



Maxtor Corporation
500 McCarthy Boulevard
Milpitas, CA 95035 USA

To: T10 SAS Protocol Working Group
Contact: Mark Evans
Phone: 408-894-5310
Email: mark_evans@maxtor.com
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Subject: SAS-1.1, adding two new protocol services

Introduction

This proposal adds the two new protocol services: Terminate Command and Terminate Data Transfer. Each of these have service request and a corresponding service confirmation. Terminate Command provides a mechanism for an application client to terminate commands that have been sent to a SCSI initiator port, and Terminate Data Transfer provides a mechanism for a logical unit to terminate requests that have been sent to SCSI target ports. Without the Terminate Command service, it is possible that commands could remain in a SCSI initiator port after a target device had been reset. Without the Terminate Data Transfer service, it is possible that requests for a logical unit could remain in a SCSI target port after that logical unit was reset as the result of a hard reset received on another SCSI target port. This proposal is based on SAS-4a.

1) In Figure 106 - PL_OC (port layer overall control) state machine in clause 8.2.2.1 PL_OC state machine overview add:

- a) a Cancel message going from PL_OC2:Overall_Control state to the PL_PM state machines.

2) In 8.2.2.3.7 PL_OC2:Overall_Control state frame transmission cancellations, change this clause as follows:

Cancel requests cause this state to cancel previous Transmit Frame requests. A Cancel request includes the following arguments:

- a) the destination SAS address; and
- b) the tag.

If this state receives a Cancel request and has not sent a Tx Frame message for the Transmit Frame request, has not been sent to a PL_PM state machine, then this state shall:

- a) discard Transmit Frame request; and
- b) send a Transmission Status (Cancel Acknowledge) confirmation to the transport layer.

If this state receives a Cancel request and a Tx Frame message for the Transmit Frame request has been sent to a PL_PM state machine, then this state shall ~~discard the request;~~ send a Cancel message to the PL_PM state machine to which the Tx Frame message was sent. The Cancel message includes the tag.

3) In Figure 108 - PL_PM (port layer phy manager) state machine (part 2), in clause 8.2.3.1 PL_PM state machine overview add:

- a) a Cancel message coming from the PL_OC state machine going to the PL_PM3:Connected state.

4) In 8.2.3.4.1 PL_PM3:Connected state description, add the following (possibly after the paragraph that begins, "If this state receives an ACK/NAK Timeout confirmation...").

If this state receives a Cancel message, then this state shall:

- a) discard the Tx Frame request with the tag; and
- b) send a Transmission Status (Cancel Acknowledge) confirmation to the transport layer.

5) In Figure 113 - ST_I (transport layer for SSP initiator ports) state machines in clause 9.2.6.2 ST_I (transport layer for SSP initiator ports) state machines add:

- a) a Terminate Command request going to ST_IFR:Initiator_Frame_Router;
- b) a Command Terminated confirmation going from ST_IFR:Initiator_Frame_Router; and
- c) A Terminate message going from ST_IFR:Initiator_Frame_Route to ST_ISF1:Send_Frame state.

6) In 9.2.6.2.2.1 [ST_ISF1:Send_Frame state] 9.2.6.2.2.1 State description, change the last paragraphs of the clause to be as follows:

If this state receives a Terminate message from the ST_IFR state machine, and this state has not sent a Transmit Frame request to the port layer, then this state machine shall terminate.

If this state receives a Terminate message from the ST_IFR state machine, and this state has sent a Transmit Frame request to the port layer, then this state machine shall send a Cancel request to the port layer. This state may also send a Cancel request to the port layer to cancel a previous Transmit Frame request. A Cancel request shall include the following arguments:

- a) the destination SAS address; and
- b) the tag.

This state machine shall terminate upon receipt of a Transmission Status (Cancel Acknowledge) confirmation.

7) For 9.2.6.2.2.1 [ST_ISF1:Send_Frame state] 9.2.6.2.2.1 State description, change the clause to be as follows [note also that this state machine no longer terminates]:

~~The ST_IFR state machine: receives confirmations from the port layer and, depending on the confirmation, may send a message to the ST_ISF, ST_IPD, or ST_IPR state machines. This state machine receives connection information from the port layer. This state machine also receives Accept_Reject OPENs requests from the SCSI application layer and sends these requests to the port layer.~~

- a) receives Terminate Command requests from the SCSI application layer;
- b) sends Command Terminated confirmations to the SCSI application layer;
- c) receives confirmations from the port layer;
- d) depending on the confirmation, may send a message to the ST_ISF, ST_IPD, or ST_IPR state machines;
- e) receives connection information from the port layer;
- f) receives Accept_Reject OPENs requests from the SCSI application layer; and
- g) sendsAccept_Reject OPENs requests requests to the port layer.

This state machine consists of one state.

This state machine shall be started after a HARD_RESET Received confirmation is received.:

- a) ~~an Accept_Reject OPENs request is received;~~
- b) ~~a Frame Received confirmation is received; or~~
- c) ~~a HARD_RESET Received confirmation is received.~~

A Terminate Command request shall include:

- a) a destination SAS address;
- b) optionally, a logical unit number; and
- c) optionally, a tag.

