IBM Library/Drive Interface (LDI)

T10/02-021r0 (see also T10/02-022r0)

Lee Jesionowski
Tape Architecture
Storage Systems Group

IBM TotalStorage™
Agenda

- LDI Physical - Overview and Recommendations
- LDI Protocol - A Comparison
- LDI Protocol - Recommendations
- LDI Messages - Overview
- LDI Messages - Recommendations
LDI Physical

- **RS-422 interface supports:**
  - Full duplex operation, asynchronous (transmit/receive simultaneously)
  - Baud rate of 9600 or 38400 (selectable via a feature switch on the tape drive)
  - Data Bits: 8
  - Parity: None
  - Stop Bits: 1 or 2 (selectable via a feature switch on the tape drive)

- **Additional signals:** drive present (for library) and LDI wrap tool present (for drive)

- **Recommendations for ADI physical layer strategy:**
  - Define mandatory signals based on those common to all vendor specs (minimum set)
  - Define connector and optional signals based on all other signals in vendor specs
## LDI Protocol - A Comparison

<table>
<thead>
<tr>
<th></th>
<th>HP</th>
<th>IBM</th>
<th>Quantum</th>
<th>Seagate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Byte Stuffing</strong></td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td><strong>Packet w/o EOF</strong></td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>(SOF+Length)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Packet w/EOF</strong></td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>(SOF+Length+EOF)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Checking</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-byte Checksum</td>
<td></td>
<td>1-byte Checksum</td>
<td>2-byte CRC</td>
<td>1-byte Checksum</td>
</tr>
<tr>
<td><strong>Flow Control</strong></td>
<td>Byte level, exception, both</td>
<td>Frame-level, exception, both</td>
<td>Frame-level, exception, both</td>
<td>Byte-level, nominal, drive-only</td>
</tr>
<tr>
<td>(byte/frame, exception/nominal, drive-only/both)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Exceptions to packet wrapper</strong></td>
<td>Acknowledgment, flow control</td>
<td>Acknowledgement</td>
<td>None</td>
<td>Acknowledgement</td>
</tr>
<tr>
<td><strong>Acknowledgement Sequence Number</strong></td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td><strong>Acknowledgement validity failure details</strong></td>
<td>N</td>
<td>N</td>
<td>Y (except CRC)</td>
<td>Y</td>
</tr>
<tr>
<td><strong>Acknowledgement timeout</strong></td>
<td>Fixed, 200 ms</td>
<td>Fixed, 5 s</td>
<td>Variable, up to 12 s</td>
<td>Variable, up to 5 s</td>
</tr>
</tbody>
</table>
LDI Protocol - Recommendations

- Recommendations for ADI transport protocol strategy:
  - Need to maximize interface robustness within reason (firmware feedback required)
  - Might be too time-consuming to standardize based on existing vendor specs due to variations in approaches
  - Should consider identifying an existing serial protocol standard and defining an ADI 'profile' of that standard (minimum mandatory subset)
LDI Messages - Overview

- 3 layers due to legacy - not recommended for standard

**Message Types**

- Set_Config
- Two_Way (message subtypes)
  - Config_Request
  - Drive_Status_Request, Drive_Status
  - Maint_Command (sub-commands), Maint_Status_Good/Error

**SCSI-like sub-commands:**
- Inquiry,
- Request Sense,
- Load/Unload,
- Send Diagnostic,
- Read/Write (media),
- Read/Write Buffer,
- Log Sense

**Other service/support sub-commands:**
- Set offline/online,
- Perform other tests,
- Firmware update,
- Failure analysis (dumps, traps, logs)
LDI Messages - Recommendations

- Recommendations for ADI command strategy:
  - Define an ADI 'profile' from the SSC-2 command set and parameters
    - Minimum mandatory commands and parameters
    - Standard and ADI-specific inquiry pages for identifying the drive
    - ADI-specific mode pages for configuring the drive (must be non-intrusive)
    - Standard and ADI-specific log pages for logs, TapeAlert, status, statistics
    - Standard and ADI-specific buffer IDs for logs, status, firmware
    - Standard and ADI-specific attribute IDs for media attributes
  - Mandatory ADI-specific default behavior (opposite behaviors can be optional):
    - No unit attentions
    - No reservation conflicts
    - No "not ready" status
    - Non-intrusive to SCSI initiators on data path interface
    - Graceful handling of differing library/drive firmware combinations (e.g. mode sense changeable values and "allow and ignore" un-supported parameters)
  - Vendor-unique extensions allowed through vendor-unique SCSI parameters
  - Consider future integration into SSC-x to ensure ADI commands and parameters are maintained by an active standards body