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To: T10 SAS Protocol Working Group
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Subject: SAS-1.1, adding the Terminate Data Transfer protocol service

Introduction

This proposal adds the new protocol service, Terminate Data Transfer, to the SSP transport layer state machines and clarifies what happens with tasks when a task management request is received by the transport layer. Terminate Data Transfer provides a mechanism for a logical unit to terminate requests that have been sent to SCSI target ports. 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. Also included in this proposal are changes to the SSP initiator state machines to clarify how initiators clear tasks from ports as the result of task management requests and other clean up of the SSP transport layer state machine descriptions. This proposal is based on SAS1r01. Revision 2 of this proposal includes input from the SAS protocol working group in Seattle, September 9, 2003.

Item 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 Cancel message going from PL_OC2:Overall_Control state to the PL_PM state machines.

Item 2) In clause 8.2.2.3.7 PL_OC2:Overall_Control state frame transmission cancellations: change the text to be 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 all Transmit Frame requests for the destination SAS address and tag; 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.

Item 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 Cancel message coming from the PL_OC state machine going to the PL_PM3:Connected state.

Item 4) In clause 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 all Tx Frame requests for the destination SAS address and tag; and
    b)   send a Transmission Status (Cancel Acknowledge) confirmation to the transport layer.

Item 5) Delete clause 9.2.4 SSP transport layer handling of link layer errors. The text in this clause is redundant with text in other clauses or belongs in a different clause. Where not redundant, the text in this clause has been corrected, where necessary, and included in the appropriate state machine description in this proposal.

Item 6) Delete clause 9.2.5 SSP transport layer error handling. The text in this clause is redundant with text in other clauses or belongs in a different clause. Where not redundant, the text in this clause has been corrected, where necessary, and included in the appropriate state machine description in this proposal.

Item 7) In order for tasks to be cleared from SSP initiator ports after a task management request affecting that task has been received, it is necessary for the ST_IFR:Initiator_Frame_Router state machine to be aware of outstanding tasks and task management requests. Because of this, this proposal moves the Send SCSI Command and Send Task Management protocol service requests from being sent to the ST_ISF1:Send_Frame state machine to being sent to the ST_IFR state machine. This makes it so that the flow of the text in the draft standard is better if the ST_IFR description precedes the ST_ISF1 description. The following proposed text makes those changes along with some other editorial changes (note also that the ST_IFR state machine no longer terminates). The following begins with clause 9.2.6.1.

0.0.0.1 ST state machines overview

The ST state machines perform the following functions:

    a)   receive and process transport protocol service requests and transport protocol service responses from the SCSI application layer;
    b)   receive and process other SAS connection management requests from the application layer;
    c)   send transport protocol service indications and transport protocol service confirmations to the SCSI application layer;
    d)   send requests to the port layer to transmit frames and manage SAS connections; and
    e)   receive confirmations from the port layer.

The Transmission Status and Frame Received confirmations received from the port layer include the following arguments:

    a)   the tag;
    b)   the destination SAS address; and
    c)   the source SAS address;

These arguments are used to route the confirmations to the correct ST state machines.

### 0.0.0.2 ST_I (transport layer for SSP initiator ports) state machines

0.0.0.2.1 ST_I state machines overview

The ST_I state machines are as follows:

[The only change in the following is the order of the list to reflect moving the ST_IFR description.]

a) ST_IFR (initiator frame router) state machine (see 0.0.0.2.2);
b) ST_ISF (initiator send frame) state machine (see 0.0.0.2.3);
c) ST_IPD (initiator process data) state machine (see 0.0.0.2.4); and
d) ST_IPR (initiator process response) state machine (see 0.0.0.2.5).

Figure 1 shows the ST_I state machines.

