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To: **T10 SAS Protocol Working Group**
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Subject: **SAS-1.1, ST_T (transport layer for SSP target ports) state machines**

Introduction

This proposal evolved from adding transport layer retries and the new protocol service, Terminate Data Transfer, to the SSP transport layer state machines. While including these elements, changes were made to simplify and clarify the description of these state machines. These changes include having all communication with the target's SCSI application layer be processed by the target frame router state machine, having a virtual target transport server state machine for each tag, and having the target transport server state machines be persistent between power cycles.

Having all communication with the SCSI application layer be processed by the target frame router state machine provides the ability for that state machine to maintain context for all tasks in process so that it can abort tasks as necessary. Having target transport servers for each tag provides the ability for one state machine to maintain context to process all elements of a task (e.g., XFER_RDY transmission, data transfer, and response). Having the target transport server state machines be persistent between power cycles simplified their description.

After this proposal is reviewed by the SAS Protocol Working Group, a second proposal for modifications to the ST_I (transport layer for SSP initiator ports) state machines will be constructed to reflect the concepts introduced here. This proposal is based on SAS1r04.

9.2.6.3 ST_T (transport layer for SSP target ports) state machines

9.2.6.3.1 ST_T state machines overview

The ST_T state machines are as follows:

a) ST_TFR (target frame router) state machine (see 9.2.6.3.2); and
b) ST_TTS (target transport server) state machine (see 9.2.6.3.3).

If implemented, this state machine shall maintain the timers listed in table 109.

Table 109 — ST_T state machine timers

Timer	Initial value
Initiator Response Timeout	The value in the INITIATOR RESPONSE TIMEOUT field in the Protocol-Specific Port mode page (see 10.2.6.2).

Figure 116 shows the ST_T state machines.

