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Project T10/1558-D

Revision 2
12 April 2003

Information technology - Automation/Drive Interface - Commands (ADC)

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1 Revision History

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- Began this revision from T10 Template
- Began incorporation of: 02-106r4, 02-253r1
- Created basic outline, as based on SSC-2 current draft
- Finished incorporation of: 02-106r4, 02-253r1
- Incorporated 02-180r0
- Incorporated 02-097r1
- Incorporated 02-239r0 item D

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- Incorporated 02-315r1
- Updated technical editor contact
- Incorporated 02-489r0 with comments
- Incorporated 02-392r0
- Incorporated 03-008r1 with comments
- General clean up

1.3 Revision 2 (12 April 2003) - RBW

- Incorporated 03-042r2 as modified per meeting review
- Incorporated 03-106r0 as modified per meeting review
- Incorporated 03-113r0
- Removed READ POSITION from table 2
- Assigned page code 0Eh to ADC Device Configuration mode page
- Changed references from SPC-3 to SPC-2 where appropriate
- Cleaned up other document references
- Updated model figures
- Resolve some previous editorial notes
- General editorial clean up

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Draft

American National Standards for Information Systems -

Automation/Drive Interface - Commands

Secretariat
InterNational Committee for Information Technology Standards

Approved mm dd yy

American National Standards Institute, Inc.

Abstract

This standard specifies the device model and functional requirements for the SCSI automation drive interface device type. This standards permits the SCSI automation drive interface device type to attach to application clients and provides the definitions for their use.

This standard does not contain material related to any service delivery subsystem which is used to transport the commands, command parameter data, command response data, and status specified in this standard. For reference to delivery subsystems and transports, refer to automation drive interface physical and transport documents.

Draft

American National Standard

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Foreword

This foreword is not part of American National Standard NCITS.***:200x.

This standard specifies the external behavior of a device server that defines itself as an automation drive interface device in the DEVICE TYPE field of the INQUIRY command response data. This device type is known as an automation drive interface device. This standard conforms to the SCSI Architecture Model - 2 (T10/1157-D) standard.

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These Bulletins, while reflecting the opinion of the Technical Committee that developed the standard, are intended solely as supplementary information to other users of the standard. This standard, ANSI NCITS.***:200x, as approved through the publication and voting procedures of the American National Standards Institute, is not altered by these bulletins. Any subsequent revision to this standard may or may not reflect the contents of these Technical Information Bulletins.

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Requests for interpretation, suggestions for improvement and addenda, or defect reports are welcome. They should be sent to the INCITS Secretariat, InterNational Committee for Information Technology Standards, Information Technology Institute, 1250 Eye Street, NW, Suite 200, Washington, DC 20005-3922.

This standard was processed and approved for submittal to ANSI by the InterNational Committee for Information Technology Standards (INCITS). Committee approval of the standard does not necessarily imply that all committee members voted for approval. At the time of it approved this standard, INCITS had the following members:

(Editor's Note: Insert INCITS member list)

Technical Committee T10 on Lower Level Interfaces, which developed and reviewed this standard, had the following members: (Editor's Note: Update for current membership)

Introduction

The Automation/Drive Interface - Commands (ADC) standard is divided into ten clauses:

Clause 1 is the scope.
Clause 2 enumerates the normative references that apply to this standard.
Clause 3 describes the definitions, symbols, and abbreviations used in this standard.
Clause 4 describes an overview and model of the automation drive interface type device.
Clause 5 describes the command set for automation drive interface type devices.
Clause 6 describes the parameters for automation drive interface type devices.

The annexes provide information to assist with implementation of the Automation Drive Interface - Commands (ADC) standard.

American National Standard **INCITS.***:200x**

American National Standard for Information Systems - Information Technology - Automation/Drive Interface - Commands (ADC)

1 Scope

This standard defines the command set extensions to facilitate operation of the automation drive interface device type member of the SCSI device class. The clauses of this standard, implemented in conjunction with the applicable clauses of the SCSI Primary Commands - 3 standard, fully specify the standard command set for the automation drive interface device type member of the SCSI device class.

The objectives of the Automation Drive Interface - Commands (ADC) standard is to provide the following:

a) Permit an application client to communicate over a SCSI service delivery subsystem, with a logical unit that declares itself to be a automation drive interface device in the device type field of the INQUIRY command response data;
b) define commands unique to the automation drive interface device type; and
c) define commands to manage the operation of the automation drive interface device type.

Figure 1 shows the relationship of this standard to the other standards and related projects in the SCSI family standards as of the publication of this standard.

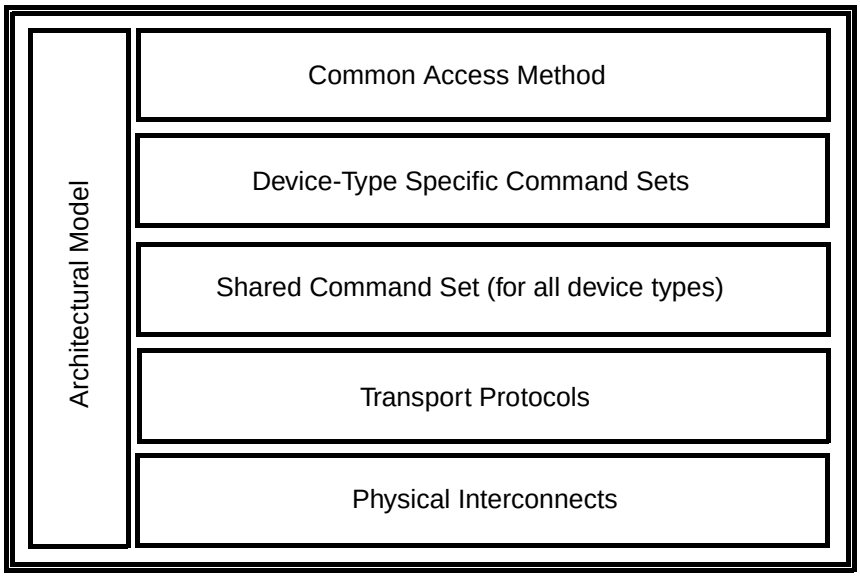

Figure 1 — General Document Structure of SCSI

Figure 1 is intended to show the general relationship of the documents to one another. Figure 1 is not intended to imply a relationship such as a hierarchy, protocol stack, or system architecture. It indicates the applicability of a standard to the implementation of a given transport.

At the time this standard was generated, examples of the SCSI general structure included: Physical Interconnects:

Interconnects:		
Automation/Drive Interface - Physical Layer	ADP	[T10/1556-D]
Fibre Channel Arbitrated Loop	FC-AL	[ANSI X3.272-1996]
Fibre Channel Arbitrated Loop -2	FC-AL-2	[ISO/IEC 14165-122] [ANSI NCITS.332-1999]
Fibre Channel Physical and Signalling Interface	FC-PH	[ISO/IEC 14165-111] [ANSI X3.230-1994]
Fibre Channel Physical Amendment 1		[ANSI X3.230/AM1-1996]
Fibre Channel 3rd Generation Physical Interface	FC-PH-3	[ISO/IEC 14165-113] [ANSI X3.303-1998]
Fibre Channel Physical Interfaces	FC-PI	[T11/1235-D]
Fibre Channel Framing and Signaling Interface	FC-FS	[T11/1331-D]
High Performance Serial Bus		[ANSI IEEE 1394-1995]
High Performance Serial Bus (supplement to ANSI/IEEE 1394-1995)		[ANSI IEEE 1394a-2000]
SCSI Parallel Interface - 2	SPI-2	[ISO/IEC 14776-112] [ANSI X3.302-1999]
SCSI Parallel Interface - 3	SPI-3	[ISO/IEC 14776-113] [ANSI NCITS.336-2000]
SCSI Parallel Interface - 4	SPI-4	[ISO/IEC 14776-114] [ANSI INCITS.362-200x]
SCSI Parallel Interface - 5	SPI-5	[ISO/IEC 14776-115] [T10/1525-D]
Serial Storage Architecture Physical Layer 1	SSA-PH	[ANSI X3.293-1996]
Serial Storage Architecture Physical Layer 2	SSA-PH-2	[ANSI NCITS.307-1998]
SCSI Protocols:		
Automation/Drive Interface - Transport Protocol	ADT	[T10/1557-D]
Serial Storage Architecture Transport Layer 1	SSA-TL-1	[ANSI X3.295-1996]
Serial Storage Architecture Transport Layer 2	SSA-TL-2	[ANSI NCITS.308-1998]
SCSI-3 Fibre Channel Protocol	FCP	[ISO/IEC 14776-221] [ANSI X3.269-1996]
SCSI Fibre Channel Protocol - 2	FCP-2	[ISO/IEC 14776-222] [ANSI NCITS.350-200x]
Serial Bus Protocol - 2	SBP-2	[ISO/IEC 14776-232] [ANSI NCITS.325-1999]
Serial Bus Protocol - 3	SBP-3	[ISO/IEC 14776-233] [T10/1467-D]
Serial Storage Architecture SCSI-3 Protocol	SSA-S3P	[ANSI NCITS.309-1998]
SCSI on Scheduled Transfer	SST	[T10/1380-D]
SCSI RDMA Protocol	SRP	[T10/1415-D]
Shared Command Sets:		
SCSI-3 Primary Commands	SPC	[ISO/IEC 14776-311] [ANSI X3.301-1997]
SCSI Primary Commands - 2	SPC-2	[ISO/IEC 14776-312] [ANSI NCITS.351-2001]