If this state machine ~~was started as the result of receiving~~receives an Accept_Reject OPENs (Accept SSP) or Accept_Reject OPENs (Reject SSP) request, then this state shall send an Accept_Reject OPENs request along with the received argument to the port layer. ~~This state machine shall terminate after sending an Accept_Reject OPENs request to the port layer.~~

If this state machine ~~was started as the result of~~receives a Frame Received (ACK/NAK Balanced) or Frame Received (ACK/NAK Not Balanced) confirmation, then this state shall check the frame type in the received frame. If the confirmation was Frame Received (ACK/NAK Balanced) and the frame type is not XFER_RDY, RESPONSE, or DATA, then this state machine shall discard the frame ~~and terminate~~. If the confirmation was Frame Received (ACK/NAK Not Balanced) and the frame type is not DATA, then this state machine shall discard the frame ~~and terminate~~.

If the frame type is correct relative to the confirmation, then this state may check that the hashed source SAS address matches the SAS address of the SAS port transmitting the frame and the hashed destination SAS address in the frame matches the SAS address of the SAS port receiving the frame based on the connection. If this state checks these SAS addresses and they do not match, then this state machine shall ~~terminated~~discard the frame.

If the frame type is:

- a) XFER_RDY, then this state shall send a XFER_RDY Arrived message to the ST_ISF1:Send_Frame state specified by the tag;
- b) RESPONSE, then this state shall send a Response Arrived message to the ST_IPR state machine
- c) specified by the tag; or
- d) DATA, then this state shall send a Data-In Arrived message to the ST_IPD state machine specified by the tag.

Each of these messages shall contain the content of the SAS frame. If the tag does not specify a valid state machine, then this state shall discard the frame and may send a vendor-specific confirmation to the SCSI application layer to abort the command using that tag.

If this state machine receives a Terminate Command request and the request does not include a logical unit number or a tag, then this state shall send a Terminate message to each ST_ISF state machine that is processing a task for the destination SAS address.

If this state machine receives a Terminate Command request and the request includes a logical unit number but does not include a tag, then then this state shall send a Terminate message to each ST_ISF state machine that is processing a task with the logical unit number.

If this state machine receives a Terminate Command request and the request includes a tag, then this state machine shall send a Terminate message to the ST_ISF state machine that is processing the task with the tag.

A Terminate message shall include:

- a) the destination SAS address; and
- b) the tag.

After sending all Terminate messages required for a Terminate Command request, this state shall send a Command Terminated transport protocol service confirmation to the SCSI application layer.

If this state machine was started as a result of a HARD_RESET Received confirmation, then this state shall send a Transport Reset event notification to the SCSI application layer.

~~This state machine shall terminate after sending a message or confirmation.~~

8) In Figure 114 - ST_T (transport layer for SSP target ports) state machines in clause 9.2.6.3.1 ST_T state machines overview add:

- a) a Terminate Data Transfer request from the application layer to ST_TFR:Target_Frame_Router;
- b) a Data Transfer Terminated confirmation from ST_TFR:Target_Frame_Router to the application layer;
- c) a Terminate message from ST_TFR:Target_Frame_Router to ST_TS2:Send_Frame; and
- d) a Terminate message from ST_TFR:Target_Frame_Router to ST_TTS4:Receive_Data_Out.

9) In 9.2.6.3.2 ST_TFR (target frame router) state machine, change the clause to be as follows [note also that this state machine no longer terminates]:

The ST_TFR state machine: ~~receives confirmations from the port layer and sends a transport protocol service indication to the SCSI application layer or a message to the ST_TTS state machine. This state machine also receives Accept_Reject OPENs requests from the application layer and sends corresponding requests to the port layer.~~

- a) receives confirmations from the port layer;
- b) receives transport protocol service requests from the SCSI application layer;
- c) sends transport protocol service indications to the SCSI application layer;
- d) sends messages to the ST_TTS state machine
- e) receives Accept_Reject OPENs requests from the application layer; and
- f) sends Accept_Reject OPENs requests to the port layer.

This state machine consists of one state.

This state machine shall be started after:

- a) an Accept_Reject OPENs request is received;
- b) a Frame Received confirmation is received; or
- c) a HARD_RESET Received confirmation is received.

If this state machine ~~was started as the result of receiving~~ receives an Accept_Reject OPENs (Accept SSP) or Accept_Reject OPENs (Reject SSP) request, then this state machine shall send an corresponding Accept_Reject OPENs request to the port layer. ~~This state machine shall terminate after sending an Accept_Reject OPENs request to the port layer.~~

If this state machine ~~was started as the result of receiving~~ receives a Frame Received (ACK/NAK Balanced) or Frame Received (ACK/NAK Not Balanced) confirmation, then this state machine shall check the frame type in the received frame (see table 93). If the frame type is not COMMAND, TASK, or DATA, then this state machine shall discard the frame ~~and terminate~~.

If the confirmation was Frame Received (ACK/NAK Not Balanced) and the frame type is not DATA, then this state machine shall discard the frame ~~and terminate~~.