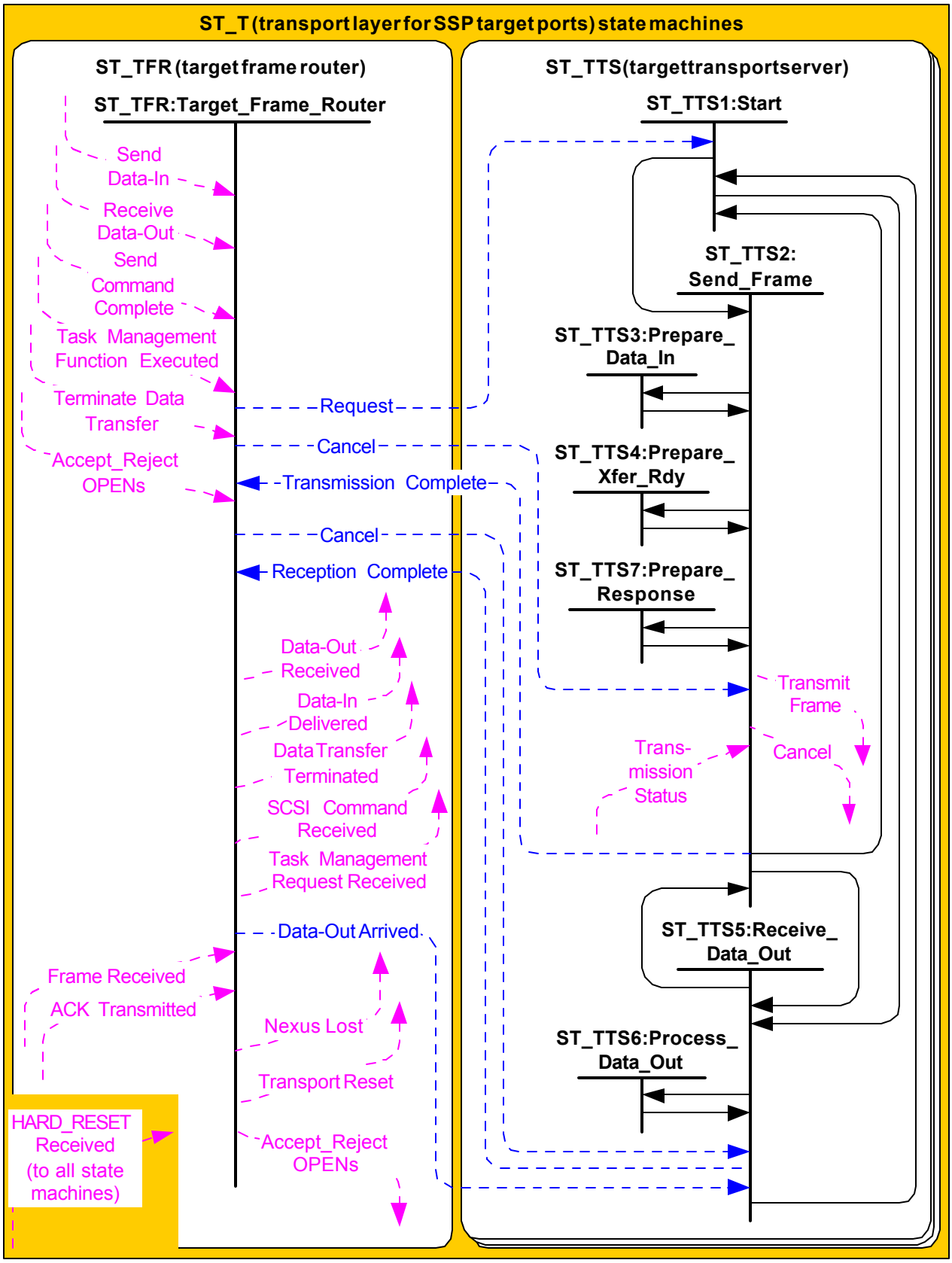

Figure 116 — ST_T (transport layer for SSP target ports) state machines

9.2.6.3.2 ST_TFR (target frame router) state machine

The ST_TFR state machine:

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 machines
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.

If this state machine receives an Accept_Reject OPENs (Accept SSP) or Accept_Reject OPENs (Reject SSP) request, then this state machine shall send a corresponding Accept_Reject OPENs request to the port layer.

If this state machine 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 96). If the frame type is not COMMAND, TASK, or DATA, then this state machine shall discard the frame. 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.

This state machine may check that reserved fields in the received frame are zero. If any reserved fields are not zero, then this state machine may send a Request (Send Transport Response) message with an argument of Invalid Frame to the ST_TTS1:Start state in an ST_TTS target transport server state machine that does not have an active task. The check of reserved fields described above shall not apply to the reserved fields within the CDB in a COMMAND frame. 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 machine may check that the hashed source SAS address matches the SAS address of the SAS port that transmitted the frame and that the hashed destination SAS address in the frame matches the SAS address of the SAS port that received the frame based on the connection information. If this state machine checks these SAS addresses and they do not match, then this state machine shall discard the frame.

If the frame type is COMMAND or TASK then this state machine shall check the length of the information unit. If the length of the information unit is not correct, then this state machine shall send a Request (Send Transport Response) message to the ST_TTS1:Start state in an ST_TTS target transport server state machine that does not have an active task. If the information unit is too short, then this state shall include an argument of Information Unit Too Short with the message. If the information unit is too long, then this state shall include an argument of Information Unit Too Long with the message.

If the frame type is COMMAND or TASK, then this state machine may check if the tag conflicts with an existing tag (i.e., an existing command or task management function). If the frame type is COMMAND and the tag conflicts, then this state machine shall send a Request (Send Transport Response) with an argument of Overlapped Command to a ST_TTS1:Start state in an ST_TTS target transport server state machine that does not have an active task. If the frame type is TASK, the tag conflicts, and the retransmit bit is set to zero, then this state machine shall send a Request (Send Transport Response) with an argument of Invalid Frame to a ST_TTS1:Start state in an ST_TTS target transport server state machine that does not have an active task. If the frame type is TASK, the tag conflicts, and the retransmit bit is set to one, then this state machine shall discard the frame.

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, then this state machine may send a Request (Send Transport Response) message with an argument of Invalid Transfer Tag to the ST_TTS1:Start state in an ST_TTS target transport server state machine that does not have an active task.

If the frame type is COMMAND or TASK, then this state machine shall check the logical unit number. If the logical unit number is unknown, then this state machine shall send a Request (Send Transport Response) message with an argument of Invalid Logical Unit Number to the ST_TTS1:Start state in an ST_TTS target transport server state machine that does not have an active task.

If the frame type is DATA and this frame is for first burst data or this state machine did not assign a target port transfer tag for the data transfer, then this state machine may check the target port transfer tag. If target port transfer tag is set to a value other than FFFFh, then this state machine may send a Request (Send Transport Response) message with an argument of Invalid Frame to the ST_TTS1:Start state in an ST_TTS target transport server state machine that does not have an active task.