SCSI Primary Commands - 3	SPC-3	[ISO/IEC 14776-313] [T10/1416-D]
Device-Type Specific Command Sets:		
SCSI-3 Block Commands	SBC	[ISO/IEC 14776-321] [ANSI NCITS.306-1998]
SCSI Block Commands - 2	SBC-2	[ISO/IEC 14776-322] [T10/1417-D]
SCSI-3 Stream Commands	SSC	[ISO/IEC 14776-331] [ANSI NCITS.335-2000]
SCSI Stream Commands - 2	SSC-2	[ISO/IEC 14776-332] [T10/1434-D]
SCSI-3 Medium Changer Commands	SMC	[ISO/IEC 14776-351] [ANSI NCITS.314-1998]
SCSI Medium Changer Commands - 2	SMC-2	[ISO/IEC 14776-352] [T10/1383-D]
SCSI-3 Multimedia Command Set	MMC	[ANSI X3.304-1997]
SCSI Multimedia Command Set - 2	MMC-2	[ISO/IEC 14776-362] [ANSI NCITS.333-2000]
SCSI Multimedia Command Set - 3	MMC-3	[ISO/IEC 14776-363] [T10/1363-D]
SCSI-3 Controller Commands	SCC	[ISO/IEC 14776-341] ANSI X3.276-1997]
SCSI Controller Commands - 2	SCC-2	[ISO/IEC 14776-342] [ANSI NCITS.318-1998]
SCSI Reduced Block Commands	RBC	[ISO/IEC 14776-326] [ANSI NCITS.330-2000]
SCSI-3 Enclosure Services Commands	SES	[ISO/IEC 14776-371] [ANSI NCITS.305-1998]
SCSI Enclosure Services Commands -2	SES-2	[ISO/IEC 14776-372] [T10/1559-D]
SCSI Specification for Optical Card Reader/Writer	OCRW	[ISO/IEC 14776-381]
Object-based Storage Devices Commands	OSD	[T10/1355-D]
SCSI Management Server Commands	MSC	[T10/1528-D]
Automation/Drive Interface - Commands	ADC	[T10/1558-D] (This standard)
Architecture Model:		
SCSI-3 Architecture Model	SAM	[ISO/IEC 14776-411] [ANSI X3.270-1996]
SCSI Architecture Model - 2	SAM-2	[ISO/IEC 14776-412] [T10/1157-D]

The term SCSI is used to refer to the family of standards described in this clause.

2 Normative References

2.1 Normative references

The following standards contain provisions that, by reference in the text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below.

Copies of the following documents may be obtained from ANSI: approved ANSI standards, approved and draft international and regional standards (ISO, IEC, CEN/CENELEC, ITUT), and approved and draft foreign standards (including BSI, JIS, and DIN). For further information, contact ANSI Customer Service Department at 212-642-4900 (phone), 212-302-1286 (fax) or via the World Wide Web at http://www.ansi.org.

Additional availability contact information is provided below as needed.

2.2 Approved references

ISO/IEC 14776-412, *SCSI Architecture Model - 2 standard*
ISO/IEC 14776-312, *SCSI Primary Commands - 2 standard*
ISO/IEC 14776-331, *SCSI-3 Stream Commands standard*
ISO/IEC 14776-351, *SCSI-3 Medium Changer Commands standard*
ISO/IEC 14776-113, *SCSI Parallel Interface - 3*

2.3 References under development

At the time of publication, the following referenced standards were still under development. For information on the current status of the document, or regarding availability, contact the relevant standards body or other organization as indicated.

ISO/IEC 14776-313, *SCSI Primary Commands - 3 standard*
ISO/IEC 14776-413, *SCSI Architecture Model - 3 standard*
ISO/IEC 14776-332, *SCSI Stream Commands - 2 standard*
ISO/IEC 14776-352, *SCSI Media Changer Commands - 2 standard*
ISO/IEC 14776-222, *SCSI Fibre Channel Protocol - 2 standard*

3 Definitions, symbols, abbreviations, and conventions

3.1 Definitions

3.1.1 application client: An object that is the source of SCSI commands. Further definition of an application client is found in the SCSI Architecture Model-2 standard

3.1.2 asynchronous event notification: An optional procedure used by SCSI target devices to notify SCSI initiator devices of events that occur when a pending task does not exist for that SCSI initiator device.

3.1.3 auto-contingent allegiance: An optional condition of a task set following the return of a CHECK CONDITION status. See the SCSI Architecture Model-2 standard for a detailed definition of auto-contingent allegiance.

3.1.4 byte: Indicates an 8-bit construct.

3.1.5 contingent allegiance: An optional condition of a task set following the return of a CHECK CONDITION status. A detailed definition of contingent allegiance may be found in the SCSI Architecture Model-2 standard.

3.1.6 data transfer device: A component of a media changer used to access the data stored on a volume. A removable medium device that supports a data transfer command set.

3.1.7 data transfer element: The address in media changer element space of a data transfer device.

3.1.8 device server: An object within the logical unit that executes SCSI tasks according to the rules for task management as described in the SCSI Architecture Model-2 standard.

3.1.9 DTD: Data transfer device.

3.1.10 DTE: Data transfer element.

3.1.11 field: A group of one or more contiguous bits.

3.1.12 hard reset: A SCSI target device action in response to a reset event in which a SCSI target device performs the operations described in.

3.1.13 indication: The second step of a four step confirmed service in reply to a request.

3.1.14 I_T nexus: A nexus that exists between a SCSI initiator port and a SCSI target port.

3.1.15 I_T_L nexus: A nexus that exists between a SCSI initiator port, a SCSI target port, and a logical unit. This relationship replaces the prior I_T nexus.

3.1.16 I_T_L_Q nexus: A nexus between a SCSI initiator port, a SCSI target port, a logical unit, and a queue tag following the successful receipt of a queue tag. This relationship replaces the prior I_T nexus or I_T_L nexus.

3.1.17 logical unit: An externally addressable entity within a SCSI target device. See the SCSI Architecture Model-2 standard for a detailed definition of a logical unit.

3.1.18 logical unit number: An identifier for a logical unit.

3.1.19 logical unit reset: A logical unit action in response to a logical unit reset event in which the logical unit

performs the operations described in SCSI Architecture Model-2.

3.1.20 logical unit reset event: An event that triggers a logical unit reset from a logical unit as described in SCSI Architecture Model–2.

3.1.21 nexus: A relationship between a SCSI initiator port and a SCSI target port that may extend to a logical unit and a queue tag.

3.1.22 object: An architectural abstraction that encapsulates data types, services, or other objects that are related in some way.

3.1.23 port: A single attachment to a SCSI bus segment from a SCSI device.

3.1.24 primary: The main data interface.

3.1.25 queue: The arrangement of tasks within a task set usually according to the temporal order that they were created.

3.1.26 SCSI initiator device: A SCSI device containing application clients and SCSI initiator ports that originate device service and task management requests to be processed by a target SCSI device. See the SCSI Architecture Model-2 standard for a detailed definition of a SCSI initiator device.

3.1.27 SCSI initiator port: A SCSI initiator device object acts as the connection between application clients and the service delivery subsystem through which requests and responses are routed. See the SCSI Architecture Model-2 standard for a detailed definition of a SCSI initiator port.

3.1.28 SCSI target device: A SCSI device containing logical units and SCSI target ports that receives device service and task management requests for processing See the SCSI Architecture Model-2 standard for a detailed definition of a SCSI target device.

3.1.29 SCSI target port: A SCSI target device object that contains a task router and acts as the connection between device servers and task managers and the service delivery subsystem through which requests and responses are routed. See the SCSI Architecture Model-2 standard for a detailed definition of a SCSI target port.

3.1.30 service delivery port: A port that receives service requests for a logical unit and returns responses to the initiator.

3.1.31 target: Synonymous with SCSI target port.

3.1.32 task: An object within the logical unit representing the work associated with a command or group of linked commands. A task consists of one initial connection and zero or more physical or logical reconnections, all pertaining to the task.

3.1.33 task manager: An agent within the device server that executes task management functions.

3.1.34 task management function: A task manager service that may be invoked by a task management message or by setting one of the task management flags in a SPI L_Q information unit to affect the execution of one or more tasks.

3.1.35 task set: A group of tasks within a device server, whose interaction is dependent on the task management, contingent allegiance and auto-contingent allegiance rules. See the SCSI Architecture Model-2 standard for a detailed definition of a task set.

3.1.36 vendor-specific: Something (e.g., a bit, field, code value) that is not defined by this standard and may be

used differently in various implementations.

