ADI Drive Polling Frames
A Proposal

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1   Introduction

The Automation Drive Interface (ADI) provides a means for automated tape libraries to communicate with drives across a serial interface to aid media handling and system management capabilities. The primary basis for the command set is encapsulated SCSI Command Descriptor Blocks (CDBs), but there is also a desire for the interface to support custom command and response frames to facilitate the retrieval of more consolidated and concise information tailored to the automation environment. The goal of this document is to propose potential response formats that can be used for this purpose.

Towards that end, the type of information typically needed by the library has been grouped into four different categories. Each category then has a corresponding suggested format. The categories are:

- **Very high frequency data** – drive and tape motion status, issued during load/unload operations and possible runtime monitoring situations.
- **High frequency data** – values that can change throughout the duration of a cartridge being loaded such as Tape Alert flags and data counters, but are less time critical.
- **Low frequency data** – information needed perhaps once after a cartridge is loaded or unloaded.
- **Very low frequency data** – information needed perhaps once for the drive, during initialization or equivalent.

By utilizing these drive polling frames in addition to the encapsulated SCSI CDBs, the hope is that interference with data path operations can be avoided, allowing the drive to concurrently support these requests while continuing to handle primary data path operations. These frames also allow some data to be gathered in a more condensed form, rather than issuing multiple SCSI commands and incur additional overhead.

In addition to these response frames, a Control Frame is also described which tells the library how the drive supports the polling frames.

2   Very High Frequency Data Frame

The goal of this response frame is to define the most critical information that is needed the most frequently during normal operation such that it can be as concise and condensed as possible for performance.

Table 1 shows the Very High Frequency Data response format.

Bit Byte	7	6	5	4	3	2	1	0
0	Status Valid	Rsvd	Rsvd	Rsvd	Rsvd	Clean Requested	Clean Required	Drive Initialized
1	Access Allowed	Unload Complete	Load Complete	Media Present	Media Ejected	MAM Accessible	Media Seated	Media Threaded
2	Tape Motion Status							
3	Drive Error Code							

Table 1 Very High Frequency Data Response Format

The fields are described below.

Status Valid – A value of 1 indicates that the contents of this response frame are valid; a value of 0 indicates that the status may still be changing and the contents may not be valid.

Clean Requested – A value of 1 indicates that the drive has requested a head cleaning; a value of 0 indicates that no cleaning is requested.

Clean Required – A value of 1 indicates that a head cleaning operation must be done before a data cartridge can be loaded, such that normal operation may not be possible. A value of 0 indicates that urgent cleaning is not required.

Drive Initialized – A value of 1 indicates that the drive is ready for operation; a value of 0 indicates drive initialization is required or incomplete.

Access Allowed – A value of 1 indicates that the library may move media to or from the drive. A value of 0 indicates that the library should not move media to or from the drive.

Unload Complete – A value of 1 indicates that the drive has finished all processing for an unload operation. It is reset at the beginning of the next load operation. A value of 0 is indeterminate.

Load Complete – A value of 1 indicates that the drive has finished all processing for a load operation. It is reset at the beginning of the next unload operation. A value of 0 is indeterminate.

Media Present – A value of 1 indicates that the drive detects the presence of media; a value of 0 indicates that the drive does not detect any media present.

Media Ejected – A value of 1 indicates that the drive has media in the ejected position. A value of 0, in conjunction with a Media Present value of 1, indicates that media is inserted into the drive.

MAM Accessible – A value of 1 indicates that the media is located within the drive at a position where the Media Auxiliary Memory can be accessed. A value of 0 indicates that the MAM cannot be accessed.

Media Seated – A value of 1 indicates that the media is mechanically seated within the loading mechanism. This means that the physical loading process has completed. A value of 0 indicates that the media is not seated.

Media Threaded – A value of 1 indicates that the media has been threaded by the drive, such that tape motion operations are possible.

Tape Motion Status – This field describes the current activity of the tape itself as follows:
- 00h   No tape motion in progress
- 01h   Cleaning operation in progress
- 02h   Firmware upgrade in progress
- 03h   Tape is being loaded
- 04h   Tape is being unloaded
- 05h   Tape in motion
- 06h   Reading
- 07h   Writing
- 08h   Locating
- 09h   Rewinding
- 0Ah-7Fh   Reserved
- 80h-FFh   Vendor Unique status

Drive Error Code – This field is a drive reported error, which could be hardware, media, or both. A value of zero indicates no error.

3   High Frequency Data Frames

The goal of these response frames is to support monitoring of data that can change throughout the duration of a media load and that can provide feedback about the health of the drive and media combination.

The first response frame contains information relating to Read and Write performance and the second frame contains a condensed version of the Tape Alert information.

3.1 Read and Write Data Response Frame

Table 2 shows the High Frequency Read and Write Data response format.