If this state machine sends a Request (Send Transport Response) message to an ST_TTS target transport server state machine as the result of this state machine receiving an invalid frame, then the message shall include the following arguments:

a) the connection rate;
b) initiator connection tag;
c) the destination SAS address;
d) the source SAS address; and
e) the tag.

If the frame type is COMMAND or TASK and the items checked in the frame are correct, then this state machine shall wait to receive an ACK Transmitted confirmation.

If the frame type is COMMAND, the items checked in the frame are correct, and this state machine receives an ACK Transmitted confirmation, 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;
e) the CDB; and
f) any additional CDB bytes.

If the frame type is TASK, the items checked in the frame are correct, and this state machine receives an ACK Transmitted confirmation, then this state machine shall send a Task Management Request 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 management function; and
e) the tag of the task to be managed.

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.

If the frame type is DATA, and the tag matches a tag for an outstanding data-out command without first burst data enabled or for which no Transmission Complete (Xfer_Rdy Delivered) message has been received from an ST_TTS target transport server state machine, then this state machine shall discard the frame.

If the frame type is DATA and a target port transfer tag was assigned in an XFER_RDY frame for the request, then this state machine shall check the target port transfer tag. If the target port transfer tag does not specify a valid state machine, then this state machine shall discard the frame.

If the frame type is DATA and the items checked in the frame are correct, and there is first burst data enabled or this state machine has received a Transmission Complete (Xfer_Rdy Delivered) from the ST_TTS target transport server state machine for the request, then this state machine shall send a Data-Out Arrived message to the ST_TTS5:Receive_Data_Out state in the ST_TTS state machine specified by the tag in the frame. The message shall include the content of the SAS frame.

If this state machine receives a HARD_RESET Received confirmation, then this state machine shall send a Transport Reset event notification to the SCSI application layer.

If this state machine receives a Send Data-In transport protocol service request from the SCSI application layer, then this state machine shall send a Request (Send Data-In) message to the ST_TTS1:Start state in an ST_TTS target transport server state machine that does not have an active task.

If this state machine receives a Receive Data-Out transport protocol service request from the SCSI application layer, then this state machine shall send a Request (Receive Data-Out) message to the ST_TTS1:Start state in an ST_TTS target transport server state machine that does not have an active task.

A Request (Send Data-In) message or a Request (Receive Data-Out) message shall include the following arguments:

a) connection rate;
b) initiator connection tag;
c) the destination SAS address;
d) the source SAS address;
e) the tag;
f) device server buffer; and
g) request byte count.

A Request (Receive Data-Out) message shall also include the target port transfer tag.

If this state machine receives a Send Command Complete transport protocol service response from the SCSI application layer, then this state machine shall send a Request (Send Application Response) message to the ST_TTS1:Start state in the ST_TTS target transport server state machine specified by the tag. The message shall include the following arguments:

a) the status; and
b) the sense data.

If this state machine receives a Task Management Function Executed transport protocol service response from the SCSI application layer, then this state machine shall send a Request (Send Application Response) message to the ST_TTS1:Start state in an ST_TTS target transport server state machine that does not have an active task. The message shall include the following arguments:

a) connection rate;
b) initiator connection tag;
c) the destination SAS address;
d) the source SAS address;
e) the tag;
f) the status; and
g) the sense data.

If this state machine receives a Terminate Data Transfer protocol service request from the SCSI application layer and this state machine has not sent a Request message to a ST_TTS target transport server state machine for the Send Data-In or Receive Data-Out protocol service request to which the Terminate Data Transfer request applies, then this state machine shall discard the Terminate Data Transfer request and any corresponding Send Data-In or Receive Data-Out request. This state shall then send a Data Transfer Terminated protocol service confirmation to the SCSI application layer.

If this state machine receives a Terminate Data Transfer protocol service request from the SCSI application layer and this state machine has sent a Request message to a ST_TTS target transport server state machine for the Send Data-In protocol service request to which the Terminate Data Transfer request applies, then this state machine shall send a Cancel message to the ST_TTS2:Send_Frame state in the ST_TTS target transport server state machine specified by the tag.