3.1.37 zero: A false signal value or a false condition of a variable.

3.2 Symbols and abbreviations

¼ or NE	not equal
£ or LE	less than or equal to
±	plus or minus
ª	approximately
x	multiply
+	add
-	subtract
< or LT	less than
= or EQ	equal
> or GT	greater than
Š or GE	greater than or equal to
CA	Contingent allegiance
CRC	Cyclic Redundancy Check
DUT	Device under test
ISI	Intersymbol interference
LSB	Least significant bit
LUN	Logical unit number
MSB	Most significant bit
SCSI	Small Computer System Interface
SAM-2	SCSI Architecture Model-2
SCSI-2	Small Computer System Interface - 2
SCSI-3	Small Computer System Interface - 3
SPC-2	SCSI Primary Commands-2
SSC-2	SCSI Streaming Commands-2

3.3 Keywords

3.3.1 expected: A keyword used to describe the behavior 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 an error.

3.3.3 mandatory: A keyword indicating an item that is required to be implemented as defined in this standard to claim compliance with this standard.

3.3.4 may: A keyword that indicates flexibility of choice with no implied preference.

3.3.5 may not: Keywords that indicates flexibility of choice with no implied preference.

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

3.3.7 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, it shall be implemented as defined in this standard.

3.3.8 reserved: A keyword referring to bits, bytes, words, fields and code values that are set aside for future standardization. Their use and interpretation may be specified by future extensions to this or other standards. A reserved bit, byte, word or field shall be set to zero, or in accordance with a future extension to this standard. Recipients are not required to check reserved bits, bytes, words or fields for zero values. Receipt of reserved code values in defined fields shall be reported as an error.

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

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

3.4 Conventions

Certain words and terms used in this American National Standard have a specific meaning beyond the normal English meaning. These words and terms are defined either in clause 3 or in the text where they first appear. Names of signals, phases, messages, commands, statuses, sense keys, additional sense codes, and additional sense code qualifiers are in all uppercase (e.g., REQUEST SENSE), names of fields are in small uppercase (e.g., STATE OF SPARE), 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 lower-case b or h are decimal values.

Numbers immediately followed by lower-case b (xxb) are binary values.

Numbers immediately followed by lower-case h (xxh) are hexadecimal values.

Decimals are indicated with a comma (e.g., two and one half is represented as 2,5).

Decimal numbers having a value exceeding 999 are represented with a space (e.g., 24 255).An alphanumeric list (e.g., a,b,c or A,B,C) of items indicate the items in the list are unordered.

A numeric list (e.g., 1,2,3) of items indicate the items in the list are ordered (i.e., item 1 must occur or complete before item 2).

In the event of conflicting information the precedence for requirements defined in this standard is:

1) text,
2) tables, then
3) figures.

4 General

4.1 Overview

The SCSI automation drive interface class specifies the behavior of a logical unit that is primarily an automation drive interface device. Only devices that conform to this specification are members of the class. The automation drive interface device type has the characteristic of primarily handling data in a sequential manner (i.e., over a dedicated serial connection). This does not limit the device's ability to transfer data over non-specific (see ADP) interfaces, as this specification is not specific to any required interface.

This standard describes an associated command set for communicating with a automation drive interface.

4.2 Automation drive interface model

4.2.1 Automation drive interface overview

An Automation/Drive Interface - Commands (ADC) device server provides the means for a media changer (automation) controller to monitor and control a removable medium device used for data transfer, such as a tape drive. In addition to the ADC device server, the data transfer device will contain a Data Transfer Device (DTD) device server, such as a SCSI Stream Command (SSC) device server, which processes tasks from application clients performing backup and restore operations. The DTD commands are received via one or more primary interface ports, e.g., Parallel SCSI or Fibre Channel. The ADC device server will typically receive commands via an Automation/Drive Interface - Transport Protocol (ADT) port.

The automation device will typically contain a SCSI-3 Media Changer Commands (SMC) device server which controls a mechanism to move storage media among tape devices and storage locations. In the process of configuring itself and the tape devices installed in it and in the process of performing a backup or restore operation, the automation controller needs to perform one or more of the following tasks:

- Configure the tape device's operational parameters, such as SCSI Port ID, Fibre Channel Port_Name, and Autoload mode.
- Enable or disable the tape device's primary interface ports, e.g., Parallel SCSI or Fibre Channel.
- Determine the tape device's status, including the position of the removable medium and whether a medium access command is in process.
- Cause the DTD to unload or load media, even if its DTD device server is reserved by an application client.

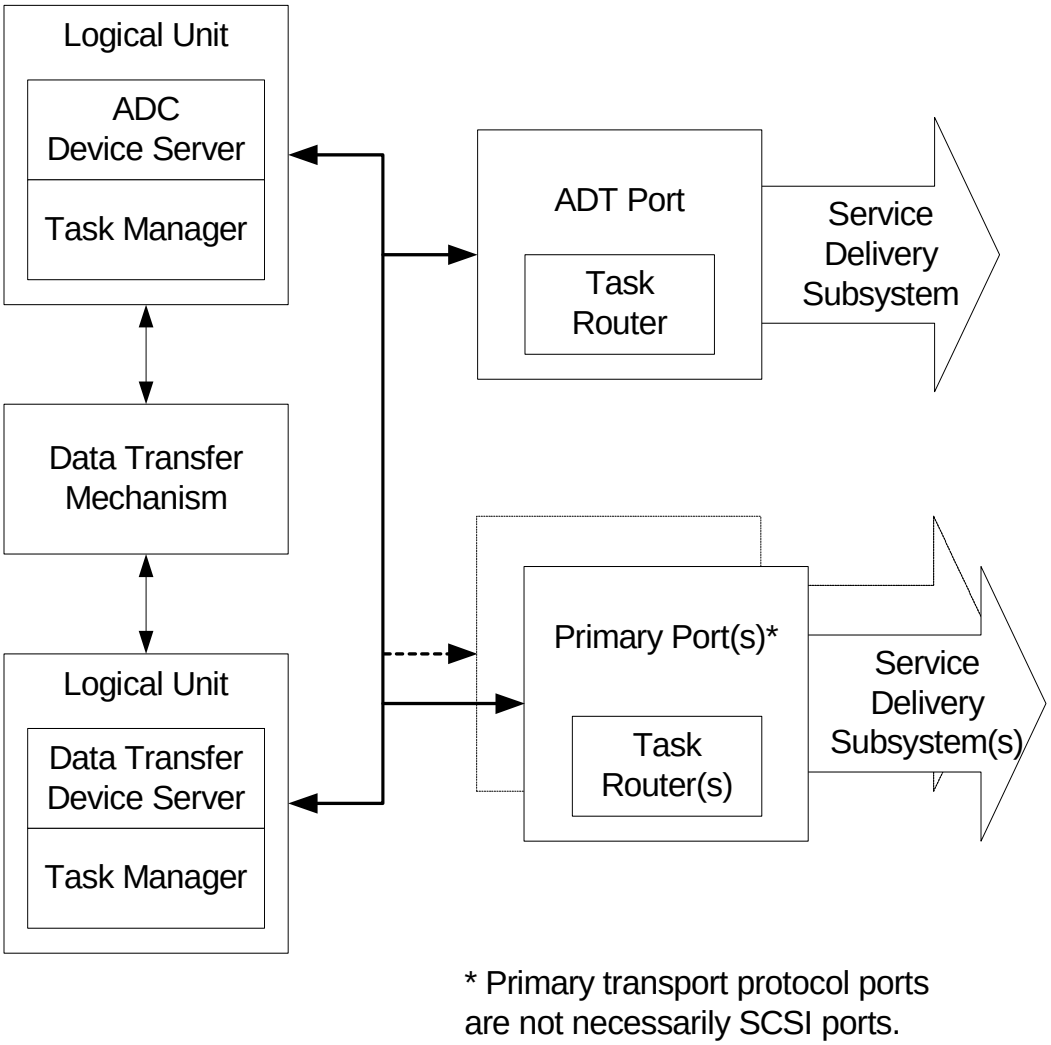

Figure 2 — Device server overview

Figure 2 shows an overview of the device servers.

Editors Note 1 - xxx: Probably need some explanatory text.