Bit Byte	7	6	5	4	3	2	1	0
0	Rsvd	Rsvd	WCR Valid	RCR Valid	PDWE Valid	TDWE Valid	PDRE Valid	TDRE Valid
1	Rsvd	Rsvd	Rsvd	Rsvd	PTWE Valid	TTWE Valid	PTRE Valid	TTRE Valid
2 ⋯ 5	Temporary Drive Read Errors							
6 ⋯ 9	Permanent Drive Read Errors							
10 ⋯ 13	Temporary Drive Write Errors							
14 ⋯ 17	Permanent Drive Write Errors							
18 ⋯ 19	Read Compression Ratio							
20 ⋯ 21	Write Compression Ratio							
22 ⋯ 25	Temporary Tape Read Errors							
26 ⋯ 29	Permanent Tape Read Errors							
30 ⋯ 33	Temporary Tape Write Errors							
34 ⋯ 37	Permanent Tape Write Errors							

Table 2 High Frequency Read and Write Data Response Format

The fields are described below.

Temporary Drive Read Errors (TDRE) Valid – A value of 1 indicates that the Temporary Drive Read Errors field contains valid data; a value of 0 indicates that it does not.

Permanent Drive Read Errors (PDRE) Valid – A value of 1 indicates that the Permanent Drive Read Errors field contains valid data; a value of 0 indicates that it does not.

Temporary Drive Write Errors (TDWE) Valid – A value of 1 indicates that the Temporary Drive Write Errors field contains valid data; a value of 0 indicates that it does not.

Permanent Drive Write Errors (PDWE) Valid – A value of 1 indicates that the Permanent Drive Write Errors field contains valid data; a value of 0 indicates that it does not.

Read Compression Ratio (RCR) Valid – A value of 1 indicates that the Read Compression Ratio field contains valid data; a value of 0 indicates that it does not.

Write Compression Ratio (WCR) Valid – A value of 1 indicates that the Write Compression Ratio field contains valid data; a value of 0 indicates that it does not.

Temporary Tape Read Errors (TDRE) Valid – A value of 1 indicates that the Temporary Tape Read Errors field contains valid data; a value of 0 indicates that it does not.

Permanent Tape Read Errors (PDRE) Valid – A value of 1 indicates that the Permanent Tape Read Errors field contains valid data; a value of 0 indicates that it does not.

Temporary Tape Write Errors (TDWE) Valid – A value of 1 indicates that the Temporary Tape Write Errors field contains valid data; a value of 0 indicates that it does not.

Permanent Tape Write Errors (PDWE) Valid – A value of 1 indicates that the Permanent Tape Write Errors field contains valid data; a value of 0 indicates that it does not.

Temporary Drive Read Errors – These four bytes contain the current recovered drive read errors.

Permanent Drive Read Errors – These four bytes contain the current unrecovered drive read errors.

Temporary Drive Write Errors – These four bytes contain the current recovered drive write errors.

Permanent Drive Write Errors – These four bytes contain the current unrecovered drive write errors.

Read Compression Ratio – These two bytes contain the current drive read compression ratio (x 100).

Write Compression Ratio – These two bytes contain the current drive write compression ratio (x 100).

Temporary Tape Read Errors – These four bytes contain the current recovered tape read errors.

Permanent Tape Read Errors – These four bytes contain the current unrecovered tape read errors.

Temporary Tape Write Errors – These four bytes contain the current recovered tape write errors.

Permanent Tape Write Errors – These four bytes contain the current unrecovered tape write errors.

3.2 Tape Alert Response Data Frame

Table 3 shows the High Frequency Tape Alert Data response format.

Bit Byte	7	6	5	4	3	2	1	0
0	FLAG 08	FLAG 07	FLAG 06	FLAG 05	FLAG 04	FLAG 03	FLAG 02	FLAG 01
1	FLAG 16	FLAG 15	FLAG 14	FLAG 13	FLAG 12	FLAG 11	FLAG 10	FLAG 09
2	FLAG 24	FLAG 23	FLAG 22	FLAG 21	FLAG 20	FLAG 19	FLAG 18	FLAG 17
3	FLAG 32	FLAG 31	FLAG 30	FLAG 29	FLAG 28	FLAG 27	FLAG 26	FLAG 25
4	FLAG 40	FLAG 39	FLAG 38	FLAG 37	FLAG 36	FLAG 35	FLAG 34	FLAG 33
5	FLAG 48	FLAG 47	FLAG 46	FLAG 45	FLAG 44	FLAG 43	FLAG 42	FLAG 41
6	FLAG 56	FLAG 55	FLAG 54	FLAG 53	FLAG 52	FLAG 51	FLAG 50	FLAG 49
7	FLAG 64	FLAG 63	FLAG 62	FLAG 61	FLAG 60	FLAG 59	FLAG 58	FLAG 57

Table 3 High Frequency Tape Alert Data Response Format

The fields represent the various Tape Alert flags.

4 Low Frequency Data Frames

The goal of these response frames is to provide information that changes infrequently, but in a consolidated form. One frame focuses on drive information while the other focuses on the media.