If this state machine receives a Terminate Data Transfer protocol service request from the SCSI application layer and this state machine has sent a Request message to a ST_TTS target transport server state machine for the Receive Data-Out protocol service request to which the Terminate Data Transfer request applies, then this state machine shall send a Cancel message to the ST_TTS5:Receive_Data_Out state in the ST_TTS target transport server state machine specified by the tag.

This state machine receives Transmission Complete and Reception Complete messages from the ST_TTS target transport server state machines that may result in this state machine sending a protocol service confirmation to the SCSI application layer. Table 1a defines the received messages that require a service confirmation and the corresponding service confirmations that shall be sent upon receipt of the message.

Table 1a — Confirmations sent to the application layer based on messages from a transport server

Message received from ST_TTS state machine	Protocol service confirmation sent to SCSI application layer
Transmission Complete (I_T Nexus Loss)	Nexus Lost
Transmission Complete (Data-In Delivered)	Data-In Delivered with the Delivery Result argument set to DELIVERY SUCCESSFUL
Transmission Complete (Xfer_Rdy Failed, NAK Received)	Data-Out Received with the Delivery Result argument set to DELIVERY FAILURE - NAK RECEIVED
Transmission Complete (Xfer_Rdy Failed, Connection Failed)	Data-Out Received with the Delivery Result argument set to DELIVERY FAILURE - CONNECTION FAILED
Transmission Complete (Data Failed, NAK Received)	Data-In Delivered with the Delivery Result argument set to DELIVERY FAILURE - NAK RECEIVED
Transmission Complete (Data Failed, Connection Failed)	Data-In Delivered with the Delivery Result argument set to DELIVERY FAILURE - CONNECTION FAILED
Reception Complete (Data-Out Received)	Data-Out Received with the Delivery Result argument set to DELIVERY SUCCESSFUL
Reception Complete (Data Offset Error)	Data-Out Received with the Delivery Result argument set to DELIVERY FAILURE - DATA OFFSET ERROR
Reception Complete (Too Much Write Data)	Data-Out Received with the Delivery Result argument set to DELIVERY FAILURE - TOO MUCH WRITE DATA
Reception Complete (Information Unit Too Short)	Data-Out Received with the Delivery Result argument set to DELIVERY FAILURE - INFORMATION UNIT TOO SHORT.
Reception Complete (Initiator Response Timeout)	Data-Out Received with the Delivery Result argument set to DELIVERY FAILURE - INITIATOR RESPONSE TIMEOUT
Transmission Complete (Data Transfer Terminated)	Data Transfer Terminated
Reception Complete (Data Transfer Terminated)	Data Transfer Terminated

A protocol service confirmation shall include the tag.

9.2.6.3.3 ST_TTS (target transport server) state machine

9.2.6.3.3.1 ST_TTS state machine overview

The ST_TTS state machine performs the following functions:

a) receives and processes messages from the ST_TFR target frame router state machine;
b) sends messages to the ST_TFR target frame router state machine;
c) communicates with the port layer via requests and confirmations regarding frame transmission; and
d) receives HARD_RESET Received confirmations from the port layer.

This state machine consists of the following states:

a) ST_TTS1:Start (see 9.2.6.3.3.2) (initial state);
b) ST_TTS2:Send_Frame (see 9.2.6.3.3.3);

c) ST_TTS3:Prepare_Data_In (see 9.2.6.3.3.4);
d) ST_TTS4:Prepare_Xfer_Rdy (see 9.2.6.3.3.5);
e) ST_TTS5:Receive_Data_Out (see 9.2.6.3.3.6);
f) ST_TTS6:Process_Data_Out (see 9.2.6.3.3.7); and
g) ST_TTS7:Prepare_Response (see 9.2.6.3.3.8).

This state machine shall be started in the ST_TTS1:Start state after power on. There shall be one ST_TTS state machine for each possible task that may be accepted by the SAS target port.

If transport layer retries are enabled, this state machine shall retain the data offset for the last DATA frame transmitted for which ACK/NAK Balance was achieved (i.e., when the number of DATA frames sent matches the number of ACK Received confirmations received) for use as the restart point in case of a retry.

If this state machine receives a HARD_RESET Received confirmation, then this state machine shall transition to the ST_TTS1:Start state.

9.2.6.3.3.2 ST_TTS1:Start state

9.2.6.3.3.2.1 State description

This state is the initial state of this state machine.