Figure 1 — ST_I (transport layer for SSP initiator ports) state machines
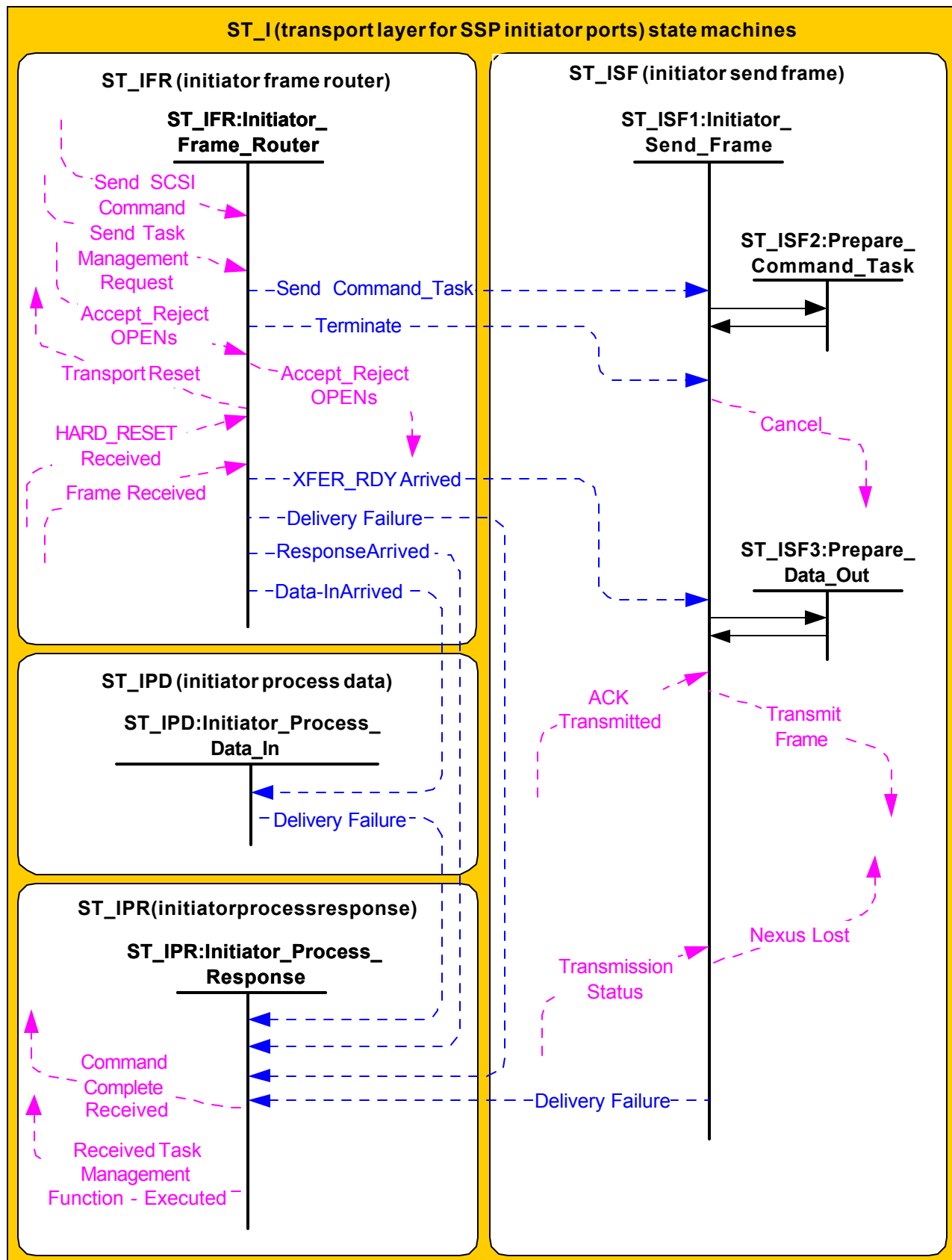
0.0.0.2.2 ST_IFR (initiator frame router) state machine

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 Send SCSI Command and Send Task Management transport protocol service requests from the SCSI application layer;
  b) sends Send Command_Task, Terminate, and XFER_RDY Arrived messages to the ST_ISF state machine;
  c) sends Data-In Arrived messages to the ST_IPD state machine;
  d) sends Response Arrived messages to the ST_IPR state machine;
  e) receives HARD_RESET Received confirmations from the port layer;
  f) sends Transport Reset confirmations to the application layer;
  g) receives Accept_Reject OPENs requests from the SCSI application layer; and
  h) sends Accept_Reject OPENs requests to the port layer.

