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Exception Recovery for Non-Interlocked Interconnects

Charles Monia
Digital Equipment Corporation
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- In a non-interlocked bus, the potential for out-of-order command execution exists whenever:
  - More than one command may be in transit at any time.
  - A command completes with an exception status.
  - The exception condition is removed before (or upon) the arrival of subsequent in-transit commands.
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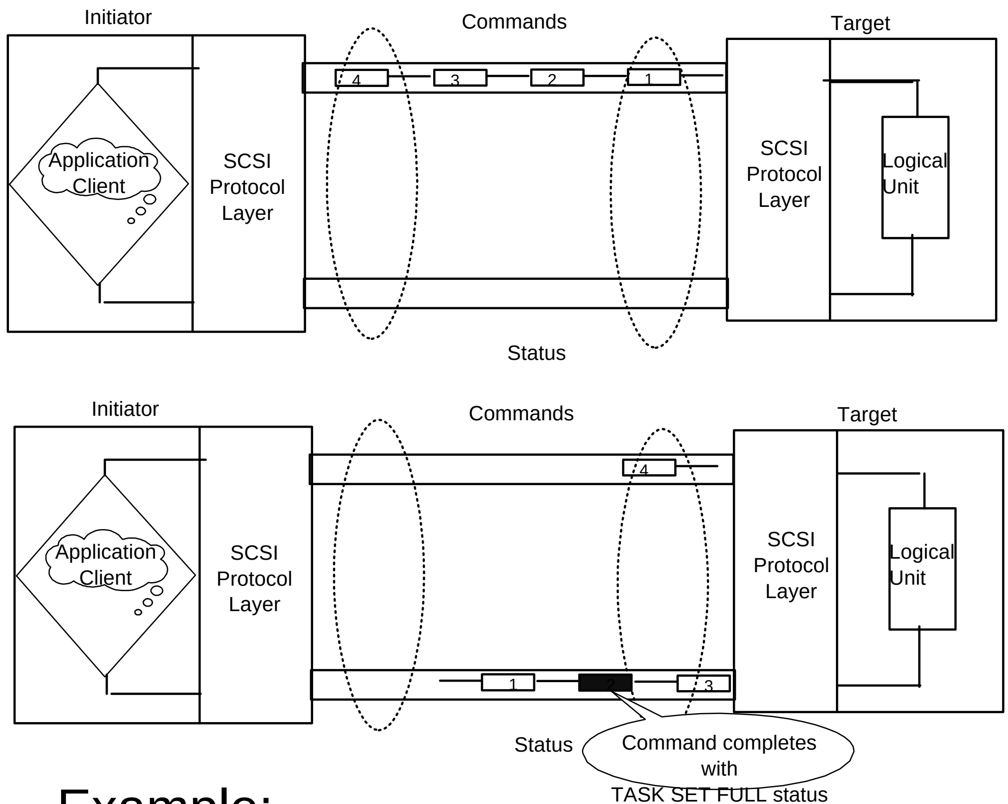

- Example:
  - A command terminates with TASK SET FULL (or some other non-ACA error status).
    - The condition may be cleared spontaneously.
    - If so, subsequent commands in-transit may be executed.

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- Goals
  - Feature should be optional
  - Prevent a command exception from causing out-of-order command execution,
  - Mechanism should be simple.
    - Don't try to optimize error cases.
  - Mechanism should be compatible with existing SCSI-2 device drivers,
    - Provided driver is written to be independent of the interconnect (as for CAM).
  - Recovery from all 'non ACA' exceptions should be hidden in 'SIM/XPORT' layer and for compatibility with SCSI-2 behavior (as seen by the device driver).
  - Device driver recovery from Contingent Allegiance is compatible with SCSI-2.

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First Proposal

- Create optional new interlock similar to ACA, which is set whenever one of the following statuses is returned:
  - ACA ACTIVE
  - TASK SET FULL
  - RESERVATION CONFLICT
  - BUSY
  - CHECK CONDITION (NACA clear)
- When an exception condition occurs the LUN:
  - Blocks further commands from entering the task set from faulted initiator. Returns special status for such commands.
  - For tasks already in the task set -- Blocks the return of further statuses from the logical unit to faulted initiator.
    - Needed for RESERVATION CONFLICT.
  - The condition must be cleared by the faulted initiator (via a new task management request).