9.2.6.3.3.2.2 Transition ST_TTS1:Start to ST_TTS2:Send_Frame

This transition shall occur after this state receives a Request message from the ST_TFR target frame router state machine that is not a Request (Receive Data-Out) message when first burst is enabled.

9.2.6.3.3.2.3 Transition ST_TTS1:Start to ST_TTS5:Receive_Data_Out

This transition shall occur after this state receives a Request (Receive Data-Out) message from the ST_TFR target frame router state machine when first burst is enabled.

9.2.6.3.3.3 ST_TTS2:Send_Frame state

9.2.6.3.3.3.1 State description

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_TTS4:Prepare_Xfer_Rdy state for transmission of an XFER_RDY frame, 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, then this state shall send a Transmit Frame (Interlocked) request to the port layer.

> NOTE 1 - 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), then this state shall send a Transmission Complete (I_T Nexus Loss) message to the ST_TFR target frame router state machine. The message shall include the tag.

If the confirmation is not Transmission Status (Frame Transmitted) or Transmission Status (I_T Nexus Loss) (see table 93), and the Transmit Frame request was for an XFER_RDY frame or a DATA frame, then this state shall send a Transmission Complete (Connection Failed) message to the ST_TFR target frame router state machine. The message shall include the following arguments:

a) the tag; and
b) the arguments received with the Transmission Status confirmation.

If the confirmation is Transmission Status (Frame Transmitted) and the Transmit Frame request was for an XFER_RDY frame, a RESPONSE frame, or a DATA frame where the number of bytes that have been transmitted equal the request byte count (i.e., all data has been transferred for the request), then this state shall wait to receive one of the following confirmations:

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).

NOTE 2 - If the number of data bytes that have been transmitted for the Request (Send Data-In) message are fewer than the request byte count, then this state transitions to the ST_TTS3:Prepare_Data_In state to construct the additional DATA frames for the request before receiving a Transmission Status (ACK Received), Transmission Status (NAK Received), Transmission Status (ACK/NAK Timeout), or Transmission Status (Connection Lost Without ACK/NAK) confirmation for Transmit Frame requests for previous DATA frames sent for the I_T_L_Q nexus.

Table 2a defines the confirmations to be received from the port layer after a Transmission Status (Frame Transmitted) and the message that shall be sent by this state to the ST_TFR target frame router state upon receipt of the confirmation based on the conditions under which the confirmation was received.

Table 2a — Messages sent to the target frame router based on port layer confirmations

Confirmation received from the port layer	Conditions under which confirmation was received	Message sent to the ST_TFR target frame router
Transmission Status (ACK Received)	the Transmit Frame request was for an XFER_RDY frame	Transmission Complete (Xfer_Rdy Delivered) with the target port transfer tag argument
Transmission Status (ACK Received)	Transmit Frame request was for a RESPONSE frame	Transmission Complete (Response Delivered)
Transmission Status (ACK Received)	a) the Transmit Frame request was for a DATA frame; b) the number of data bytes transmitted equal the request byte count; and c) this state has received a Transmission Status (ACK Received) confirmation for each DATA frame transmitted for the request	Transmission Complete (Data-In Delivered)
Transmission Status (NAK Received), Transmission Status (ACK/NAK Timeout), or Transmission Status (Connection Lost Without ACK/NAK)	a) the Transmit Frame request was for a RESPONSE frame; and b) the vendor specific number of retries has been reached	Transmission Complete (Response Delivery Failed)
Transmission Status (NAK Received)	a) the Transmit Frame request was for an XFER_RDY frame; and b) the vendor specific number of retries has been reached	Transmission Complete (Xfer_Rdy Failed, NAK Received)
Transmission Status (ACK/NAK Timeout) or Transmission Status (Connection Lost Without ACK/NAK)	a) the Transmit Frame request was for an XFER_RDY frame; and b) the vendor specific number of retries has been reached	Transmission Complete (Xfer_Rdy Failed, Connection Failed)
Transmission Status (NAK Received)	a) the Transmit Frame request was for an DATA frame; and b) the vendor specific number of retries has been reached	Transmission Complete (Data Failed, NAK Received)
Transmission Status (ACK/NAK Timeout) or Transmission Status (Connection Lost Without ACK/NAK)	a) the Transmit Frame request was for an DATA frame; and b) the vendor specific number of retries has been reached	Transmission Complete (Data Failed, Connection Failed)

If this state receives a Cancel message from the ST_TFR:Target_Frame_Router state machine and this state has received confirmations for all Transmit Frame requests sent to the port layer, then this state shall send a Transmission Complete (Cancel Acknowledged) message to the ST_TFR target frame router state machine.