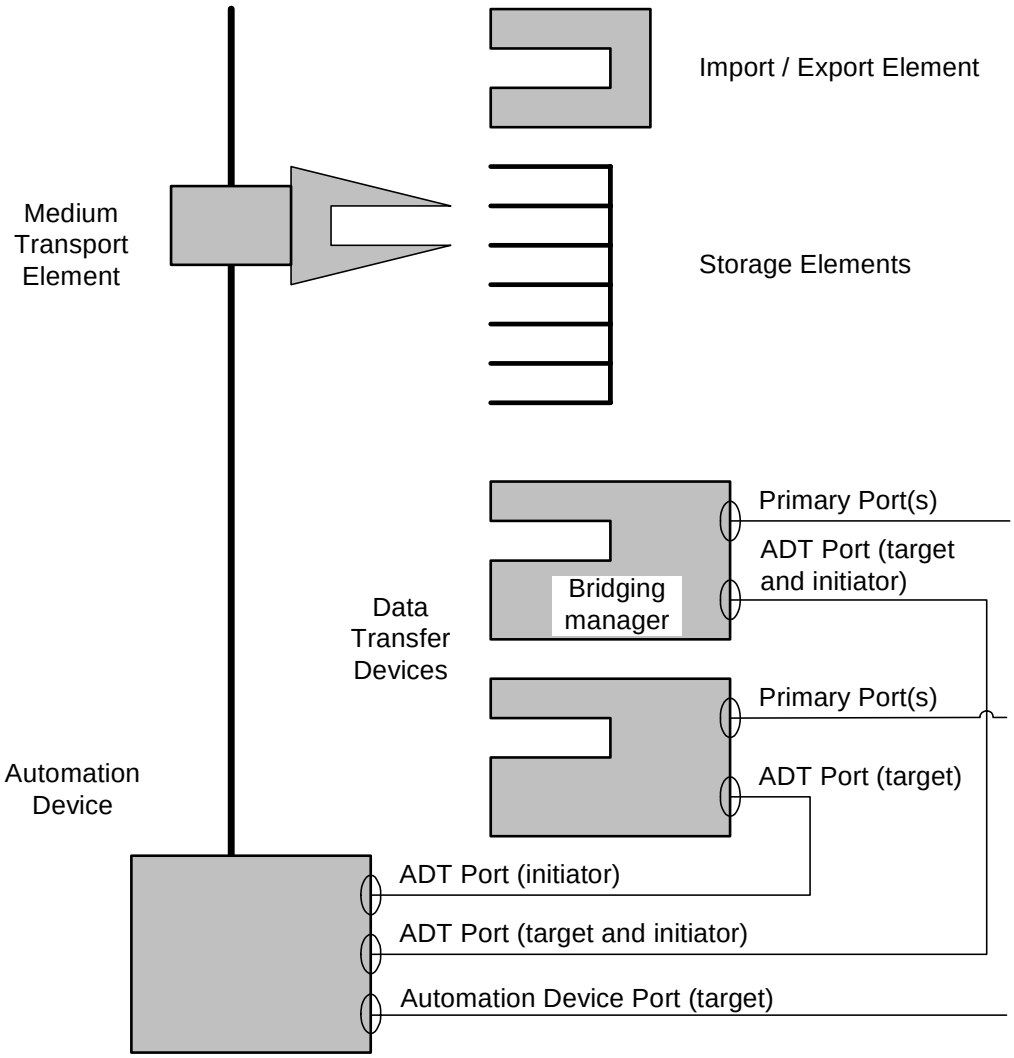

Figure 3 — Automation and Data Transfer Element relationship

Figure 3 shows a hardware view of the relationship between the automation device and the data transfer elements, with the automation drive interface in use.

Editors Note 2 - xxx: Probably need some better text for this figure.

4.2.1.1 Load and unload nominal states

Table 1 defines the nominal states that may be reported in the Very High Frequency data during load operations. Automation devices rely on this information to coordinate handling of the media into the DTD, as well as to provide activity status back to users of the system.

Table 1 — Load sequence nominal states

Load Sequence State	INXTN	RAA	MPRSNT	MSTD	MTHRD	DACC
a) DTD initialized, no media present	0	1	0	0	0	0
b) Early detection of media placement by DTD	0	1	1	0	0	0
c) Acknowledgement of media control by DTD	0	0	1	0	0	0
d) Media seating	1	0	1	0	0	0
e) Media seated	0	0	1	1	0	0
f) Media threading	1	0	1	1	0	0
g) Media threaded	0	0	1	1	1	0
h) Preparing for data access	1	0	1	1	1	0
i) Load complete (DTD ready)	0	0	1	1	1	1

Load states (a) and (i) shall be supported by the ADC device server at a minimum. States (b) through (h) should be reported to accurately reflect the states actually used by the DTD.

To indicate an error in any of the listed states, or to report a state not listed, the recovery requested (RRQST) field in the Very High Frequency data shall be set to one and the in transition (INXTN) field shall be set to zero.

When the in transition (INXTN) field is set to zero, the DTD requires an external stimulus (such as a command or physical translation of media) to attempt to reach another state.

Load state (a) represents an empty DTD, available for loading by the automation device.

Load state (b) represents initial placement of media into the DTD by automation. Depending on the DTD's design, media present may also be detected and reported coincident with this state. An additional external stimulus is required to leave this state, such as a "push" of the media by the automation.

Load state (c) represents detection and acknowledgement by the DTD of media presence, and that the DTD is now able to relinquish robotic access and assume control of the media. This state may be reflected after a media "push" by the automation for example. An additional external stimulus is required to leave this state, such as a "load" command from the automation.

Load state (d) represents media loading under the control of the DTD. It is used while seating the media.

Load state (e) represents seated media. An additional external stimulus is required to leave this state, such as a "thread" command from the automation. This state may be used in conjunction with MAM access for example.

Load state (f) represents media threading under control of the DTD.

Load state (g) represents threaded media. An additional external stimulus is required to leave this state, such as a command from the automation.

Load state (h) represents any additional processing that may be done by the DTD after threading the media, but prior to the load being fully complete to allow data access.

Load state (i) represents the completion of the load operation, and the DTD being in the SCSI READY state.

An example showing use of a few of the states is given in table 2.

Table 2 — Load sequence example

Load Sequence Event	INXTN	RAA	MPRSNT	MSTD	MTHRD	DACC
1) DTD initialized, no media present	0	1	0	0	0	0
2) Initial media placement into DTD	0	1	0	0	0	0
3) After “push” by automation, now seating	1	0	1	0	0	0
4) After seating, media now threading	1	0	1	1	0	0
5) Media threaded, preparing for data access	1	0	1	1	1	0
6) Load complete (DTD ready)	0	0	1	1	1	1

In this example, the DTD loads by first placing media into it, then pushing the media far enough into the DTD so that it engages the media and completes the operation in one continuous motion.

The load sequence begins with the drive initialized, no media present and robotic access allowed (1). The automation device then places media into the drive, which is not yet recognized by the drive (2). After the initial placement, the automation device pushes the media into the drive, such that media presence is detected and the DTD assumes control of the media and seats it (3). The drive continues transitioning through states as it threads the media (4). After threading, the drive has some final firmware preparations to make (5) prior to completing the load (6).

Table 3 defines the nominal states that may be reported in the Very High Frequency data during unload operations. Automation devices rely on this information to coordinate handling of the media from the DTD, as well as to provide activity status back to users of the system.

Table 3 — Unload sequence nominal states

Unload Sequence State	INXTN	RAA	MPRSNT	MSTD	MTHRD	DACC
a) DTD ready	0	0	1	1	1	1
b) DTD rewinding	1	0	1	1	1	0
c) Media unthreaded, still unloading	1	0	1	1	0	0
d) Media unseated, unloading or ejecting	1	0	1	0	0	0
e) DTD unloaded (hold point), seated	0	0	1	1	0	0
f) DTD unloaded (hold point), unseated	0	0	1	0	0	0
g) Media ejected, presence detected	0	1	1	0	0	0
h) Media ejected, presence not detected	0	1	0	0	0	0

Unload states (a) and (h) shall be supported by the ADC device server at a minimum. States (b) through (g) should be reported to accurately reflect the states actually used by the DTD.

To indicate an error in any of the listed states, or to report a state not listed, the recovery requested (RRQST) field in the Very High Frequency data shall be set to one and the in transition (INXTN) field shall be set to zero.

Unload state (a) reflects the initial DTD state prior to receiving a request to unload.

Unload state (b) reflects the initial DTD state after receiving a request to unload.

Unload state (c) reflects the DTD state during the unload operation after the media has been unthreaded.

Unload state (d) reflects the DTD state during the unload operation after the media has been unseated, as well as the state during the eject operation.

Unload state (e) reflects the DTD state after unloading to hold point, where media is still seated. An external stimulus, such as a request to eject or load, is needed to leave this state.

Unload state (f) reflects the DTD state after unloading to hold point, where media is also unseated. An external stimulus, such as a request to eject or load, is needed to leave this state.

Unload state (g) reflects the DTD state after the media is unloaded and ejected and the DTD is still able to report media present until the media is completely removed.

To Unload state (h) reflects the DTD state after the media is ejected and the presence of the cartridge is not detected (i.e., the device either does not support detection of media presence at this point or the media has been removed).

As an example, an “unload to hold point” sequence could use states (a), (b), (c) and (e), or alternatively (a), (b), (c), (d), and (f). An “unload to eject” sequence could use states (a), (b), (c), (d), and (h).