This state machine consists of one state.

This state machine shall ~~be~~ start~~ed~~ after power on.~~:~~

  ~~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 receives a Send SCSI Command transport protocol service request or a Send Task Management Request transport protocol service request, then this state shall send a Send Command_Task message to an ST_ISF state machine. The message includes the following to be used in any OPEN address frames required to service the request:

  a) connection rate;
  b) initiator connection tag; and
  c) destination SAS address.

If the request is a Send SCSI Command transport protocol service request, then the message also includes the following to be used in any SSP frame for the request:

  a) logical unit number;
  b) tag;
  c) task attribute;
  d) additional CDB length;
  e) CDB; and
  f) additional CDB bytes.

If the request is for a data-out command, then the message also includes the number of bytes for the first burst size for the logical unit.

If the request is a Send Task Management Request transport protocol service request, then the message includes the following to be used in the TASK frame:

  a) logical unit number;
  b) tag;
  c) task management function; and
  d) tag of task to be managed.

If the request is a Send SCSI Command transport protocol service request, and the request causes one or more outstanding tasks in the port to be cleared or aborted (e.g. PREEMPT), then this state shall send a Terminate message to any ISF state machine that is processing one of the affected tasks.

If the request is a Send Task Management Request transport protocol service request, and the request causes one or more outstanding tasks in the port to be cleared or aborted, then this state shall send a Terminate message to any ISF state machine that is processing one of the affected tasks.

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 ~~terminate~~discard the frame.

If the frame type is XFER_RDY, then this state shall check the length of the frame. If the length of the frame is not 12 bytes, then this state shall:

   a)   discard the frame;
   b)   if the frame contains fewer than 12 bytes, then send a Delivery Failure (XFER_RDY Information Unit Too Short) message to the ST_IPR state machine;
   c)   if the frame contains more than 12 bytes, then send a Delivery Failure (XFER_RDY Information Unit Too Long) message to the ST_IPR state machine; and
   d)   send a Terminate message to the ST_IPD state machine for the tag,

If the frame type is XFER_RDY and the tag is for a task with no write data, then this state shall;

   a)   discard the frame;
   b)   send a Delivery Failure (XFER_RDY Not Expected) message to the ST_IPR state machine; and
   c)   if there is an ST_IPD state machine for the tag, send a Terminate message to that state machine.

~~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 the frame type is XFER_RDY and the frame is correct, then this state shall send a XFER_RDY Arrived message to the ST_ISF1:Send_Frame state specified by the tag. The message shall include the content of the SAS frame as an argument.

If the frame type is RESPONSE and this state has received a RESPONSE frame for this I_T_L_Q nexus, then this state shall discard the frame.

If the frame type is RESPONSE, the frame is correct, and this state has not received a RESPONSE frame for this I_T_L_Q nexus, then this state shall send a Response Arrived message to the ST_IPR state machine specified by the tag. The message shall include the content of the SAS frame as an argument.

If the frame type is DATA and the frame is correct, then this state shall send a Data-In Arrived message to the ST_IPD state machine specified by the tag. The message shall include the content of the SAS frame as an argument.

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 a result of~~ receives a HARD_RESET Received confirmation, then this state shall send a Transport Reset event notification to the SCSI application layer and send a Cancel message to any ISF state machine processing a task.