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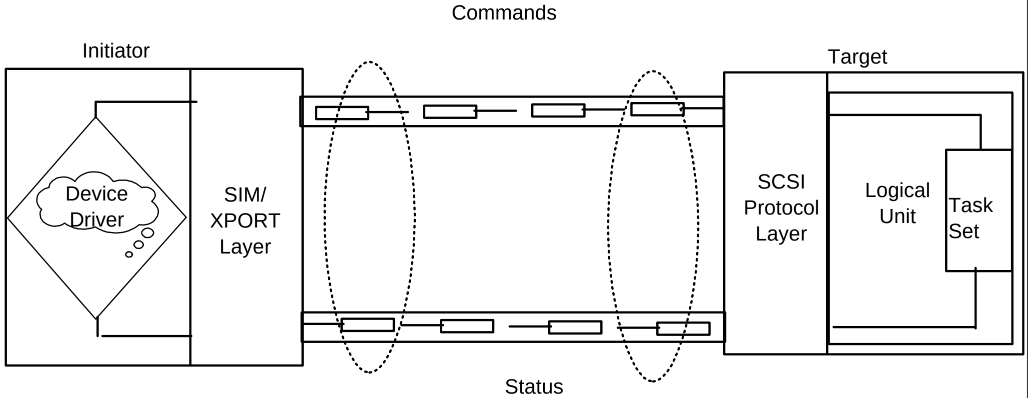
First Proposal (cont)

- When the initiator's protocol layer detects the exception, its SIM/XPORT layer:
  - Stops sending commands to the logical unit.
  - Automatically flushes all in-transit commands.
  - Marks all flushed commands for resend.
  - Passes the exception status to the application client.
  - Performs recovery based on exception type.

Issue

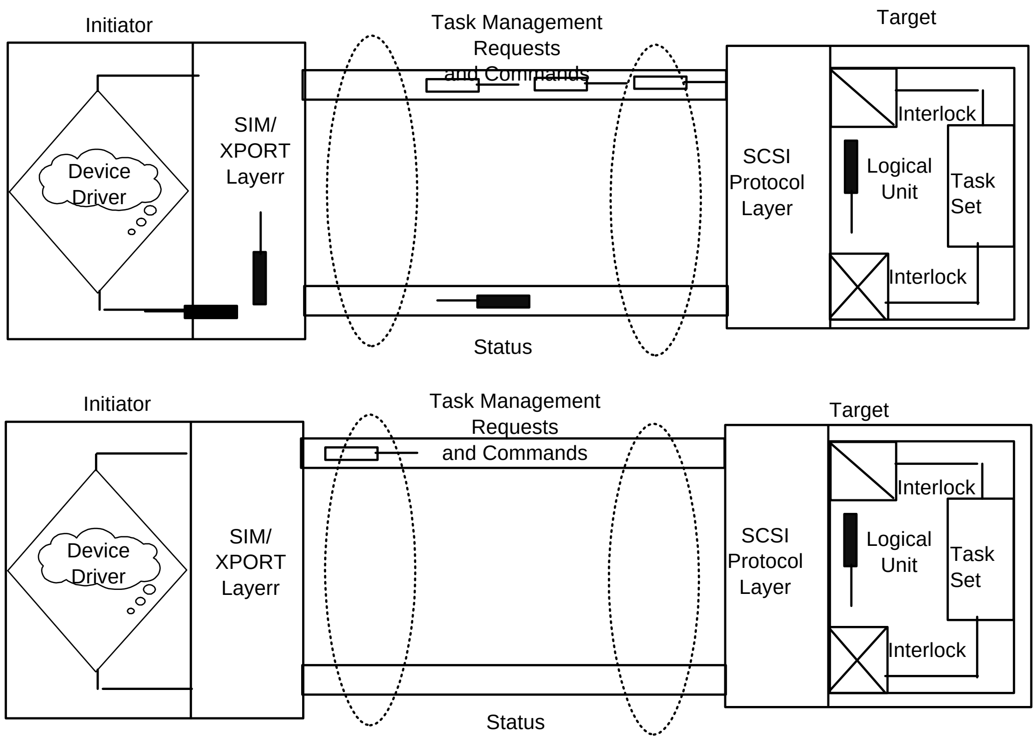
- What layer should contain the interlock?
  - Protocol Layer
    - Interlock controlled in a protocol-specific manner.
    - Advantage: Possible to optimize based on protocol characteristics.
    - Downside:Different implementation for each interconnect.
  - Application layer (Device server)
    - Interlock controlled by standard task management functions.
    - Advantage:One implementation fits any interconnect
    - Downside:May not be as efficient as protocol layer control.

