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ADC Proposal

Cleaning Protection

Introduction

HP Ultrium tape drives automatically perform a head cleaning operation after successfully loading a cleaning cartridge. Each unnecessary cleaning operation increases our product warranty costs due to the abrasive nature of the cleaning media and the subsequent wear on the tape drive heads.

In an automation environment, the cartridge magazine may or may not contain a cleaning cartridge. Under normal circumstances, the automation controller identifies each cartridge that contains cleaning media during the process of magazine inventory. The automation controller may or may not provide protection, independent of the tape drive, against requests by an application client to load a cleaning cartridge into a tape drive that has not requested cleaning.

Scenarios also exist, generally due to operator or service engineer error, that result in cleaning cartridges misidentified by the automation controller as containing normal (data) media. In this case, the automation controller cannot protect the tape drive against unnecessary cleaning without a specific protection feature built in to the tape drive.

To protect against the inadvertent loading of a cleaning cartridge in an automation environment, the existing HP Auto-Changer Interface (ACI) specification includes an additional control parameter (CLEANING PROTECT in the SET DRIVE CONFIGURATION command) and a LOAD command bit (CLEAN) that collectively regulate the loading of cleaning cartridges.

HP wishes to add Cleaning Protection functionality to the ADC standard so that automation customers moving from the ACI to the ADI will continue to have access to this feature.

In the 'Detailed Changes to Draft Technical Standard' section, text copied from SSC appears in **violet** and wholly new text appears in **blue**. Some re-formatting of copied text has occurred.

Extract from HP ACI Specification

5.3 Load (0x01)

This command instructs the tape drive to load and optionally thread the tape of a cartridge that is in the *Load Position*. A cartridge is in the *Load Position* when located between Load Point 1 (LP1) and the seated position in the tape drive. If the tape drive already contains a loaded and threaded cartridge, this command will perform a Rewind operation, ignoring all CMD_DATA parameters except **Immed Resp**. A successful Rewind operation will leave the tape threaded and positioned at the beginning of media (BOM).

See section 6 for additional information on different load/unload scenarios and the position of LP1.

5.3.1 Load CMD_OPCODE & CMD_DATA

Bit => Byte:	7	6	5	4	3	2	1	0
0	Op-code = 0x01							
1	Vendor Unique		Reserved		Clean	Upgrade	Immed Resp	Thread

Parameters

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Clean:

With this bit set, the tape drive will clean the heads, provided a Cleaning cartridge is in the *Load Position* and the automation controller has also set the Thread bit in the command parameters. If the command passes its pre-execution checks and the Cleaning cartridge has not expired its usage count, the tape drive will return a Response packet with Status equal to Good.

If a Cleaning cartridge is in the *Load Position* and the automation controller sends a Load command with the Clean bit set but the Thread bit clear, then provided the command passes its pre-execution checks the tape drive will seat the cartridge and return a Response packet with Status equal Good. The tape drive will not thread the tape, and cleaning of the heads will not take place.

With this bit clear, the cleaning behavior of the tape drive will depend on the Cleaning Protect configuration setting (see Section 5.6.1).

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5.3.1.1 Error Handling

If the Clean bit is set and the Cleaning cartridge has expired its usage count, the tape drive will return a Response packet with Status equal to CHECK CONDITION and shall set the Error Information to:

- Sense Key equals Not Ready (0x02)

- Additional Sense Code and Qualifier equal Cleaning Failure (0x3007).

If a non-Cleaning cartridge is in the *Load Position* and the automation controller sends a Load command with the Clean bit set, the tape drive will return a Response packet with Status equal to CHECK CONDITION and shall set the Error Information to:

- Sense Key equals Media Error (0x03)

- Additional Sense Code and Qualifier equal Incompatible Media Installed (0x3000).

If a Cleaning cartridge is in the *Load Position*, Clean Protect has been configured (see Section 5.6.1) and the automation controller sends a Load command with the Clean bit not set, the tape drive will return a Response packet with Status equal to CHECK CONDITION and shall set the Error Information to:

- Sense Key equals Not Ready (0x02)

- Additional Sense Code and Qualifier equal Cleaning Failure (0x3007).

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5.6 Set Drive Configuration (0x04)

This command controls the configuration settings of the tape drive.

The format of this command depends on the primary transport protocol supported by the tape drive. This specification includes command definitions for products supporting either one parallel SCSI or two Fibre Channel ports.

5.6.1 Set Drive Configuration CMD_OPCODE & CMD_DATA – Parallel SCSI

Bit => Byte:	7	6	5	4	3	2	1	0
0	Op-code = 0x04							
1	Bus Enable	Reserved	Packet Seq.	Cleaning Protect	Upgrade Protect	Auto-Thread	Auto-Eject	Auto-Load
2	Auto-Load Point							
3	Vendor Unique				SCSI Target ID			
4 : 11	Reserved							
12	Drive Error Notify	Media Error Notify	Tape Alert Notify	CDB Waiting Notify	Reserved	Reserved	Clean Required Notify	Clean Needed Notify
13	Response Period							

Parameters

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Cleaning Protect:

This bit allows the automation controller to protect the drive's heads from accidental cleaning. With this bit set, a Cleaning cartridge will fail to load unless the ACI Load command has the Clean bit set (see section 5.3). With this bit clear, any load and thread of a Cleaning cartridge will result in cleaning of the drive's heads.