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

0.0.0.2.3 ST_ISF (initiator send frame) state machine

0.0.0.2.3.1 ST_ISF state machine overview

The ST_ISF state machine: ~~receives transport protocol service requests from the SCSI application layer,~~

- a) receives Send Command_Task and XFER_RDY Arrived messages from the ST_IFR state machine;
- b) constructs COMMAND, TASK, ~~or~~and data-out DATA frames; ~~. The service request may be to process either a command or task management function. This state machine also~~
- c) sends Transmit Frame requests to the port layer; ~~communicates with the port layer via requests and confirmations regarding frame transmission,~~
- d) receives Transmission Status and ACK Transmitted confirmations from the port layer;
- e) receives Terminate messages from the ST_IFR state machine;
- f) sends Cancel requests to the port layer; and
- g) ~~may~~ communicates to the ST_IPR state machine regarding service delivery subsystem failures.

This state machine consists of the following states:

- a) ST_ISF1:Send_Frame (see 0.0.0.2.3.2)(initial state);
- b) ST_ISF2:Prepare_Command_Task (see 0.0.0.2.3.3); and
- c) ST_ISF3:Prepare_Data_Out (see 0.0.0.2.3.4).

This state machine shall be started when a Send Command Task message ~~Send SCSI Command or a Send Task Management Request transport protocol service request~~ is received from the ST_IFR state machine~~SCSI application layer or when an XFER_RDY Arrived message is received~~.

0.0.0.2.3.2 ST_ISF1:Send_Frame state

0.0.0.2.3.2.1 State description

~~A Send SCSI Command transport protocol service request or a Send Task Management Request transport protocol service request includes the following to be used in any OPEN address frames required to service the request:~~

- ~~a) connection rate;~~
- ~~b) initiator connection tag; and~~
- ~~c) destination SAS address.~~

~~A Send SCSI Command transport protocol service request also includes the following to be used in any SSP frame for the request:~~

- ~~a) logical unit number;~~
- ~~b) tag;~~
- ~~c) task attribute;~~
- ~~d) additional CDB length;~~
- ~~e) CDB; and~~
- ~~f) additional CDB bytes.~~

~~If the request is for a data-out command, then the request also includes the number of bytes for the first burst size for the logical unit.~~

~~A Send Task Management Request transport protocol service request includes the following to be used in the TASK frame:~~

- ~~a) logical unit number;~~
- ~~b) tag;~~
- ~~c) task management function; and~~
- ~~d) tag of task to be managed.~~

If this state machine ~~was started as the result of receiving~~ receives an XFER_RDY Arrived message~~, then~~ and the length of the XFER_RDY information unit is 12 bytes and the write data length is zero or exceeds the amount of data remaining to be transferred for the data-out command, then this state shall:

   a)   send a Delivery Failure (XFER_RDY Incorrect Write Data Length) message to the ST_IPR state machine; and
   b)   terminate after sending the message.

If this state machine receives an XFER_RDY Arrived message and the requested offset is not expected, then this state shall:

   a)   send a Delivery Failure (XFER_RDY Requested Offset Error) message to the ST_IPR state machine; and
   b)   terminate after sending the message.
   ~~a)   If an XFER_RDY frame is not expected for the command (e.g., for a read command), then this state shall discard the frame and shall send a Delivery Failure (XFER_RDY Not Expected) message to the ST_IPR state machine. This state machine shall terminate if it sends after sending the message;~~
   ~~b)   If the length of the information unit is not 12 bytes, then this state shall discard the frame and shall send a Delivery Failure (XFER_RDY Information Unit Too Short) message or Delivery Failure (XFER_RDY Information Unit Too Long) to the ST_IPR state machine. This state machine shall terminate after sending the message;~~
   ~~c)   If the length of the XFER_RDY information unit is 12 bytes and the write data length is zero or exceeds the amount of data remaining to be transferred for the data-out command, then this state shall send a Delivery Failure (XFER_RDY Incorrect Write Data Length) message to the ST_IPR state machine. This state machine shall terminate after sending the message; or~~
   ~~d)   If the length of the XFER_RDY information unit is 12 bytes and the requested offset is not expected, then this state shall send a Delivery Failure (XFER_RDY Requested Offset Error) message to the ST_IPR state machine. This state machine shall terminate after sending the message.~~

If this state is entered from the ST_ISF2:Prepare_Command_Task state, then this state shall send a Transmit Frame (Interlocked) request to the port layer.