If this state receives a Cancel message from the ST_TFR target frame router 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 to cancel previous Transmit Frame requests. A Cancel request shall include the following arguments:

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

Upon receipt of a Transmission Status (Cancel Acknowledged) confirmation this state shall send a Transmission Complete (Cancel Acknowledged) message to the ST_TFR target frame router state machine.

A Transmission Complete message to the ST_TFR target frame router state machine shall include the following arguments:

c) the destination SAS address; and
d) the tag.

9.2.6.3.3.3.5 Transition ST_TTS2:Send_Frame to ST_TTS1:Start

This transition shall occur after this state has sent a Transmission Complete message to the ST_TFR target frame router state machine.

9.2.6.3.3.3.6 Transition ST_TTS2:Send_Frame to ST_TTS3:Prepare_Data_In

This transition shall occur after this state:

a) receives a Transmission Status (ACK Received) confirmation for an XFER_RDY frame;
b) receives a Transmission Status (Frame Transmitted) confirmation for a DATA frame and the number of bytes moved for a Request (Send Data-In) message is less than the requested byte count; or
c) receives a Transmission Status (Frame Transmitted) confirmation and a confirmation other than Transmission Status (ACK Received) for a DATA frame for which a Transmission Complete message was not sent to the ST_TFR target frame router state machine (i.e., in order to retry transmitting the frame).

9.2.6.3.3.3.7 Transition ST_TTS2:Send_Frame to ST_TTS4:Prepare_Xfer_Rdy

This transition shall occur after this state machine has received a Request (Receive Data-Out) message and:

a) first burst is enabled, all first burst data has been received, and there is more data to transfer for the message;
b) first burst is not enabled and no XFER_RDY has been transmitted for the message;
c) all data for a previous XFER_RDY has been received and there is more data to transfer for the message; or
d) this state receives a Transmission Status (Frame Transmitted) confirmation for an XFER_RDY frame followed by a Transmission Status (NAK Received), Transmission Status (ACK/NAK Timeout), or Transmission Status (Connection Lost Without ACK/NAK) confirmation for the frame, and the vendor specific number of retries has not been reached.

9.2.6.3.3.3.8 Transition ST_TTS2:Send_Frame to ST_TTS5:Receive_Data_Out

This transition shall occur after this state receives a Transmission Status (Frame Transmitted) confirmation for an XFER_RDY frame followed by a Transmission Status (ACK Received) confirmation for the frame.

9.2.6.3.3.3.9 Transition ST_TTS2:Send_Frame to ST_TTS7:Prepare_Response

This transition shall occur after:

a) this state machine receives a Request (Send Transport Response) from the ST_TFR target frame router state machine;
b) this state machine receives a Request (Send Application Response) from the ST_TFR target frame router state machine; or
c) this state receives a Transmission Status (Frame Transmitted) confirmation for a RESPONSE frame followed by a Transmission Status (NAK Received), Transmission Status (ACK/NAK Timeout), or Transmission Status (Connection Lost Without ACK/NAK) confirmation for the frame, and the vendor

specific number of retries has not been reached. The vendor specific number of retries for a RESPONSE frame shall be greater than or equal to one.

9.2.6.3.3.4 ST_TTS3:Prepare_Data_In state

9.2.6.3.3.4.1 State description

This state fetches the data from the Device Server Buffer and constructs a DATA frame. This state shall use arguments received in the Request (Send Data-In) message to construct the frame (see 9.2.6.3.2).

This state shall generate the following values when constructing the frame:

a) frame type;
b) hashed destination SAS address;
c) hashed source SAS address;
d) retransmit bit set to zero;
e) number of fill bytes;
f) fill bytes;
g) data offset; and
h) data.

If this is the first DATA frame constructed by this state, then this state shall set the CHANGING DATA POINTER bit and the DATA OFFSET field in the DATA frame to zero.