Current Text

5 Commands for automation drive interface devices

5.1 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	2
LOG SELECT	O	SPC-2	
LOG SENSE	M	SPC-2	
MODE SELECT(6)	O	SPC-3	
MODE SELECT(10)	M	SPC-3	
MODE SENSE(6)	O	SPC-3	
MODE SENSE(10)	M	SPC-3	
NOTIFY DATA TRANSFER DEVICE	M	5.2	
READ ATTRIBUTE	M	SPC-3	2
READ BUFFER	O	SSC	
RECEIVE DIAGNOSTIC RESULTS	O	SPC-2	
REPORT DENISTY SUPPORT	M	SSC	3
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	2, 4
WRITE ATTRIBUTE	O	SPC-3	2
WRITE BUFFER	O	SPC-2	

1) Only self test shall be mandatory.
2) These commands are subject to the readiness of the removable medium, such that the logical unit is able to accept these identified medium-access commands without returning CHECK CONDITION status. Other commands may be subject to readiness of the removable medium due to vendor unique features.
3) Same as note 2 above, expect only when the MEDIA bit is set.
4) TEST UNIT READY indicates the readiness of the removable medium, not the ADC device server. The ADC device server does not have a Not Ready state.

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6.2.2.3.2 RMC Logical Unit descriptor parameters

The descriptor parameters for an RMC logical unit (e.g., Device Type = 01h in the case of a stream device) are defined in table 35.

Table 35 – RMC Logical Unit 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 DENISTY							
11	Reserved							
12	Reserved							
13	Reserved							
14	Reserved							
15	Reserved							
	Identification descriptor list							
16	IDENTIFICATION DESCRIPTOR (first)							
n	IDENTIFICATION DESCRIPTOR (last)							

If the ENABLE bit is set to one it indicates the RMC Logical Unit is reported and supported on the DTD primary port. 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 DTD primary port. This field has no effect on the availability of the RMC device server on the ADT port if one is available on the data transfer device.

If the OFFLINE bit is set to one, the RMC device server shall return CHECK CONDITION to all commands that require the logical unit 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 RMC device server shall respond normally to commands.

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 36.

Table 36 — 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 37.

Table 37 — 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 LOAD UNLOAD command as processed by the RMC device server. When set to one, the Hold bit in a SCSI LOAD UNLOAD command shall be ignored by the RMC device server and the medium shall not be ejected. When set to zero, the Hold bit in the SCSI LOAD UNLOAD command shall control if the medium is ejected or not, as processed by the RMC device server. This field shall not effect unload requests as processed by the ADC device server.

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 allow the device to prepare to accept a medium containing a firmware image. This preparation is vendor specific. 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.

Detailed Changes to Draft Technical Standard

3.1 Definitions

3.1.x **cleaning medium**: A physical entity, removable from a data transfer device, that cleans the read/write mechanism of the device. This standard does not specify how the data transfer device uses the cleaning medium to clean the device's read/write mechanism.

3.1.x **data medium**: A physical entity, removable from a data transfer device, that stores data in a nonvolatile manner (retained through a power cycle) in accordance with commands processed by a device server.

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5 Commands for automation drive interface devices

5.1 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	5.3	2
LOG SELECT	O	SPC-2	
LOG SENSE	M	SPC-2	
MODE SELECT(6)	O	SPC-3	
MODE SELECT(10)	M	SPC-3	
MODE SENSE(6)	O	SPC-3	
MODE SENSE(10)	M	SPC-3	
NOTIFY DATA TRANSFER DEVICE	M	5.2	
READ ATTRIBUTE	M	SPC-3	2
READ BUFFER	O	SSC	
RECEIVE DIAGNOSTIC RESULTS	O	SPC-2	
REPORT DENISTY SUPPORT	M	SSC	3
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	2, 4
WRITE ATTRIBUTE	O	SPC-3	2
WRITE BUFFER	O	SPC-2	

1) Only self test shall be mandatory.
2) These commands are subject to the readiness of the removable medium, such that the logical unit is able to accept these identified medium-access commands without returning CHECK CONDITION status. Other commands may be subject to readiness of the removable medium due to vendor unique features.
3) Same as note 2 above, expect only when the MEDIA bit is set.
4) TEST UNIT READY indicates the readiness of the removable medium, not the ADC device server. The ADC device server does not have a Not Ready state.

5.3 LOAD UNLOAD command

The LOAD UNLOAD command (see Table 7) requests that the logical unit enable or disable the logical unit for further operations. This command may also be used to request a re-tension function. Prior to performing the LOAD UNLOAD operation, the RMC logical unit shall ensure that all buffered data, filemarks, and setmarks have been transferred to the medium. See SSC for a description of the effect the LOAD UNLOAD command has on buffered data (buffer mode not equal to 0h).