If this state is entered from the ST_ISF3:Prepare_Data_Out state, then this state shall send a Transmit Frame (Non-Interlocked) request to the port layer.

A Transmit Frame request shall include the SSP frame and the following to be used for any OPEN address frame:

   a)   the initiator port bit set to one;
   b)   protocol set to SSP;
   c)   connection rate;
   d)   initiator connection tag;
   e)   destination SAS address; and
   f)   source SAS address set to the SAS address of the SSP initiator port.

After sending a Transmit Frame request to the port layer this state shall wait for a Transmission Status confirmation. If the confirmation is not Transmission Status (Frame Transmitted), then this state shall send a Delivery Failure (Service Delivery Subsystem Failure) message to the ST_IPR state machine. The Delivery Failure message shall include:

   a)   any argument received with the Transmission Status confirmation; and
   b)   I_T_L_x nexus information (i.e., destination SAS address and tag);

~~If the transmitted frame was a DATA frame, then this state shall transition to the ST_ISF3:Prepare_Data_Out state after receiving a Transmission Status (Frame Transmitted) confirmation if there is more data to transfer.~~

After receiving a Transmission Status (Frame Transmitted) confirmation, ~~the~~ this state ~~machine~~ shall expect to receive one of the following confirmations for the frame:

   a)   Transmission Status (ACK Received);
   b)   Transmission Status (NAK Received);
   c)   Transmission Status (ACK/NAK Timeout); or
   d)   Transmission Status (Connection Lost Without ACK/NAK).

If the ~~transmitted frame~~Transmit Frame request was ~~for~~ a COMMAND frame or TASK frame requiring a data-out operation, then ~~the~~ this state ~~machine~~ shall wait to receive a Transmission Status (ACK Received), Transmission Status (NAK Received), Transmission Status (ACK/NAK Timeout), or Transmission Status (Connection Lost Without ACK/NAK) confirmation. ~~before transitioning from this state~~. ~~If the transmitted frame was a DATA frame, the state machine may transition to ST_ISF3:Prepare_Data_Out as described in 9.2.6.2.2.2.3.~~

If the Transmit Frame request was for a DATA frame and the number of data bytes that have been transmitted for the Send SCSI Command or Send Task Management transport protocol service request equal the number of bytes in the service request, then this state shall wait to receive a Transmission Status (ACK Received), Transmission Status (NAK Received), Transmission Status (ACK/NAK Timeout), or Transmission Status (Connection Lost Without ACK/NAK) confirmation for the Transmit Frame request for each DATA frame.

If a Transmission Status (NAK Received) confirmation is received, then this state shall send a Delivery Failure (Service Delivery Subsystem Failure - NAK Received) message to the ST_IPR state machine.

If a Transmission Status (ACK/NAK Timeout) or Transmission Status (Connection Lost Without ACK/NAK) confirmation is received, then this state shall send a Delivery Failure (Service Delivery Subsystem Failure - Connection Failed) message to the ST_IPR state machine.

After sending a Delivery Failure message to the ST_IPR state machine, this state machine shall terminate.

If the Transmit Frame request was for a DATA frame and the number of data bytes that have been transmitted for the Send SCSI Command or Send Task Management transport protocol service request equal the number of bytes in the service request, then this state machine shall terminate.after receiving a Transmission Status (ACK Received) confirmation for the Transmit Frame request for each DATA frame,

If this state receives a Terminate message from the ST_IFR state machine, and this state has received confirmations for all Transmit Frame requests sent 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 not received confirmations for all Transmit Frame requests sent to the port layer, then this state 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.

0.0.0.2.3.2.2 Transition ST_ISF1:Send_Frame to ST_ISF2:Prepare_Command_Task

This transition shall occur after receiving a Send ~~SCSI~~ Command ~~or Send~~ _ Task message ~~Management Request transport protocol service request~~.