Exception Recovery Example



- Assumptions
  - Host I/O architecture similarto CAM.
  - Initiator's SIM/XPORT layer (or equivalent)retains lists of pendingcommands in the orde sent by the device driver.
    - List of commands waiting to be sent.
    - List of commands that have been sent.
  - A command is removed from the appropriate list:
    - When status is received,
    - When the command is aborted. by the applicationclient.

Command Fault Recovery



- **The initiator's SIM/XPORT layer, on receiving the exceptionstatus:**
  - **Passes the exception status to the application client.**
  - **Stops sending commands to the faulted LUN.**
  - **Flushes in-transit commands.**
    - **Procedure is protocol-specific.**
  - **Marks flushed commands for resend.**
  - **Clears exception interlock.**
- **Resends marked commands when requestedby application client.**

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SCSI-2 Compatibility

- What a CAM-type Device Driver sees:
  - Behavior is identical to parallel SCSI.
  - Command Queue frozen as for CAM.
    - No out-of-order command execution.
  - Contingent Allegiance
    - Sense data automatically preserved.
  - Interface for manipulating the queue of unsent SCSI commands is implementation-specific but protocol independent.
- What the Device Driver doesn't see:
  - Management of 'pending command list' by SIM/XPORT layer.

Auto Contingent Allegiance Recovery

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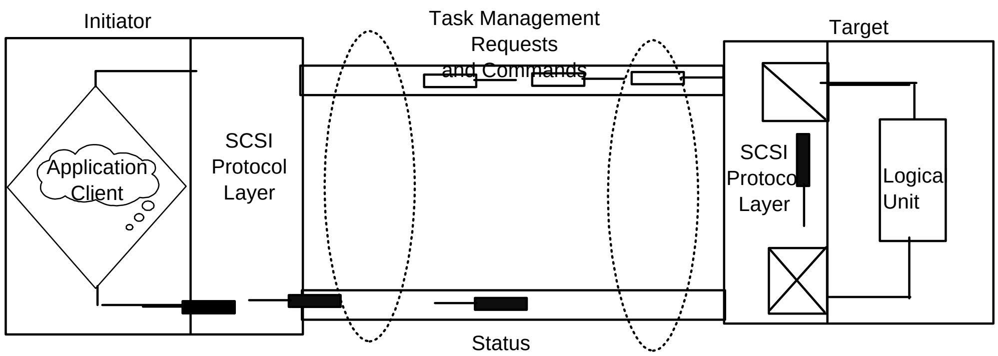

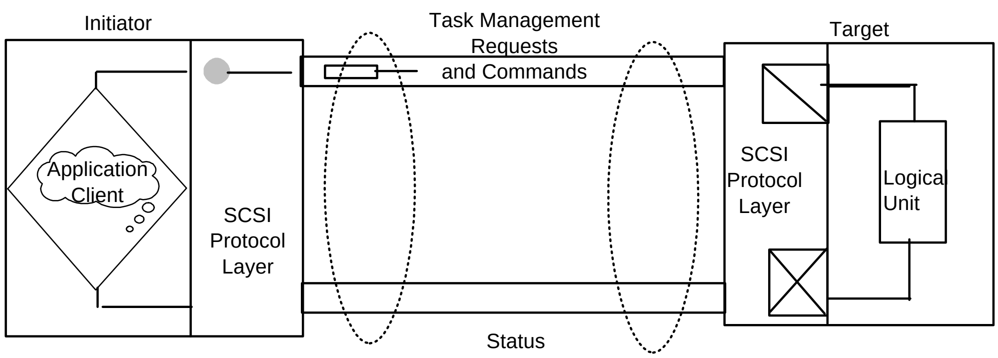

- **The initiator's SIM/XPORT layer, on receiving the exceptionstatus:**
  - **Passes the exception status to the device driver.**
  - **Stops sending commands to the faulted LUN.**
  - **Does not flush in-transit commands. (This is done by thedevice driver using the ACA interlock).**
  - **Passes all completion statuses to device driver.**
- **No flushed commands to resend.**
- **Application client may send one or more ACA commands followed byCLEAR ACA request.**

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- Status of proposal:
  - WG Observed that proposal was similar to ACA. Therefore ACA should be extended.
  - 96-173R1 written to extend ACA mechanism to handle all exceptions.
  - Glitches found by WG
    - Proposal broke the following ACA properties:
    - ACA can only be in effect for one initiator at a time.
    - ACAs don't nest. (What happens when a command terminates with an ACA ACTIVE status if an ACA is already in effect for that initiator?)
- Proposal:
  - Revert back to initial approach (new optional interlock).
  - Get WG feedback.
  - Prepare strawman and post on reflector
  - Discuss at next WG.
  - Vote up or down.