4.2.2 ADC device server and DTD device server interaction

Editors Note 3 - xxx: Awaiting proposals, one for SCSI pass-through behavior, one for general device server interaction. Revisit need for ADC device server and SMC device server interaction clause. Need statement that DTD device server should be available on ADT (i.e., automation can issue commands to SSC device server in addition to ADC)

4.2.3 Error reporting

If any of the following conditions occur during the processing of a command or if a deferred error prevented the command from processing, the device server shall return CHECK CONDITION status. The appropriate sense key and additional sense code should be set. Table 1 illustrates some error conditions and the applicable sense keys. Table 1 does not provide an exhaustive enumeration of all conditions that may cause the CHECK CONDITION status.

Table 4 — Error Conditions and Sense Keys

Condition	Sense Key
Unsupported option requested	ILLEGAL REQUEST
Logical unit reset or medium change since last command from this initiator.	UNIT ATTENTION
Device internal reset or Tranceiver Mode change	UNIT ATTENTION
Mode Parameters Changed	UNIT ATTENTION
Operating, State, Inquiry, Mode or Device Code has Changed	UNIT ATTENTION

4.2.4 Tape Alert application client interface

Editors Note 4 - xxx: Awaiting proposal.

4.2.5 Medium Auxiliary Memory attributes

ADC device servers shall not modify attributes of type Host. If the library needs to modify one of these attributes, it shall issue the command to the DTD logical unit.

4.2.6 Enabling and disabling primary ports

An ADC device server allows the primary service delivery ports to be disabled and enabled via MODE SELECT commands which modify the ADC device specific mode page.

When in the disabled state, the port shall not accept SCSI commands or task management requests and shall not respond to transport-level actions, such as SCSI Bus Reset or the Fibre Channel Loop Initialization or Loop Port Enable primitives.

When an enabled port is disabled, if the transport layer supports logins by other ports, then all logged-in ports shall be implicitly logged out. All tasks received via the disabled port shall be implicitly aborted. If the command disabling a port is received through the port being disabled, then the device server shall return status before disabling the port.

Disabling and re-enabling of a port shall be treated as an I_T nexus loss event for any existing nexii, as specified in SAM-3.

4.2.7 Device reservations and command behavior

4.2.7.1 Avoiding reservation conflicts

The ADT interface shall allow access to two logical units, one an ADC device server and the other a DTD device server. The ADC device server implements four classes of commands:

1) Commands which are mandatory for all device types - INQUIRY, TEST UNIT READY, and REQUEST SENSE.
2) Commands which must always ignore reservations placed by other initiators - such as LOAD UNLOAD.
3) Commands which must ignore reservations for some values of command parameters, such as MODE SELECT.
4) Vendor unique commands; the device vendor is responsible for avoiding reservation conflicts.

Commands outside of these four categories shall not be implemented by an ADC device server. No restrictions are placed on which commands may be implemented by the DTD device server.

5 Summary of commands for automation drive interface devices

The command set for automation drive interface devices shall be as shown in table 5. Commands specified as mandatory in table 5 shall be implemented if the command set is supported.

Table 5 — Command set for automation drive interface

Command	Required	Reference	Notes
INQUIRY	M	SPC-2	
LOAD UNLOAD	M	SSC	
LOG SELECT	O	SPC-2	
LOG SENSE	M	SPC-2	
MODE SELECT	M	SPC-2	
MODE SENSE	M	SPC-2	
READ ATTRIBUTE	M	SPC-3	
READ BUFFER	O	SSC	
RECEIVE DIAGNOSTIC RESULTS	O	SPC-2	
REPORT DENISTY SUPPORT	M	SSC	
REPORT LUNS	M	SPC-2	
REPORT SUPPORTED OPERATION CODES	M	SPC-3	
REQUEST SENSE	M	SPC-2	
SEND DIAGNOSTICS	M	SPC-2	1
TEST UNIT READY	M	SPC-2	
WRITE ATTRIBUTE	O	SPC-3	
WRITE BUFFER	O	SPC-2	

1) Only self test shall be mandatory.

6 Parameters for automation drive interface devices

6.1 Log parameters

6.1.1 Log parameters overview

This subclause defines the descriptors and pages for log parameters used with ADC devices.

The log page codes for ADC devices are defined in table 6.

Table 6 — Log page codes

Page Code	Description	Required	Reference
00h	Supported log pages	M	SPC-2
11h	Very High Frequency log page	M	6.1.2
12h	TapeAlert Response log page	M	6.1.3
13h	Requested Recovery log page	M	6.1.4
14h	Interface Status log page	M	6.1.5
15h	Device Statistics log page	O	6.1.6

Log parameters of ADC and DTD device servers in the same target shall be independent. That is, changes to log parameters caused by either LOG SELECT commands or other device operation of a DTD device server shall not be reflected by changes in the corresponding parameters reported by the ADC device server. Changes in log parameters caused by either LOG SELECT commands or other device operation of an ADC device server shall not be reflected by changes in the corresponding parameters reported by the DTD device server.

6.1.2 Very High Frequency log page

The Very High Frequency log page (see table 7) defines the most critical data that is needed most frequently during normal operation.

Table 7 — Very High Frequency log page

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved		PAGE CODE (11h)					
1	Reserved							
2	(MSB)		PAGE LENGTH (n-3)					
3								(LSB)
4	Very high frequency log parameters							
n								

Refer to SPC-2 for a description of the PAGE CODE and PAGE LENGTH fields.

Table 8 defines the Very High Frequency log page parameter codes.

Table 8 — Very High Frequency parameter codes

Parameter code	Description	Reference
0000h	Very high frequency data	6.1.2.1
0001h	Very high frequency polling delay	6.1.2.2

6.1.2.1 Very High Frequency Data log parameter

The Very High Frequency Data log parameter is shown in table 9.

Table 9 — Very High Frequency Data log parameter

Bit Byte	7	6	5	4	3	2	1	0
4	(MSB)							
5	PARAMETER CODE (0000h)							(LSB)
6	DU(0)	DS(1)	TSD(0)	ETC(0)	TMC(0)		LBIN(1)	LP(1)
7	PARAMETER LENGTH (04h)							
8	(MSB)							
11	VHF DATA							(LSB)

The PARAMETER CODE field shall be set to 0000h to indicate the very high frequency data log parameter.

The PARAMETER LENGTH field shall be set to 04h to allow transfer of the complete parameter.

Refer to table 10 for a description of the VHF DATA. Values returned shall reflect the last known since the drive having become initialized.

NOTE 1 In addition to indication of drive initialization, reliance on returned values should take into consideration conditions indicated by changes in Tape Alert flag status, and process those first as needed.

Table 10 — VHF Data

Bit Byte	7	6	5	4	3	2	1	0
8	Rsvd	Rsvd	MACC	CMPR	WRTP	CRQST	CRQRD	DINIT
9	INXTN	Rsvd	RAA	MPRSNT	Rsvd	MSTD	MTHRD	DACC
10	TAPE MOTION STATUS							
11	Rsvd	Rsvd	Rsvd	Rsvd	Rsvd	RRQST	INTFC	TAFS

A value of one in the media auxiliary memory accessible (MACC) field indicates that the media is located at a position where the Media Auxiliary Memory (MAM) can be accessed. A value of zero indicates that the MAM cannot be accessed. When set to one, the drive shall also support commands to access the MAM. If supported, this field should only be set to one in conjunction with Media Present.

NOTE 2 The MACC field is only applicable for drives and media that support MAM.

A value of one in the compress (CMPR) field indicates that the drive currently has data compression enabled. A value of zero indicates that it is not.

A value of one in the write protect (WRTP) field indicates that any currently present media is physically write protected; a value of zero indicates that it is not. This field is only valid if media present is one, and should be set to zero when no media is present in the drive.

NOTE 3 “Physically write protected” refers to any mechanism used within the media shell itself to write protect the media, such as sliding windows or tabs, and not logical states of write protection issued by commands to the drive.

A value of one in the clean requested (CRQST) field indicates that the drive has requested a head cleaning. A value of zero indicates that no cleaning is requested.

A value of one in the clean required (CRQRD) field indicates that a head cleaning operation must be done before a data cartridge can reach the data accessible state, such that normal operation may not be possible. A value of zero indicates that urgent cleaning is not required. This field shall take priority over clean requested. It shall not be considered an error for both fields to be set to one.

A value of one in the drive initialized (DINIT) field indicates that the drive is able to return valid very high frequency data. A value of zero indicates drive initialization is required or incomplete. This field should be monitored for a value of one before relying on any other fields in the VERY HIGH FREQUENCY DATA log parameter.

The in transition (INXTN) field governs the remaining fields within this byte to indicate the stability of the values returned and whether activity relative to state transitions is taking place. A value of one indicates that the state currently reflected by the remaining fields in this byte is in transition, as the drive is attempting to go to another state. A value of zero indicates that the drive is in the state reflected by the remaining fields in this byte and is making no attempt to leave this state. When the recovery requested (RRqst) field is set to 1, the in transition field shall be set to 0.

A value of one in the robotic access allowed (RAA) field indicates that the library may move media to or from the drive. A value of zero indicates that the library should not move media to or from the drive. The drive should indicate that access is allowed by the robotics if it is reasonably certain that media can be successfully inserted into or removed from the drive.