0.0.0.2.3.2.3 Transition ST_ISF1:Send_Frame to ST_ISF3:Prepare_Data_Out

[No change proposed to the text in this clause.]

0.0.0.2.3.3 ST_ISF2:Prepare_Command_Task state

[No change proposed to the text in this clause.]

0.0.0.2.3.4 ST_ISF3:Prepare_Data_Out state

[No change proposed to the text in this clause.]

0.0.0.2.4 ST_IPD (initiator process data) state machine

[No change proposed to the text in this clause.]

0.0.0.2.5 ST_IPR (initiator process response) state machine

[No change proposed to the text in this clause.]

Item 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.
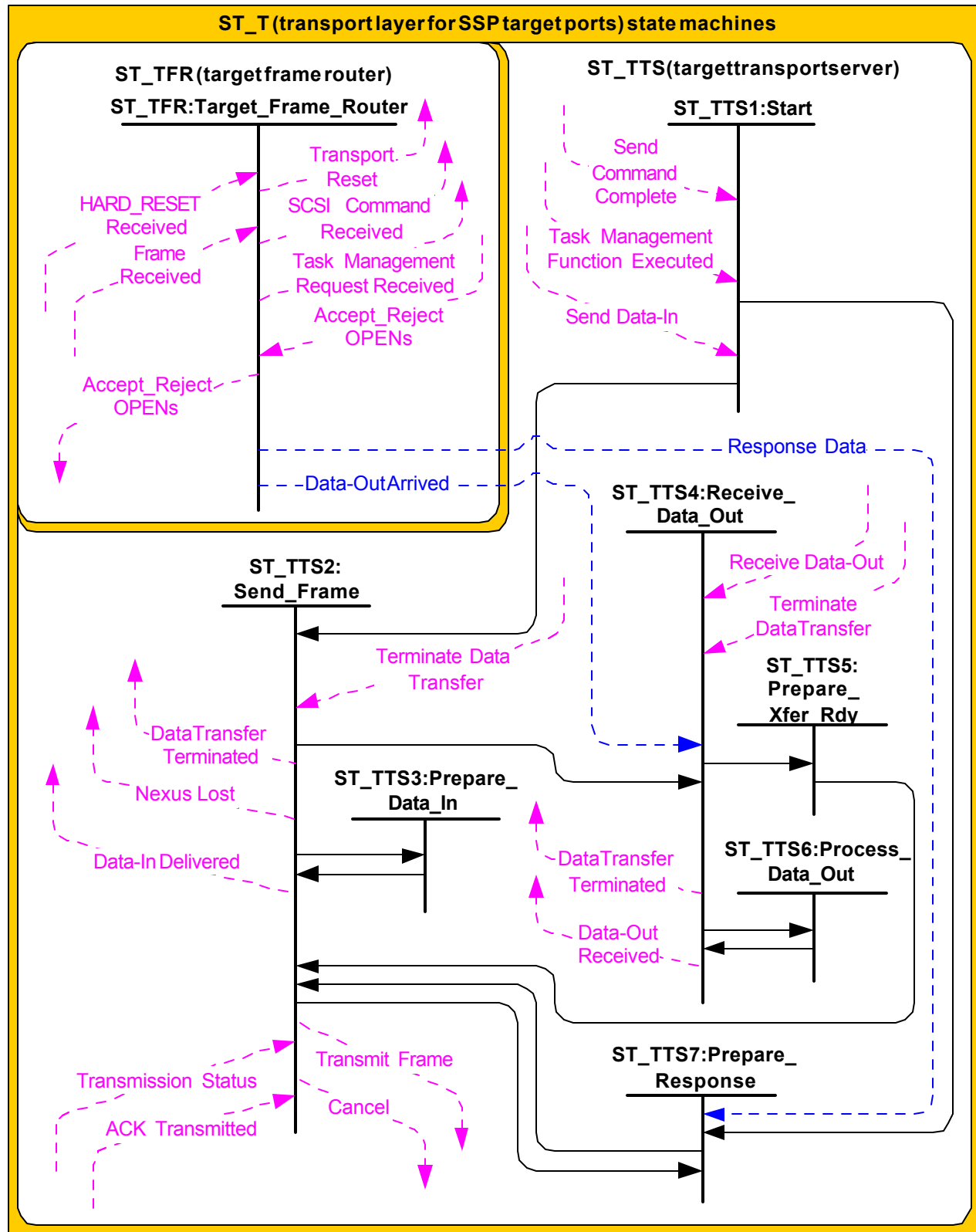
These changes are shown in the following figure.