This state machine may check that reserved fields in the frame are zero. If any reserved fields are not zero, then this state machine may send a Response Data (Invalid Frame) message to the ST_TTS7:Prepare_Response state including the logical unit number and tag.

NOTE 30 - This check only applies to reserved fields defined in the SSP frame formats (e.g. formats defined in this clause), not reserved fields within the CDB in a COMMAND frame. Handling checking of reserved fields in a CDB is described in SAM-3.

If the frame type is correct relative to the confirmation, then this state may check that the hashed source SAS address matches the SAS address of the SAS port transmitting the frame and the hashed destination SAS address in the frame matches the SAS address of the SAS port receiving the frame based on the connection. If this state checks these SAS addresses and they do not match, then this state machine shall discard the frame ~~and terminate~~.

If the frame type is DATA, and the tag does not match a tag for an outstanding data-out command, then this state machine shall discard the frame ~~and terminate~~.

If the frame type is DATA, and the tag matches a tag for an outstanding data-out command without first burst data for which no XFER_RDY frame is outstanding, then this state machine shall discard the frame ~~and terminate~~.

If the frame type is COMMAND, then this state machine shall check the length of the information unit. If the length of the information unit is not correct (see 9.2.2.2), then this state machine shall send a Response Data (Invalid Frame) message to the ST_TTS7:Prepare_Response state including the logical unit number and tag.

If the frame type is TASK, then this state machine shall check the length of the information unit. If the length of the information unit is not correct (see 9.2.2.2), then this state machine shall send a Response Data (Invalid Frame) message to the ST_TTS7:Prepare_Response state including the logical unit number and tag.

If the frame type is COMMAND and the length of the information unit is correct, then this state machine shall send a SCSI Command Received transport protocol service indication to the SCSI application layer.

If the frame type is TASK, then this state machine shall check the logical unit number. If there is no logical unit at the specified logical unit number, then this state machine shall send a Response Data (Invalid Logical Unit Number) message to the ST_TTS7:Prepare_Response state including the logical unit number and tag.

If the frame type is COMMAND or TASK, then this state machine may check the target port transfer tag. If target port transfer tag is invalid, then this state machine may send a Response Data (Invalid Frame) message to the ST_TTS7:Prepare_Response state including the logical unit number and tag.

If the frame type is TASK and the length of the information unit is correct, then this state machine may check if the tag conflicts with an existing tag (i.e., an existing command or task management function). If this state machine checks the tag, and the tag conflicts with an existing tag, then this state machine shall send a Response Data (Invalid Frame) message to the ST_TTS7:Prepare_Response state including the logical unit number and tag. If this state machine does not check the tag or the tag does not conflict, then this state machine shall send a Task Management Request Received transport protocol service indication to the SCSI application layer. If the frame type is DATA, then this state machine shall send a Data-Out Arrived message to the ST_TTS4:Receive_Data_Out state. Each indication or message shall contain the content of the SAS frame.

If this state machine was started as the result of receiving a HARD_RESET Received confirmation, then this state machine shall send a Transport Reset event notification to the SCSI application layer and terminate.

If this state machine receives a Terminate Data Transfer request and the request does not include a logical unit number or a tag, then this state shall send a Terminate message to the ST_TTS2:Send_Frame and ST_TTS4:Receive_Data_Out states in each ST_TTS state machine that is processing a task for the destination SAS address.

If this state machine receives a Terminate Command request and the request includes a logical unit number but does not include a tag, then then this state shall send a Terminate message to to the ST_TTS2:Send_Frame and ST_TTS4:Receive_Data_Out states in each ST_TTS state machine that is processing a task with the logical unit number.

If this state machine receives a Terminate Command request and the request includes a tag, then this state machine shall send a Terminate message to the ST_TTS2:Send_Frame and ST_TTS4:Receive_Data_Out states in the ST_TTS state machine that is processing the task with the tag.

A Terminate message shall include:

- a) the destination SAS address; and
- b) the tag.

After sending all Terminate messages required for a Terminate Command request, this state shall send a Command Terminated transport protocol service confirmation to the SCSI application layer.

~~This state machine shall terminate after sending a message, transport protocol service indication, or event notification.~~

10) In 9.2.6.3.3.3.1 [ST_TTS2:Send_Frame] State description, change the last paragraphs as follows:

If this state receives a Terminate message, then ~~if~~ this state shall ~~may also~~ send a Cancel request to the port layer to cancel ~~a~~ previous Transmit Frame requests. A Cancel request shall include the following arguments:

- a) the destination SAS address; and
- b) the tag.

If ~~if~~ this state ~~machine terminates upon receipt of~~ receives a Transmission Status (Cancel Acknowledge) confirmation, ~~then this state shall terminate~~.

11) In 9.2.6.3.3.5.1 [ST_TTS4:Receive_Data_Out state] State description, add the following at the end of the clause:

If this state receives a Terminate message, then this state shall terminate.

[If more data is received for this tag, it will be discarded by the ST_TFR:Target_Frame_Router state machine because no target transport server state machine associated with the tag exists].