NOTE 4 The RAA field is not intended to reflect the value of any PREVENT/ALLOW MEDIA REMOVAL command settings, nor the ability of the library to issue commands to the drive.

A value of one in the media present (MPRSNT) field indicates that the drive detects the presence of media. A value of zero indicates that the drive does not detect any media present. This would typically be a direct reflection of some type of hardware sensor.

A value of one in the media seated (MSTD) field indicates that the media is mechanically seated within the loading mechanism. This means that the physical loading process has completed. A value of zero indicates that the media is not seated, and that further mechanical motion remains in order to complete the loading process (exclusive of tape threading).

A value of one in the media threaded (MTHRD) field indicates that the media has been threaded by the drive, such that tape motion operations are possible.

NOTE 5 This may or may not correspond to the drive responding “Ready” to a TEST UNIT READY command, as additional processing may be required by the drive after threading to achieve a SCSI “Ready” state.

A value of one in the data accessible (DACC) field indicates that the drive has finished all processing for a load operation. It corresponds to the drive being able to respond “Ready” to a TEST UNIT READY command. It is reset to zero at the beginning of the next unload operation when the drive is no longer in the Ready state.

The TAPE MOTION STATUS field is used to describe the current activity of the tape itself, as defined in table 11.

Table 11 — Tape Motion Status

Status	Description
00h	No tape motion
01h	Cleaning operation in progress
02h	Tape is being loaded
03h	Tape is being unloaded
04h	Tape in motion
05h	Reading
06h	Writing
07h	Locating
08h	Rewinding
09h-7Fh	Reserved
80h-FFh	Vendor Unique status

The recovery requested (RRQST) field shall be set to one to indicate that the drive has detected an error and that a recommended or requested recovery procedure is available via the Requested Recovery log page. A value of zero indicates that it does not. This field shall remain set to one until no further recoveries are requested. When this field is set to 1, the in transition (InXtn) field shall be set to 0.

NOTE 6 The recommended or requested recovery procedure in the log page may indicate “none” or “unknown.”

A value of one in the interface changed (INTFC) field indicates that interface status has changed since the last retrieval of the Interface Status log page. This field is reset to zero after retrieval of the Interface Status log page.

A value of one in the TapeAlert flag set (TAFS) field indicates that at least one TapeAlert flag has been set to one since the last retrieval of the TapeAlert flags. This field is reset to zero after retrieval of the TapeAlert Response log page. This field does not indicate when TapeAlert flags are reset to zero. It is possible to not find any TapeAlert flags set to one upon retrieval if the condition changed between the time of reporting through this field and retrieving the actual flags. This should not be considered an error.

NOTE 7 This field should be processed following the DINIT field. Pending TapeAlert flags may affect the reliability of the values returned in other fields.

6.1.2.2 Very High Frequency Polling Delay log parameter

The Very High Frequency Polling Delay log parameter is shown in table 12.

The PARAMETER CODE field shall be set to 0001h to indicate the very high frequency polling delay log parameter.

The PARAMETER LENGTH field shall be set to 02h to allow transfer of the complete parameter.

Table 12 — Very High Frequency Polling Delay log parameter

Bit / Byte	7	6	5	4	3	2	1	0
4	(MSB)							
5		PARAMETER CODE (0001h)						(LSB)
6	DU(0)	DS(1)	TSD(0)	ETC(0)	TMC(0)		LBIN(1)	LP(1)
7	PARAMETER LENGTH (02h)							
8	(MSB)							
9		VHF POLLING DELAY						(LSB)

The VHF POLLING DELAY field indicates the minimum delay in milliseconds the library shall wait before requesting another Very High Frequency log page.

6.1.3 TapeAlert Response log page

Table 13 describes the TapeAlert Response log page. The parameter fields represent the various TapeAlert flags (see SSC-2 for a description of TapeAlert and a definition of the flags).

The TapeAlert flags shall be maintained independently by the ADC server from the flags maintained by the DTD device server. Retrieving the flags from the ADC device server shall only reset those flags maintained by the ADC device server and shall not reset the flags maintained by the DTD device server. Retrieving flags from the DTD device server shall only reset those flags maintained by the DTD device server and shall not reset the flags maintained by the ADC device server.

Table 13 — TapeAlert Response log page

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved		PAGE CODE (12h)					
1	Reserved							
2	(MSB)		PAGE LENGTH (000Ch)					
3								(LSB)
4	(MSB)		PARAMETER CODE (0000h)					
5								(LSB)
6	DU(0)	DS(1)	TSD(0)	ETC(0)	TMC(0)		LBIN(1)	LP(1)
7	PARAMETER LENGTH (08h)							
8	FLAG01	FLAG02	FLAG03	FLAG04	FLAG05	FLAG06	FLAG07	FLAG08
9	FLAG09	FLAG10	FLAG11	FLAG12	FLAG13	FLAG14	FLAG15	FLAG16
10	FLAG17	FLAG18	FLAG19	FLAG20	FLAG21	FLAG22	FLAG23	FLAG24
11	FLAG25	FLAG26	FLAG27	FLAG28	FLAG29	FLAG30	FLAG31	FLAG32
12	FLAG33	FLAG34	FLAG35	FLAG36	FLAG37	FLAG38	FLAG39	FLAG40
13	FLAG41	FLAG42	FLAG43	FLAG44	FLAG45	FLAG46	FLAG47	FLAG48
14	FLAG49	FLAG50	FLAG51	FLAG52	FLAG53	FLAG54	FLAG55	FLAG56
15	FLAG57	FLAG58	FLAG59	FLAG60	FLAG61	FLAG62	FLAG63	FLAG64

The PAGE LENGTH field shall be set to 000Ch to allow the transfer of the complete log page.

The PARAMETER CODE field shall be set to 0000h to indicate the single log parameter.

The PARAMETER LENGTH field shall be set to 08h to allow transfer of the complete parameter.

A value of one in any FLAGXX field specifies the flag is set. A value of zero specifies the flag is not set.

6.1.4 Requested Recovery log page

Editors Note 5 - xxx: Awaiting proposal (T10/03-095).

6.1.5 Interface Status log page

Editors Note 6 - xxx: Awaiting proposal (from Lee J.; to now be additional parameter in VHF page, and this page removed).

6.1.6 Device Statistics log page

The Device Statistics log page (see table 14) defines data counters associated with utilization of the device. An ADC device server that implements the Device Statistics log page shall implement one or more of the defined

parameters. Support of the individual parameters in the Device Statistics log page is optional. Parameters can not be reset or changed via LOG SELECT.

Table 14 — Device Statistics log page

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved		PAGE CODE (15h)					
1	Reserved							
2	(MSB)		PAGE LENGTH (n-3)					
3								(LSB)
	Device statistics log parameters							
4	First device statistics parameter							
n	Last device statistic parameter							

Refer to SPC-2 for a description of the Page Code and Page Length fields.

Table 15 defines the Device Statistics log page parameter codes.

Table 15 — Device statistics parameter codes

Parameter Code	Description
0000h	Lifetime media loads
0001h	Lifetime cleaning operations
0002h	Lifetime power on hours
0003h	Lifetimemedia motion (head) hours
0004h	Lifetime meters of tape processed
0005h – 7FFFh	Reserved
8000h - FFFFh	Vendor specific

The device statistics log parameter format is shown in table 16.

Table 16 — Device statistics log parameter

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)	PARAMETER CODE						
1								(LSB)
2	DU(0)	DS(1)	TSD(0)	ETC(0)	TMC(0)		LBIN(0)	LP(0)
3	PARAMETER LENGTH (n-3)							
4	(MSB)	DEVICE STATISTICS DATA COUNTER						
n								(LSB)

6.2 Mode Parameters

6.2.1 Mode parameters overview

This subclause defines the descriptors and pages for mode parameters used with ADC devices.

The mode parameter list, including the mode parameter header and mode block descriptor, are in SPC-2.

The MEDIUM TYPE field is contained in the mode parameter header. This field is reserved ADC devices.

The DEVICE-SPECIFIC PARAMETER field is contained in the mode parameter header. This field is reserved for ADC devices.

The DENSITY CODE field is contained in the mode parameter block descriptor. This field is reserved for ADC devices.

The mode page codes for independent media changer devices are shown in table 17.

Table 17 — Mode page codes

Page Code	Description	Reference
0Eh	ADC Device Configuration mode page	6.2.2
20h-3Eh	Vendor Specific	
3Fh	Return all pages (valid only for the MODE SENSE command)	

6.2.2 ADC Device Configuration mode page

The ADC Device Configuration mode page (see table 18) is used to specify the appropriate DTD and ADC device configurations as needed in the automation environment. Sub-pages are used to extend the scope of the mode page.

Table 18 — ADC Device Configuration mode page

Bit / Byte	7	6	5	4	3	2	1	0
0	PS	SPF (1b)	PAGE CODE (0Eh)					
1	SUBPAGE CODE							
2	(MSB)	PAGE LENGTH (n-3)						
3								(LSB)
4	(MSB)	Mode parameters						
n								(LSB)

The mode sub-page codes for automation drive interface devices are defined in table 19.