Table 7 — LOAD UNLOAD command

Bit / Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (1Bh)							
1	Reserved							IMMED
2	Reserved							
3	Reserved							
4	Reserved		CLEAN	Reserved	HOLD	EOT	RETEN	LOAD
5	CONTROL							

See the LOAD UNLOAD command in SSC for a description of the EOT, IMMED and RETEN fields in this command. See the LOAD UNLOAD command in SSC for a description of the interaction between the AUTOLOAD MODE field in the control mode page and the HOLD bit.

A LOAD bit of one, a CLEAN bit of zero and a HOLD bit of zero indicates the data medium in the data transfer device shall be loaded and positioned to the beginning-of-partition zero. A LOAD bit of one, a CLEAN bit of zero and a HOLD bit of zero indicates the cleaning medium in the data transfer device shall not be loaded. The device server shall return CHECK CONDITION status with the sense key set to MEDIUM ERROR and the additional sense code and additional sense code qualifier equal to INCOMPATABLE MEDIA INSTALLED.

A LOAD bit of one, a CLEAN bit of one and a HOLD bit of zero indicates the cleaning medium in the data transfer device shall be loaded. This standard does not specify the final position of a cleaning medium after a successful load. A LOAD bit of one, a CLEAN bit of one and a HOLD bit of zero indicates the data medium in the data transfer device shall not be loaded. The device server shall return CHECK CONDITION status with the sense key set to MEDIUM ERROR and the additional sense code and additional sense code qualifier equal to INCOMPATABLE MEDIA INSTALLED.

A LOAD bit of zero and a HOLD bit of zero indicates the medium in the logical unit shall be positioned for removal at the extreme position along the medium specified by the EOT bit. Following successful completion of an unload operation, the device server shall return CHECK CONDITION status with the sense key set to NOT READY for all subsequent medium access commands until a new volume is mounted or a load operation is successfully completed.

A LOAD bit of one and a HOLD bit of one indicates if the medium has not been moved into the logical unit, the medium shall be moved in but not positioned for access. The CLEAN, EOT and RETEN bits shall be set to zero. Following successful completion, the device server shall return GOOD STATUS. If both the medium and device server support MAM, the device server shall generate a unit attention condition for all initiators with the additional sense code and additional sense code qualifier set to MEDIUM AUXILIARY MEMORY ACCESSIBLE.

A LOAD bit of zero and a HOLD bit of one indicates if the medium is in the logical unit, the medium shall be positioned as specified by the RETEN and EOT bits or shall be unthreaded (whichever is appropriate for the medium type) but shall not be ejected. Following successful completion, the device server shall return GOOD STATUS. If both the medium and device server support MAM, the device server shall generate a unit attention condition for all initiators with the additional sense code and additional sense code qualifier set to MEDIUM AUXILIARY MEMORY ACCESSIBLE.

A HOLD bit of one indicates MAM shall be accessible upon completion of the command but the medium shall not be positioned for access. A HOLD bit of zero and a LOAD bit of one indicates the medium shall be positioned for access. A HOLD bit of zero and a LOAD bit of zero indicates MAM shall not be accessible upon completion of the command.

A LOAD bit of zero and a CLEAN bit of one shall result in CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code and additional sense code qualifier equal to INVALID FIELD IN CDB.

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6.2.2.3.2 RMC Logical Unit descriptor parameters

The descriptor parameters for an RMC logical unit (e.g., Device Type = 01h in the case of a stream device) are defined in table 36.

Table 36 - RMC Logical Unit 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		CP	Reserved	DENOVR	WP
9	CURRENT DENSITY							
10	SELECT WRITE DENISTY							
11	Reserved							
12	Reserved							
13	Reserved							
14	Reserved							
15	Reserved							
	Identification descriptor list							
16	IDENTIFICATION DESCRIPTOR (first)							
	IDENTIFICATION DESCRIPTOR (last)							
n								

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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.

With the Clean Protect (CP) bit set to one, the ADC device server shall regulate the loading of Cleaning Media using the CLEAN bit in the LOAD UNLOAD command (See section 5.3). The device shall not allow auto-loading of Cleaning Media, and attempts to load Cleaning Media via the RMC device server shall result in CHECK CONDITION status with the sense key set to MEDIUM ERROR and the additional sense code and additional sense code qualifier equal to INCOMPATABLE MEDIA INSTALLED. With the CP bit set to zero, the ADC device server shall load Cleaning Media regardless of the value of the CLEAN bit, the device shall permit auto-loading of Cleaning Media, and the RMC device server shall permit loading of Cleaning Media through the appropriate command for the RMC device type.

The firmware update enable (FUE) bit shall be set to one to allow the device to prepare to accept a medium containing a firmware image. This preparation is vendor specific. 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.

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