If this state is entered after the ST_TTS2:Send_Frame state received a Transmission Status (Frame Transmitted) confirmation and that state has only received confirmations of Transmission Status (Frame Transmitted) and Transmission Status (ACK Received), then this state shall set the CHANGING DATA POINTER bit to zero and shall set the value in the DATA OFFSET field to the value in the DATA OFFSET field in the previous DATA frame plus the number of bytes in the previous DATA information unit.

If this state is entered after the ST_TTS2:Send_Frame state received a Transmission Status (Frame Transmitted) confirmation and a confirmation other than Transmission Status (ACK Received) for which a Transmission Complete message was not sent to the ST_TFR target frame router state machine (i.e., to retry transmitting a frame), then this state shall set the CHANGING DATA POINTER bit in the frame to one and shall set the DATA OFFSET FIELD to a data offset value associated with a previous ACK/NAK balance.

9.2.6.3.3.4.2 Transition ST_TTS3:Prepare_Data_In to ST_TTS2:Send_Frame

This transition shall occur after this state constructs a DATA frame.

9.2.6.3.3.5 ST_TTS4:Prepare_Xfer_Rdy state

9.2.6.3.3.5.1 State description

This state shall construct an XFER_RDY frame. This state shall use the arguments received in the Request (Receive Data-Out) message to construct the frame (see 9.2.6.3.2).

If first burst is enabled, this state shall adjust the write data length to reflect the amount of first burst data.

This state shall generate the following values when constructing the frame:

a) frame type;
b) hashed destination SAS address;
c) hashed source SAS address;
d) retransmit bit set to zero;
e) retry data frames bit set to the value of the transport layer retries bit in the Protocol-Specific Logical Unit mode page; and
f) number of fill bytes.

If this state is entered after the ST_TTS2:Send_Frame state received a Transmission Status (Frame Transmitted) confirmation and a confirmation other than Transmission Status (ACK Received) for which a Transmission Complete message was not sent to the ST_TFR target frame router state machine (i.e., to retry

transmitting a frame), then this state shall construct a new XFER_RDY frame using the values from the previous XFER_RDY frame except:

a) the RETRANSMIT bit shall be set to one; and
b) the value in the TARGET PORT TRANSFER TAG field shall be set to a different value than the value in the previous XFER_RDY frame. The new target port transfer tag value shall not conflict with any other target port transfer tag currently in use. If data-out data is received for a subsequent XFER_RDY frame for a command, then all target port transfer tags used for previous XFER_RDY frames for the command are no longer in use.

9.2.6.3.3.5.2 Transition ST_TTS4:Prepare_Xfer_Rdy to ST_TTS2:Send_Frame

This transition shall occur after this state constructs an XFER_RDY frame.

9.2.6.3.3.6 ST_TTS5:Receive_Data_Out state

9.2.6.3.3.6.1 State description

If this state receives a Data-Out Arrived message from the ST_TFR target frame router state machine, then this state shall verify the DATA frame received with the message as follows:

1) check the data offset. If the data offset was not expected (i.e., the CHANGING DATA POINTER bit is set to 1 and the value in the DATA OFFSET field is not set to a data offset associated with a previous ACK/NAK balance, or the CHANGING DATA POINTER bit is set to zero and the value in the DATA OFFSET field is not set to the value in the DATA OFFSET FIELD in the previous DATA information unit plus the number of bytes in that information unit), then this state shall send a Reception Complete (Data Offset Error) message to the ST_TFR target frame router state machine;
2) check the length of the data. If first burst is enabled and the length of the data exceeds the amount indicated by the FIRST BURST SIZE field in the Disconnect-Reconnect mode page (see 10.2.6.1.5) or if an XFER_RDY frame was sent for the data and the length of the data exceeds that indicated by the XFER_RDY frame, then this state shall send a Reception Complete (Too Much Write Data) message to the ST_TFR target frame router state machine;
3) check the length of the data. If the length of the data is zero, then this state shall send a Reception Complete (Information Unit Too Short) message to the ST_TFR target frame router state machine.

A Reception Complete message shall include the tag.

If the Initiator Response Timeout timer is implemented, this state shall initialize and start the Initiator Response Timeout timer after any of the following occur:

a) this state is entered from the ST_TTS1:Start state (i.e., a Request (Receive Data-Out) message is received and first burst is enabled);
b) this state is entered from the ST_TTS2:Send_Frame state (i.e., an XFER_RDY was successfully transmitted); or
c) this state is entered from the ST_TTS6:Process_Data_Out state (i.e., Data-Out data was received and processed).