Table 19 — Mode sub-page codes

Sub-page Code	Description	Reference
01h	Node descriptor sub-page	6.2.2.1
02h	Service Delivery Port descriptor sub-page	6.2.2.2
03h	Logical Unit descriptor sub-page	6.2.2.3

Each sub-page is comprised of one or more descriptors. The descriptors may be included in any order. On a MODE SENSE command, all descriptors supported by the device shall be returned. On a MODE SELECT command, all of the supported descriptors shall be included. Any descriptor included shall be included in its entirety.

6.2.2.1 Node descriptor sub page

This mode sub-page is fixed length and contains a descriptor of the target device Node. The page is defined in table 20.

Table 20 — Node descriptor sub page

Bit / Byte	7	6	5	4	3	2	1	0
0	PS	SPF (1b)	PAGE CODE (0Eh)					
1	SUB_PAGE CODE (01h)							
2	(MSB)	PAGE LENGTH (0Ch)						
3								(LSB)
4	Reserved						MNN	
5	Reserved							
6	Reserved							
7	Reserved							
8	(MSB)	WORLD WIDE NODE NAME						
15								(LSB)

The modify node name (MNN) field is used to modify and report modifications to the device's Node_name, as defined in table 21.

Table 21 — MNN Field description

MNN	MODE SENSE	MODE SELECT
00b	The value in the WWNN field is the manufacturer assigned Node_name.	Do not modify the node's world wide name. The WWN field shall be ignored.
01b	The value in the WWNN field has been modified from the manufacturer's assigned value.	Used the World Wide Node Name for logical unit 0 as the Node_Name. The value in the WWNN field shall be ignored..
10b	Invalid value for a MODE SENSE.	Set the node's world wide name to the manufacturer's default value. The value in the WWNN field shall be ignored.
11b	Invalid value for a MODE SENSE.	Set the node's world wide name to the value in the WWNN field.

6.2.2.2 Service Delivery Port descriptor sub-page

The Service Delivery Port descriptor sub-page is variable length, and consists of a mode sub-page header followed by one or more descriptors (see table 22).

Table 22 — Service Delivery Port descriptor sub-page

Bit / Byte	7	6	5	4	3	2	1	0
0	PS	SPF (1b)	PAGE CODE (0Eh)					
1	SUB_PAGE CODE (02h)							
2	(MSB)	PAGE LENGTH						
3								(LSB)
4	(MSB)	SERVICE DELIVERY PORT DESCRIPTOR						
n								(LSB)

6.2.2.2.1 Service Delivery Port descriptor header

The SERVICE DELIVERY PORT DESCRIPTORS vary between different protocols. Each descriptor contains a common header to facilitate parsing of the descriptors (see table 23).

Table 23 — Service delivery port descriptor header

Bit / Byte	7	6	5	4	3	2	1	0
0	RELATIVE TARGET PORT							
1	PORT TYPE							
2	(MSB)	ADDITIONAL DESCRIPTOR LENGTH						
3								(LSB)
4	(MSB)	SERVICE DELIVERY PORT DESCRIPTOR PARAMETERS						
n								(LSB)

The RELATIVE TARGET PORT field contains a value assigned by the device that uniquely identifies the port relative to other ports in the device, independent of port type. Once assigned, the relative target port value for a port shall not be changed as long as the port remains on the device.

The PORT TYPE indicates the type of protocol supported by the port. Values for this field are a subset of those defined in the SPC-2 PROTOCOL IDENTIFIER values table. Legal values for this field can be found in table 24.

Table 24 — Port type descriptors

Port Type	Transport layer type
00H	Fibre Channel (FCP, FCP-2)
01H	Parallel SCSI (SPI, SPI-2, SPI-3, SPI-4,…)
02H – FFH	Reserved

6.2.2.2.2 Fibre Channel descriptor parameters

Table 25 describes the fields in the Fibre Channel descriptor parameters.

Table 25 — Fibre Channel descriptor parameters

Byte \ Bit	7	6	5	4	3	2	1	0
4	P2P	TOPLOCK	RHA	LIV	MPN		Rsvd	PE
5	Reserved				SPDLOCK	SPEED		
6	Reserved							
7	Rsvd	FC-AL LOOP ID						
8	(MSB)	PORT NAME						
15								(LSB)

The port enable (PE) bit is set to one to enable the port. When it is set to zero, the port shall not enable its drivers and shall not respond to primitives, e.g., LIP and LPE (see clause 4.2.6).

The modify port name (MPN) field is used to modify and report modifications to the device's port name, as defined in table 26.

Table 26 — Modify Port Name

MPN	MODE SENSE	MODE SELECT
00b	The value in the PORT_NAME field is the manufacturer assigned port name.	Do not modify the port's world wide name. The PORT_NAME field shall be ignored.
01b	The value in the PORT_NAME field has been modified from the manufacturer's assigned value.	Do not modify the port's world wide name. The PORT_NAME field shall be ignored.
10b	Invalid value for a MODE SENSE.	Set the port's world wide name to the manufacturer's default value. The value in the PORT_NAME field shall be ignored.
11b	Invalid value for a MODE SENSE.	Set the port's world wide name to the value in the PORT_NAME field.

If the loop ID valid (LIV) bit is set to one, the value in the FC-AL LOOP ID field indicates the loop ID that the port shall use to set the Hard AL_PA to be used during a LIHA process when the RHA bit is set to one.

A require hard address (RHA) bit of one indicates that a target attached to an arbitrated loop shall only attempt to obtain its hard address using the value in the FC-AL LOOP ID field during loop initialization. The target shall not attempt to obtain an address during the LISA phase of initialization (see FC-AL-2). If there is a conflict for the hard address selection during loop initialization or the target does not have a valid hard address available, the target shall enter the nonparticipating state. If the target detects loop initialization while in the nonparticipating state, the target shall again attempt to get its hard address. If the hard address has not changed from the address obtained in a previous successful loop initialization, the target shall attempt to obtain the address in the LIFA phase if a valid Fabric Login exists or LIPA phase of loop initialization. If the hard address has changed, the target shall attempt to obtain the new address in the LIHA phase.

When the RHA bit is set to zero, the target follows the normal initialization procedure, including the possibility of obtaining a soft address during the loop initialization process.

Targets not attached to an arbitrated loop shall ignore the RHA bit.

The point-to-point (P2P) is set to one to indicate the port is configured to operate in point to point mode. When set to zero, the port is configured to operate in arbitrated loop mode.

The topology lock (TOPLOCK) bit is set to one to force the port to only operate in the mode selected by the P2P bit. When set to zero, the port may negotiate the topology and select the appropriate one. When this bit is set to zero on a MODE SELECT command, the P2P bit is ignored.

The SPEED field indicates the bit rate that the port is configured to operate in. The valid values can be found in table 27.

Table 27 — Speed Values

Value	Speed
000b	1 GB/Sec
001b	2 GB/Sec
010b – 111b	Reserved

The speed lock (SPDLOCK) field is set to one to force the port to only operate in the speed selected by the SPEED field. When set to zero, the port may negotiate the speed and select the appropriate one. When this bit is set to zero on a MODE SELECT command, the SPEED field is ignored.

The FC-AL LOOP ID field contains the Loop ID that shall be converted to a FC_PA value per the table in FC-AL-2.

6.2.2.2.3 Parallel SCSI descriptor parameters

Table 28 defines the fields in the Parallel SCSI descriptor parameters.

Table 28 - Parallel SCSI descriptor parameters

Bit Byte	7	6	5	4	3	2	1	0
4	Reserved			BMQ		BUS MODE		PE
5	Reserved							
6	MINIMUM TRANSFER PERIOD FACTOR							
7	SCSI ADDRESS							

The port enable (PE) bit is set to one to enable the port to respond to selections on the SCSI bus. When set to zero, the port shall not respond to or attempt selections or reselections on the SCSI bus and shall not respond to SCSI Bus Reset (see clause 4.2.6).

The BUS MODE field identifies the transmission mode that the target device shall use for this target port. Table 91 – Bus Mode of the SCSI Parallel Interface 4 (SPI-4) standard defines values for this field.

The bus mode qualifier (BMQ) field qualifies the effect that the BUS MODE field has on the target port as listed in table 29.

Table 29 — Effect of bus mode qualifier field

Value	Effect
00b	The target ignores the value of the bus mode qualifier field.
01b	The target operates the target port in the mode specified by the bus mode qualifier field; the target port does not drive the DIFFSENS line with the associated voltage and current characteristics.[a]
10b	Reserved
11b	The target operates the target port in the mode specified by the bus mode qualifier field; the target port drives the DIFFSENS line with the associated voltage and current characteristics.[a]
[a] – See SE/HVD transmission mode detection in SPI-4 for details regarding the DIFFSENS line.	

The MINIMUM TRANSFER PERIOD FACTOR field identifies the minimum transfer period factor that the target shall use when negotiating transfer agreements for this target port. Table 5 – Transfer Period Factors of the SCSI Parallel Interface 4 (SPI-4) standard defines values for this field. Devices that cannot support the identified minimum transfer period factor may enter negotiation using the next larger supported transfer period factor.

