sense code

value in the ADDITIONAL SENSE CODE and ADDITIONAL SENSE CODE QUALIFIER fields of REQUEST SENSE command response data (see SPC)

3.1.2

application client

object that is the source of SCSI commands. Further definition of an application client may be found in the SCSI-3 Architecture Model (SAM)

3.1.3

attached medium changer

medium changer that accepts commands issued to the same logical unit as a primary SCSI device that is not a medium changer

3.1.4**autosense data**

sense data that is automatically delivered to the application client by the device server in a protocol-specific manner when a command completes with a CHECK CONDITION or COMMAND TERMINATED status (see SAM)

3.1.5**byte**

indicates an 8-bit construct

3.1.6**command**

request describing a unit of work to be performed by a device server
A detailed definition of a command may be found in SAM.

3.1.7**command descriptor block**

structure up to 16 bytes in length used to communicate commands from an application client to a device server

3.1.8**data transfer element**

component of a medium changer used to access the data stored on a volume
It is the address in a medium changer element space of a primary device.

3.1.9**device service request**

request, submitted by an application client, conveying a SCSI command to a device server
A detailed definition of a device service request may be found in SAM.

3.1.10**device type**

type of device (or device model) implemented by the device server

3.1.11**element**

addressable physical component of a medium changer device that can serve as the location of a removable unit of data storage medium

3.1.12**extent**

extent is a specified number of logical blocks, typically identified by a starting logical block address and a count of the number of blocks in the extent

3.1.13**field**

a group of one or more contiguous bits

3.1.14**hard reset**

a target response to a reset event or TARGET RESET task management function
A detailed definition of hard reset may be found in SAM.

3.1.15

host

a device with the characteristics of a primary computing device, typically a personal computer, workstation, minicomputer, mainframe computer or auxiliary computing device or server
A host includes application clients, one or more initiators and may in some cases take on a target role.

3.1.16

import/export element

a location within a medium changer device that can be accessed by both the medium transport elements and by the operator or an external device

3.1.17

independent medium changer

a medium changer addressed as a separate SCSI device or logical unit

3.1.18

initiator

a SCSI device containing application clients that generate device service requests to be processed in a device server

A detailed definition of an initiator may be found in SAM.

3.1.19

linked command

one in a series of SCSI commands executed by a single task, which collectively make up a discrete I/O operation

A detailed definition of a linked command may be found in SAM.

3.1.20

logical unit

an externally addressable entity within a target that implements a SCSI device model and contains a device server

A detailed definition of a logical unit may be found in SAM.

3.1.21

logical unit number

an encoded 64-bit identifier for a logical unit

A detailed definition of a logical unit number may be found in SAM.

3.1.22

medium

one unit of media, equivalent to volume as defined in this standard

3.1.23

medium changer

a medium changer mechanizes the movement of media to and from the device that records on or reads from the media

3.1.24

medium transport element

a component of a medium changer device that is used to move volumes

3.1.25

one

value of 1, the logical true condition of a variable

3.1.26**page**

several commands use regular parameter structures that are referred to as pages
These pages are identified with a value known as a page code.

3.1.27**port**

a portion of the service delivery interface of a SCSI-3 device
A SCSI-3 device may have more than one port. Each port may attach to the same or a different physical interface.

3.1.28**primary device**

device for reading or writing data on medium
Examples are magnetic disk drives, cartridge tape drives, optical disk drives and CD-ROM drives. Use in a medium changer environment implies that the device supports removable volumes.

3.1.29**protocol-specific**

requirements for the referenced item are defined by a SCSI-3 protocol standard
A detailed definition of protocol-specific may be found in SAM.

3.1.30**SCSI device**

a device that is connected to a service delivery subsystem and supports a SCSI application protocol
A detailed definition of a SCSI device may be found in SAM.

3.1.31**SCSI domain**

the interconnection of two or more SCSI devices and a service delivery subsystem forms a SCSI domain
A detailed definition of a SCSI domain may be found in SAM.