4.1 Drive Information Response Data Frame

Table 4 shows the format of the Low Frequency Drive Information Data response format.

Bit Byte	7	6	5	4	3	2	1	0
0	Rsvd	Rsvd	Rsvd	POH Valid	ECT Valid	CC Valid	LC Valid	Compress
1 — 4	Total Load Count							
5 — 8	Total Clean Count							
9 — 12	Elapsed Clean Time							
13 — 16	Power On Hours							

Table 4 Low Frequency Drive Information Data Response Format

The fields are described below.

Compress – A value of 1 indicates that data compression is enabled on the drive; a value of 0 indicates it is disabled.

Load Count (LC) Valid – A value of 1 indicates that the Load Count field contains valid data; a valid of 0 indicates it does not.

Clean Count (CC) Valid – A value of 1 indicates that the Clean Count field contains valid data; a valid of 0 indicates it does not.

Elapsed Clean Time (ECT) Valid – A value of 1 indicates that the Elapsed Clean Time field contains valid data; a value of 0 indicates it does not.

Power On Hours (POH) Valid – A value of 1 indicates that the Power On Hours field contains valid data; a value of 0 indicate it does not.

Total Load Count – These four bytes contain the total number of loads the drive has performed during its lifetime.

Total Clean Count – These four bytes contain the total number of cleans the drive has performed during its lifetime.

Elapsed Clean Time – These four bytes contain the number of hours since the last cleaning operation.

Power On Hours – These four bytes contain the total number of power on hours for the drive's lifetime.

4.2 Media Information Response Data Frame

Table 5 shows the Low Frequency Media Information Data response format.

Bit Byte	7	6	5	4	3	2	1	0
0	Rsvd	Rsvd	Rsvd	CR Valid	FT Valid	MT Valid	LC Valid	WRTPRT
1 4	Total Load Count							
5	Media Type							
6	Format Type							
7 8	Cleans Remaining							

Table 5 Low Frequency Media Information Data Response Format

The fields are described below.

Write Protect (WRTPRT) – A value of 1 indicates that the cartridge is write protected; a value of 0 indicates it is not.

Load Count (LC) Valid – A value of 1 indicates that the Total Load Count field contains valid data; a value of 0 indicates it does not.

Media Type (MT) Valid – A value of 1 indicates that the Media Type field contains valid data; a value of 0 indicates it does not.

Format Type (FT) Valid – A value of 1 indicates that the Format Type field contains valid data; a value of 0 indicates it does not.

Cleans Remaining (CR) Valid - A value of 1 indicates that the Cleans Remaining field contains valid data; a value of 0 indicates it does not.

Total Load Count – These four bytes contain the total number of loads this cartridge has had. In the case of cleaning media, this field indicates the number of times a cleaning cartridge has been used.

Media Type – This field indicates the type of cartridge as follows:
- 01h   Data cartridge
- 02h   Firmware cartridge
- 03h   Cleaning cartridge
- 04h-7Fh   Reserved
- 80h-FFh   Vendor Unique

Format Type – This field is used in conjunction with the Media Type field to further refine the type of media. This field is Vendor Unique and can be used to describe media length, format, generation, or other format qualifiers.

Cleans Remaining – This field is only valid for cleaning media and indicates the remaining number of times this cleaning cartridge can be used.

5 Very Low Frequency Data Frame
At this time, the encapsulated SCSI commands seem sufficient to accommodate this category.

6 Control Frame
In order to provide a way for the drive to indicate what support it has for the drive polling frames, a Control Frame is defined as shown in Table 6.

Bit Byte	7	6	5	4	3	2	1	0
0	Rsvd	Rsvd	Rsvd	LFMI Valid	LFDI Valid	HFTA Valid	HFRW Valid	VHF Valid
1 --- 2	VHF Polling Delay							
3	HFRW Polling Delay							
4	HFTA Polling Delay							

Table 6 Drive Polling Control Frame

The fields are described below.

Very High Frequency (VHF) Valid – A value of 1 indicates that this response frame is supported; a value of 0 indicates it is not.

High Frequency Read and Write (HFRW) Valid – A value of 1 indicates that this response frame is supported; a value of 0 indicates it is not.

High Frequency Tape Alert (HFTA) Valid – A value of 1 indicates that this response frame is supported; a value of 0 indicates it is not.

Low Frequency Drive Information (LFDI) Valid – A value of 1 indicates that this response frame is supported; a value of 0 indicates it is not.

Low Frequency Media Information (LFMI) Valid – A value of 1 indicates that this response frame is supported; a value of 0 indicates it is not.

VHF Polling Delay - The minimum delay in milliseconds the library must wait before requesting another Very High Frequency data response frame.

HFRW Polling Delay - The minimum delay in seconds the library must wait before requesting another High Frequency Read and Write data response frame.

HFRW Polling Delay - The minimum delay in seconds the library must wait before requesting another High Frequency Tape Alert data response frame.