The SCSI ADDRESS field indicates the address that the port shall respond to on the SCSI bus.

A device receiving a MODE SELECT command for an enabled target port, where the command attempts to change the value of the BUS MODE, BMQ, MINIMUM TRANSFER PERIOD FACTOR, or SCSI ADDRESS fields, shall return CHECK CONDITION. The Sense Key shall be ILLEGAL REQUEST, and the additional sense code shall be Invalid Field in Parameter List. If the port is disabled, it shall not be an error to change the BUS MODE, BMQ, MINIMUM TRANSFER PERIOD FACTOR, or SCSI ADDRESS fields and enable the port with the same MODE SELECT command.

6.2.2.3 Logical Unit descriptor sub-page

The Logical Unit descriptor sub-page is variable length, and consists of a mode sub-page header followed by one or more descriptors. The descriptors may be included in any order. On a MODE SENSE command, all Logical Units supported by the device other than W-LUNs shall have descriptors returned. On a MODE SELECT command, all of the supported descriptors shall be included. Any descriptor included shall be included in its entirety.

Table 30 describes the Logical Unit descriptor sub-page.

6.2.2.3.1 Logical Unit descriptor header

The logical unit descriptors vary between different devices. Each descriptor contains a common header to facilitate parsing of the descriptors (see table 31).

The LOGICAL UNIT INDEX field contains a value assigned by the device that uniquely identifies it from all other logical units on the device, independent of device server. Once assigned, the Logical Unit Index value for a logical unit shall not be changed.

The DEVICE TYPE field indicates the type of command set supported by the logical unit. This field contains the same value that would be returned by the logical unit in the Peripheral Device Type field for an INQUIRY command.

Table 30 — Logical Unit descriptor sub-page

Bit / Byte	7	6	5	4	3	2	1	0
0	PS	SPF (1b)	PAGE CODE (0Eh)					
1	SUB_PAGE CODE (03h)							
2	(MSB)	PAGE LENGTH						
3								(LSB)
4	(MSB)	LOGICAL UNIT DESCRIPTORS						
n								(LSB)

Table 31 - Logical Unit descriptor header

Bit / Byte	7	6	5	4	3	2	1	0
0	LOGICAL UNIT INDEX							
1	DEVICE TYPE							
2	(MSB)	ADDITIONAL DESCRIPTOR LENGTH						
3								(LSB)
4	(MSB)	LOGICAL UNIT NUMBER						
5								(LSB)
6	(MSB)	LOGICAL UNIT DESCRIPTOR PARAMETERS						
n								(LSB)

The ADDITIONAL DESCRIPTOR LENGTH field contains a count of additional bytes used by the descriptor.

The LOGICAL UNIT NUMBER field can be used to change the logical unit number of the device.

6.2.2.3.2 Stream Device descriptor parameters

The descriptor parameters for a stream device (Device Type = 01h) are defined in table 32.

If the ENABLE bit is set to one it indicates the Logical Unit is reported and supported. When it is set to zero, the logical unit is not reported to a REPORT LUNS command and does not respond to commands.

If the OFFLINE bit is set to one, the device shall return CHECK CONDITION to all commands that require the device to be ready. The Sense Key shall be NOT READY. The additional sense code shall be Logical Unit Not Ready, Operation In Progress. If the OFFLINE bit is set to zero, the logical unit shall respond normally to commands.

Table 32 - Stream Device descriptor parameters

Bit / Byte	7	6	5	4	3	2	1	0
6	MLUN		Reserved				OFFLINE	ENABLE
7	Reserved		AUH	SUHO	AMO	AUTOLOAD MODE		
8	FUE	DRMODE	Reserved				DENOVR	WP
9	CURRENT DENSITY							
10	SELECT WRITE DENSITY							
11	Reserved							
12	Reserved							
13	Reserved							
14	Reserved							
15	Reserved							
	Identification descriptor list							
16	IDENTIFICATION DESCRIPTOR (first)							
	IDENTIFICATION DESCRIPTOR (last)							
n								

The modify logical unit name (MLUN) field is used to modify and report modifications to the logical unit's device identifiers, as defined in table 33.

Table 33 — Modify logical unit name field desriptors

MLUN	MODE SENSE	MODE SELECT
00b	The values in the identification descriptor list are the manufacturer assigned device identifiers.	Do not modify the logical unit's device identifiers. The identification descriptor list shall be ignored.
01b	The values in the identification descriptor list have been modified from the manufacturer's assigned values.	Do not modify the logical unit's device identifiers from the current values. The identification descriptor list shall be ignored.
10b	Invalid value for a MODE SENSE.	Set the logical unit's device identifiers to the manufacturer's default values. The values in the identification descriptor list shall be ignored.
11b	Invalid value for a MODE SENSE.	Set the logical unit's device identifiers to the values in the identification descriptor list.

The autoload mode override (AMO) field can be used to override the Autoload Mode settings for the logical unit controlled with the Control mode page for the logical unit. When set to one, the load process shall be controlled by

the Autoload Mode field in this page, overriding the settings in the Control mode page. When set to zero, the settings in the Control mode page shall be used to control the load process.

The AUTOLOAD MODE field specifies the action to be taken when a medium is inserted. This field is ignored on the MODE SELECT if the AMO bit is set to zero. The field is defined in table 34.

Table 34 — Autoload mode field desriptors

Value	Definition
000b	Medium shall be loaded for full access.
001b	Medium shall be loaded for medium auxiliary memory access only.
010b	Medium shall not be loaded.
011b – 111b	Reserved.

The SCSI unload hold override (SUHO) bit shall be set to one to override the Hold bit in the SCSI UNLOAD command. When set to one, the Hold bit in a SCSI UNLOAD command shall be ignored and the medium shall not be ejected. When set to zero, the Hold bit in the SCSI UNLOAD command shall control if the medium is ejected or not.

The automatic unload hold (AUH) bit shall be set to one to disable ejecting the medium when it is unloaded due to device specific conditions. These conditions can include cleaning complete, invalid medium type, firmware update complete, unsupported format, or other error conditions detected by the device. This bit does not affect the unload operation initiated by the front panel.

The write protect (WP) bit shall write protect the medium when set to one. This bit shall be set to zero by the device each time a medium is unloaded.

The density override (DENOVR) bit is use to override the Density Code field in the Mode Descriptor Block used by the device. When set to one, any write operation that the device is capable of selecting a density by using the Mode Descriptor Block shall use the density in the SELECT WRITE DENSITY field. When the DENOVR field is set to zero, the density shall be selected through other means and the SELECT WRITE DENSITY field shall be ignored. The DENOVR field shall be set to zero by the device each time a medium is unloaded. On a MODE SENSE command, the SELECT WRITE DENSITY field shall contain the density code that will be used by the device should a write operation be started such that the device is capable of selecting a density.

The firmware update enable (FUE) bit shall be set to one to prepare the device to accept a medium containing a firmware image. This bit shall be set to zero by the device once the firmware update process is complete or aborted.

The disaster recovery mode (DRMODE) bit shall be set to one to place the device into Disaster Recovery Mode. When set to zero, the device shall operate in normal mode. The definition of Disaster Recovery mode is beyond the scope of this standard.

The CURRENT DENSITY field shall be set to the density code indicating the density in which the device is currently operating. This field shall be ignored by the device on MODE SELECT commands.

The IDENTIFICATION DESCRIPTOR fields are the same as used in the Device Identification VPD page as described in SPC-2.

6.2.2.3.3 Medium Changer descriptor parameters

The descriptor parameters for a Medium Changer device (Device Type = 08h) are defined in table 35.

Table 35 — Medium Changer descriptor parameters

Bit / Byte	7	6	5	4	3	2	1	0
6	Reserved							ENABLE
7	Reserved							

If the ENABLE field is set to one it indicates the Logical Unit is reported and supported. Commands received for this logical unit shall be passed on to the automation using the ADI interface. When it is set to zero, the logical unit is not reported to a REPORT LUNS command and does not respond to commands.

6.2.2.3.4 Automation Drive descriptor parameters

The descriptor parameters for an Automation Drive device (Device Type = 12h) are defined in table 36.

Table 36 - Automation Drive descriptor parameters

Bit / Byte	7	6	5	4	3	2	1	0
6	Reserved							ENABLE
7	Reserved							

If the ENABLE bit is set to one it indicates the Logical Unit is reported and supported on the primary interface. Commands received for this logical unit shall be passed on to the automation drive command set device server. When it is set to zero, the logical unit is not reported to a REPORT LUNS command and does not respond to commands on the primary interface. This sub-page has no effect on the availability of the ADC device server on the ADT Service Delivery Port if one is available on the device.

6.3 Vital product data parameters

6.3.1 Vital product data parameters overview

No unique vital product data (VPD) parameters are defined for ADC devices. Device Identification page 83h (as defined in SPC-2) may be different between ADC and DTD devices.