If the Initiator Response Timeout timer is running, this state shall stop the timer before transitioning from this state.

If the Initiator Response Timeout timer expires this state shall send a Reception Complete (Initiator Response Timeout) message to the ST_TFR target frame router state machine.

If this state is entered from the ST_TTS6:Process_Data_Out state and number of bytes moved for the Request (Receive Data-Out) message equals the request byte count, then this state shall send a Reception Complete (Data-Out Received) message to the ST_TFR target frame router state machine.

If this state receives a Cancel message from the ST_TFR target frame router state machine, then this state shall send a Reception Complete (Cancel Acknowledged) message to the ST_TFR target frame router state machine.

9.2.6.3.3.6.2 Transition ST_TTS5:Receive_Data_Out to ST_TTS6:Process_Data_Out

This transition shall occur after this state receives and verifies a Data-Out Arrived message.

9.2.6.3.3.6.3 Transition ST_TTS5:Receive_Data_Out to ST_TTS1:Start

This transition shall occur after this state sends a Reception Complete message to the ST_TFR target frame router state machine.

9.2.6.3.3.7 ST_TTS6:Process_Data_Out state

9.2.6.3.3.7.1 State description

This state shall process the data received in the Data-Out Arrived message using the Device Server Buffer (e.g., logical block address) to which the data is to be transferred.

9.2.6.3.3.7.2 Transition ST_TTS6:Process_Data_Out to ST_TTS5:Receive_Data_Out

This transition shall occur after this state has processed the data received in a Data-Out Arrived message.

9.2.6.3.3.8 ST_TTS7:Prepare_Response state

9.2.6.3.3.8.1 State description

If this state was entered as a result of this state machine receiving a Request (Send Transport Response) or a Request (Send Application Response) message, then this state shall construct a RESPONSE frame. This state shall use the arguments received with the Request message to construct the frame (see 9.2.6.3.2).

This state shall generate the following values when constructing the frame:

a) frame type;
b) hashed destination SAS address;
c) hashed source SAS address;
d) retransmit bit set to zero;
e) number of fill bytes;
f) fill bytes;
g) data present;
h) sense data length; and
i) response data length.

Table 110 specifies how the DATAPRES, STATUS, RESPONSE DATA, and SENSE DATA fields shall be set based on the arguments received with the Request (Send Transport Response) or Request (Send Application Response) message.

NOTE 3 - When the DATAPRES field is set to SENSE_DATA, the RESPONSE DATA LENGTH field is set to zero, and when the DATAPRES field is set to RESPONSE_DATA, the STATUS field and the SENSE DATA LENGTH field are set to zero (see 9.2.2.5).

Table 109 — Request argument to RESPONSE frame content mapping

Request argument	RESPONSE frame
Invalid Frame	The DATAPRES field shall be set to RESPONSE_DATA and the RESPONSE DATA field shall be set to INVALID FRAME
Information Unit Too Short	The DATAPRES field shall be set to SENSE_DATA, the STATUS field shall be set to CHECK CONDITION and the SENSE DATA field shall be set to INFORMATION UNIT TOO SHORT
Information Unit Too Long	The DATAPRES field shall be set to SENSE_DATA, the STATUS field shall be set to CHECK CONDITION and the SENSE DATA field shall be set to INFORMATION UNIT TOO LONG
Overlapped Command	The DATAPRES field shall be set to SENSE_DATA, the STATUS field shall be set to CHECK CONDITION and the SENSE DATA field shall be set to OVERLAPPED COMMANDS ATTEMPTED
Invalid Transport Tag	The datapres field shall be set to SENSE_DATA, the STATUS field shall be set to CHECK CONDITION and the SENSE DATA field shall be set to INVALID TARGET PORT TRANSFER TAG RECEIVED
Invalid Logical Unit	The DATAPRES field shall be set to RESPONSE_DATA and the RESPONSE CODE field shall be set to INVALID LOGICAL UNIT

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 vendor specific number of retries has not been reached), then this state shall construct a new RESPONSE frame using all of the values for the previous RESPONSE frame except that the retransmit bit shall be set to one.

9.2.6.3.3.8.2 Transition ST_TTS7:Prepare_Response to ST_TTS2:Send_Frame

This transition shall occur after this state constructs a RESPONSE frame.