3.1.32**sense data**

Data describing an error or device exception condition that a device server delivers to an application client (see SPC)
Sense data may be delivered in response to a REQUEST SENSE command or as auto-sense data.

3.1.33**sense key**

contents of the sense key field of REQUEST SENSE command response data

3.1.34**service delivery subsystem**

the part of a SCSI I/O system that transmits service requests to a logical unit and returns logical unit responses to an initiator
A detailed definition of a service delivery subsystem may be found in SAM.

3.1.35**status**

one byte of response information sent from a device server to an application client upon completion of each command
A detailed definition of status may be found in SAM.

3.1.36

storage element

component of a medium changer device used only for physical storage of a volume

3.1.37

system

one or more SCSI domains operating as a single configuration

3.1.38

target

a SCSI device containing one or more logical units that receive and execute commands from an initiator

A detailed definition of a target may be found in SAM.

3.1.39

task

an object within a logical unit that represents the work associated with a command or a group of linked commands

A detailed definition of a task may be found in SAM.

3.1.40

task set

a group of tasks within a logical unit, whose interaction is dependent on the queuing and auto-contingent allegiance rules defined in SAM

3.1.41

third-party

when used in reference to RESERVE or RELEASE commands, third-party means a reservation made on behalf of another device

For example, a processor device requests that a direct-access device reserve itself for use by a sequential-access device.

3.1.42

unit attention condition

a state that a logical unit maintains while it has asynchronous status information to report to one or more initiators

A detailed definition of the unit attention condition may be found in SAM.

3.1.43

vendor-specific

an item (e.g., a bit, field, code value, etc.) that is not defined in this standard

This item may be vendor specific.

3.1.44

volume

recording media and its carrier that is removable from a primary device and may be moved from one element to another by a medium changer

3.1.45

volume rotation

process of changing the orientation of a volume

In particular, volume rotation refers to inverting a two-sided volume cartridge so that a data transport element that accesses only one side at a time may access data on the other side.

3.1.46

zero

value of 0, the logical false condition of a variable

3.2 Symbols and abbreviations

- **CDB** command descriptor block
- **I/O** input/output
- **ID** identifier
- **LSB** least significant bit
- **LUN** logical unit number
- **MCHNGR bit** medium changer bit (specified in ISO/IEC 14776-452)
- **MSB** most significant bit
- **MMC** SCSI-3 Multi-Media Commands standard
- **RSVD** reserved field or bit
- **SAM** SCSI-3 Architecture Model
- **SBC** SCSI-3 Block Commands standard
- **SCSI-3** standards identified in the foreword as being part of the SCSI-3 standard document set
- **SMC** SCSI-3 Medium Changer Commands standard
- **SPC** SCSI-3 Primary Commands standard
- **SSC** SCSI-3 Stream Commands standard

3.3 Keywords

3.3.1

expected

A keyword used to describe the behaviour of the hardware or software in the design models assumed by this standard. Other hardware and software design models may also be implemented.

3.3.2

invalid

A keyword used to describe an illegal or unsupported bit, byte, word, field or code value. Receipt of an invalid bit, byte, word, field or code value shall be reported as error.

3.3.3

mandatory

A keyword indicating an item that is required to be implemented as defined in this standard.

3.3.4

may

A keyword that indicated flexibility of choice with no implied preference.

3.3.5

obsolete

A keyword indicating that an item was defined in prior SCSI standards but has been removed from this standard.

3.3.6

optional

A keyword that describes features that are not required to be implemented by this standard. However, if any optional feature defined by this standards is implemented, then it shall be implemented as defined in this standard.

3.3.7

reserved

A keyword referring to bits, bytes, words, fields and code values that are set aside for future standardization. A reserved bit, byte, word or field shall be set to zero, or in accordance with a future extension to this standard. Recipients may check reserved bits, bytes, words or fields for zero values and report errors if non-zero values are received. Receipt of reserved code values in defined fields shall be reported as error.