Figure 2 — ST_T (transport layer for SSP target ports) state machines

Item 9) For clause 9.2.6.3.2 ST_TFR (target frame router) state machine: change the text 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 seaport 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 power on.:

  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 or TASK, then this state machine may check the target port transfer tag. If target port transfer tag is ~~set to a value other than FFFFh~~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 COMMAND 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 SCSI Command Received transport protocol service indication to the SCSI application layer. The indication shall include:

    a)   the source SAS address;
    b)   the tag;
    c)   the logical unit number;
    d)   the task attribute; and
    e)   the CDB.

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 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 an SSP target port is using target port transfer tags and it receives a DATA frame with an unknown target port transfer tag, it shall discard the frame.

If the frame type is DATA and the information unit is correct, 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~~receives a HARD_RESET Received confirmation, then this state machine shall send a Transport Reset event notification to the SCSI application layer ~~and terminate~~.

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

Item 10) For clause 9.2.6.3.3.3.1 [ST_TTS2:Send_Frame] State description: change the text to be as follows.

If this state is entered from the ST_TTS3:Prepare_Data_In state for transmission of a DATA frame, then this state shall send a Transmit Frame (Non-Interlocked) request to the port layer.

If this state is entered from the ST_TTS5:Prepare_Xfer_Rdy state for transmission of an XFER_RDY frame ~~and this state has received an ACK Transmitted confirmation for each DATA frame previously received (i.e., received by this state machine with a Data-Out Arrived message)~~, then this state shall send a Transmit Frame (Interlocked) request to the port layer.

If this state is entered from the ST_TTS7:Prepare_Response state for transmission of a RESPONSE frame and this state has received an ACK Transmitted confirmation for each DATA frame previously received (i.e., received by this state machine with a Data-Out Arrived message), then this state shall send a Transmit Frame (Interlocked) request to the port layer.

> NOTE 31 - The XFER_RDY and RESPONSE frame rules ensure that wide ports do not send an XFER_RDY or RESPONSE frame on a phy until all the ACKs have been transmitted for write DATA frames on a different phy. In a narrow port, the link layer ensures that ACK/NAKs are balanced before transmitting an interlocked frame.

A Transmit Frame request from this state shall include the SSP frame and the following to be used for any OPEN address frame:

  a) the initiator port bit set to zero;
  b) protocol set to SSP;
  c) connection rate;
  d) initiator connection tag;
  e) destination SAS address; and
  f) source SAS address set to the SAS address of the SSP target port.

After sending a Transmit Frame request this state shall wait to receive a Transmission Status confirmation.

If the confirmation is Transmission Status (I_T Nexus Loss), this state shall send a Nexus Lost confirmation to the SCSI application layer.

If the confirmation is Transmission Status (Frame Transmitted) confirmation, then this state machine shall expect to receive one of the following confirmations for the frame:

  a) Transmission Status (ACK Received);
  b) Transmission Status (NAK Received);
  c) Transmission Status (ACK/NAK Timeout); or
  d) Transmission Status (Connection Lost Without ACK/NAK).

