ADI Drive Polling Frames

A Proposal

T10/02-097r0

February 2002

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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.
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.
<table>
<thead>
<tr>
<th>Bit</th>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Rsvd</td>
<td>Rsvd</td>
<td>WCR Valid</td>
<td>RCR Valid</td>
<td>PDWE Valid</td>
<td>TDWE Valid</td>
<td>PDRE Valid</td>
<td>TDRE Valid</td>
</tr>
<tr>
<td>1</td>
<td>Rsvd</td>
<td>Rsvd</td>
<td>Rsvd</td>
<td>Rsvd</td>
<td>PTWE Valid</td>
<td>TTWE Valid</td>
<td>PTE Valid</td>
<td>TTRE Valid</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>Temporary Drive Read Errors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>9</td>
<td>Permanent Drive Read Errors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>13</td>
<td>Temporary Drive Write Errors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>17</td>
<td>Permanent Drive Write Errors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>19</td>
<td>Read Compression Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>21</td>
<td>Write Compression Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>25</td>
<td>Temporary Tape Read Errors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>29</td>
<td>Permanent Tape Read Errors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>33</td>
<td>Temporary Tape Write Errors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>37</td>
<td>Permanent Tape Write Errors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Byte</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>FLAG 08</td>
</tr>
<tr>
<td>1</td>
<td>FLAG 16</td>
</tr>
<tr>
<td>2</td>
<td>FLAG 24</td>
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<tr>
<td>3</td>
<td>FLAG 32</td>
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<tr>
<td>4</td>
<td>FLAG 40</td>
</tr>
<tr>
<td>5</td>
<td>FLAG 48</td>
</tr>
<tr>
<td>6</td>
<td>FLAG 56</td>
</tr>
<tr>
<td>7</td>
<td>FLAG 64</td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Byte</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Rsvd</td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th>Bit</th>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Rsvd</td>
<td>Rsvd</td>
<td>Rsvd</td>
<td>CR Valid</td>
<td>FT Valid</td>
<td>MT Valid</td>
<td>LC Valid</td>
<td>WRTPRT</td>
</tr>
<tr>
<td>1</td>
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<td></td>
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<td>4</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th>Bit</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Byte</td>
<td>Rsvd</td>
<td>Rsvd</td>
<td>Rsvd</td>
<td>LFMI Valid</td>
<td>LFDI Valid</td>
<td>HFTA Valid</td>
<td>HFRW Valid</td>
<td>VHF Valid</td>
</tr>
<tr>
<td>1</td>
<td>VHF Polling Delay</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>HFRW Polling Delay</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>HFTA Polling Delay</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**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.