3.3.8

shall

A keyword indicating a mandatory requirement. Designers are required to implement all such mandatory requirements to ensure interoperability with other products that conform to this standard.

3.3.9

should

A keyword indicating flexibility of choice with a strongly preferred alternative; equivalent to the phrase "it is strongly recommended".

3.4 Conventions

Certain words and terms used in this standard have a specific meaning beyond the normal English meaning. These words and terms are defined either in 3.1 or in the text where they first appear. Names of commands, statuses, sense keys, additional sense codes and additional sense code qualifiers are in all uppercase (e.g., REQUEST SENSE). Field names and bit names are in SMALL CAPS. Lower case is used for words having the normal English meaning.

Fields containing only one bit are usually referred to as the name bit instead of the name field.

Numbers that are not immediately followed by lowercase b or h are decimal values.

Numbers immediately followed by lowercase b (xxb) are binary values.

Numbers or upper case letters immediately followed by lowercase h (xxh) are hexadecimal values.

Lists sequenced by letters (e.g., a-red, b-blue, c-green) show no priority relationship between the listed items. Numbered lists (e.g., 1-red, 2-blue, 3-green) show a priority ordering between the listed items. If a conflict arises between text, tables or figures, the order of precedence to resolve the conflicts is: text, then tables and finally figures. Not all tables or figures are fully described in the text. Tables show data format and values. NOTES do not constitute any requirements for implementors.

4 Overview

The SCSI-3 medium changer device class specifies a logical unit that is involved, primarily, with the movement of removable volumes in a controlled environment without human intervention. The SCSI-3 device classes that provide for removable volumes are block, multi-media and sequential. (See the SBC, MMC and SSC standards.)

A medium changer logical unit receives commands to move volumes between various element types in the element address space of the medium changer. The element types are storage, data transfer, medium transport and import/export. A volume handling robotic subsystem, addressed as a medium transport element, moves volumes within a medium changer.

A medium changer logical unit maintains an inventory of volumes and the element address they can be found in. The medium changer logical unit reports this inventory when requested as well as identifying the element addresses assigned to different types of elements.

Different levels of sophistication may be implemented in how this inventory is managed, reported, detected and maintained. The elements in a medium changer may be reserved to different initiators. For example, one data transport element may be reserved for exclusive use by one initiator. The primary device, located at that data transfer element, may then be attached to various systems for their use. In some cases, the primary device associated with a data transfer element may not be a SCSI device.

The split between load and unload control of the medium and read and write control by a primary device is a key feature of this device class. The mechanism for coordinating this kind of sophisticated activity is not specified in this standard. The medium changer device class provides the means for mount/dismount management only.

Figure 2 shows an example of an independent medium changer. The data transfer elements (primary devices) shown may be any type of removable media device such as a tape drive, disk drive or optical drive. Supporting multiple types of removable media within the same medium changer is also permitted. Also, the ports on each primary device may or may not attach to the same service delivery subsystem, and the interfaces to the primary devices may or may not be SCSI. The number and arrangement of elements is arbitrary.