If the ~~frame transmitted~~Transmit Frame request was for an XFER_RDY frame or a RESPONSE frame, then th~~is~~e state ~~machine~~ shall wait to receive a Transmission Status (ACK Received), Transmission Status (NAK Received), Transmission Status (ACK/NAK Timeout), or Transmission Status (Connection Lost Without ACK/NAK) confirmation ~~before transitioning from this state~~. ~~If the frame transmitted was a DATA frame, then the state machine may transition to ST_TTS3:Prepare_Data_In as described in 9.2.6.3.3.3.2.~~

This state shall send a Data-In Delivered (Delivery Result = DELIVERY SUCCESSFUL) transport protocol service confirmation to the SCSI application layer if:

  a) for a DATA frame, this state receives a Transmission Status (Frame Transmitted) confirmation followed by a Transmission Status (ACK Received) confirmation for each of the DATA frames transmitted and the number of bytes moved for the Send Data-In transport protocol service request equals the Request Byte Count; or
  b) for a RESPONSE frame, this state receives a Transmission Status (Frame Transmitted) confirmation followed by a Transmission Status (ACK Received) confirmation.

This state shall send a Data-In Delivered (Delivery Result = DELIVERY FAILURE - NAK RECEIVED) transport protocol service confirmation to the SCSI application layer if the received transmission status confirmation message for a DATA or XFER_RDY frame was Transmission Status (Frame Transmitted) followed by a confirmation of Transmission Status (NAK Received).

This state shall send a Data-In Delivered (Delivery Result = DELIVERY FAILURE - ACK/NAK TIMEOUT) transport protocol service confirmation to the SCSI application layer if the received transmission status confirmation message for a DATA or XFER_RDY frame was Transmission Status (Frame Transmitted) followed by a confirmation of Transmission Status (ACK/NAK Timeout) or Transmission Status (Connection Lost Without ACK/NAK).

A Data-In Delivered transport protocol service confirmation to the SCSI application layer shall include the following:

  a) any argument received from the port layer (e.g., Transmission Status (Frame Transmitted) or Service Delivery Subsystem Failure); and
  b) I_T_L_x nexus information (i.e., destination SAS address and tag).

This state machine shall terminate after sending the Data-In Delivered confirmation.

If this state receives a Terminate Data Transfer request and this state has received confirmations for all Transmit Frame requests sent to the port layer, then this state shall send a Data Transfer Terminated confirmation to the application layer. After sending the confirmation, this state machine shall terminate.

If this state receives a Terminate Data Transfer request and this state has not received confirmations for all Transmit Frame requests sent to the port layer, then ~~T~~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.

~~This state machine terminate u~~Upon receipt of a Transmission Status (Cancel Acknowledge) confirmation~~.~~ this state shall:

   a)   send a Transmission Status (Cancel Acknowledge) confirmation; and
   b)   terminate.

Item 11) For clause 9.2.6.3.3.3.4 Transition ST_TTS2:Send_Frame to ST_TTS7:Prepare_Response: change it to be as follows.
This transition shall occur after receiving a Transmission Status (Frame Transmitted) and a Transmission Status confirmation with an argument other than ACK Received for a RESPONSE frame.

Item 12) In clause 9.2.6.3.3.5.1 [ST_TTS4:Receive_Data_Out state] State description, add the following sentence at the end of the clause:

If this state receives a Terminate Data Transfer request, 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].

Item 13) In clause 9.2.6.3.3.8.1 [ST_TTS7:Prepare_Response state] State description, change the last two paragraphs in the clause as follows:

.....

If this state was entered as the result of the ST_TTS2:Send_Frame state receiving something other than a Transmission Status (Frame Transmitted) confirmation followed by a Transmission Status (ACK Received) confirmation for a RESPONSE frame (i.e., the frame transmission was unsuccessful) and the RETRANSMIT bit was set to zero in the frame, or the vendor specific number of retries has not been exceeded then this state shall:

   a)   generate a RESPONSE frame using all of the values from the previous RESPONSE frame, except the RETRANSMIT bit~~check to see if the vendor-specific number of retries for the~~
   b)   set the RETRANSMIT bit to one; and
   c)   send the new RESPONSE frame~~has been exceeded~~.

~~If the vendor-specific number of retries has not been exceeded, the this state generate a RESPONSE frame using all of the values for the previous RESPONSE frame except that the retransmit bit shall be set to one.~~