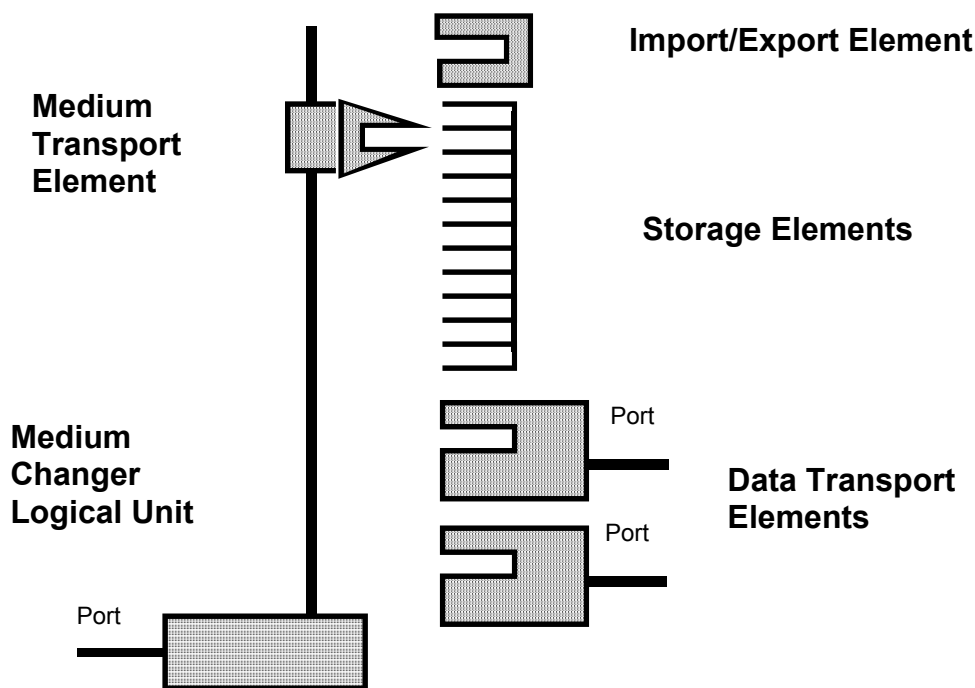


Figure 2 – Example independent medium changer device

The independent changer model applies to implementations where the medium changer is addressed as a separate logical unit. The logical unit for the medium changer may be accessed via the same SCSI ID as the primary device, or via a different SCSI ID. This type of medium changer may support more than one primary device.

The attached medium changer model permits a subset of the functions of an independent changer to be incorporated directly into a primary device. Only one data transport element is permitted. In this case, only one logical unit is used to access all functions.

A medium changer moves volumes among the several element types accessible to it on command from an initiator. Medium changers shall be capable of reporting the full or empty status of any element address in its domain.

5 Medium changer models

5.1 Independent medium changer

An independent medium changer is a device server that returns 8h in the PERIPHERAL DEVICE TYPE field (see SPC) of INQUIRY command response data.

Independent medium changers for the SMC standard respond to a LUN different from those used by a primary device. Communication with a primary device may use the same service delivery subsystem as the medium changer device or a different SCSI service delivery subsystem. Primary devices that are not SCSI devices are also permitted. Multiple primary devices may be attached to an independent changer.

If a primary device served by the medium changer is a SCSI device, the primary device may be addressed on a SCSI-3 service delivery subsystem though the same port as the medium changer but with a different LUN or the primary device may be addressed through independent ports and any LUN on the same or a different service delivery subsystem.

The READ ELEMENT STATUS command response data page for each data transfer element may provide the identity of the primary device serviced by a medium changer device. This support is optional since a primary device is not required to be a SCSI-3 device.

5.2 Attached medium changer

An attached medium changer is part of a device server that sets the MCHNGR bit to one in its standard INQUIRY data (see SPC). Attached medium changers respond to the same LUN as a primary device that is not a medium changer. In an attached medium changer, the PERIPHERAL DEVICE TYPE field of INQUIRY command response data returns the type of the primary device.

Two medium changer commands, READ ELEMENT STATUS ATTACHED and MOVE MEDIUM ATTACHED are added to the command set of the primary device. The other commands available depend on the model for the primary device.

5.3 Medium changer elements

A medium changer has an address space separate and distinct from the physical address space of a SCSI-3 service delivery subsystem. The term element is used throughout this standard to refer to one member of the medium changer address space. Within a medium changer, the element addresses are a set of physical locations and mechanisms within the scope of a medium changer device.

Each element is an instance of one of four element types:

- Medium Transport Element;
- Storage Element;
- Import/Export Element,
- Data Transfer Element.

Each element is a discrete physical entity with a unique element address that may provide storage for zero or one volume. A volume is in exactly one element at a time. The point in time during movement when a volume is considered in a different element is implementation dependent. When requested to report element status, a volume shall be reported as being at