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To: T10 Committee (SCSI)

From: George Penokie (IBM/Tivoli)

Subject: SAS 1.1 - Transport layer retry and argument passing fixes

Overview

During letter ballot review of SAS 1.1 transport layer state machine descriptions it became apparent that the frame level retry description in the state machines was not complete and that the states in state machines that contained more than one state were not passing arguments. There appeared to be an assumption that a state would always have the information it wanted without regard as to where the information came from.

This proposal addressed both those problems. In the first half of this proposal all changes are indicated with blue underlines and red strike-through. The second half contains only change bars.

Editor's Note 13: Note that cross-references to tables, figures, and subclauses that are to areas outside the sections in this proposal may not be accurate.

Sections with changed bars only

8.2.4 ST (transport layer for SSP ports) state machines

8.2.4.1 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 following confirmations between the ST state machines and the port layer:

a) Transmission Status; and
b) Frame Received;

include the following as arguments:

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

and are used to route the confirmations to the correct ST state machines.

NOTE 43 - Although allowed by this standard, the ST state machines do not handle bidirectional commands that result in concurrent write DATA frames and read DATA frames.

8.2.4.2 ST_I (transport layer for SSP initiator ports) state machines

8.2.4.2.1 ST_I state machines overview

The ST_I state machines are as follows:

a) ST_IFR (initiator frame router) state machine (see 8.2.4.2.2); and
b) ST_ITS (initiator transport server) state machine (see 8.2.4.2.3).

The SAS initiator port shall include:

a) one ST_IFR state machine; and
b) one ST_ITS state machine for each possible task and task management function (i.e., for each tag).

Figure 149 shows the ST_I state machines.

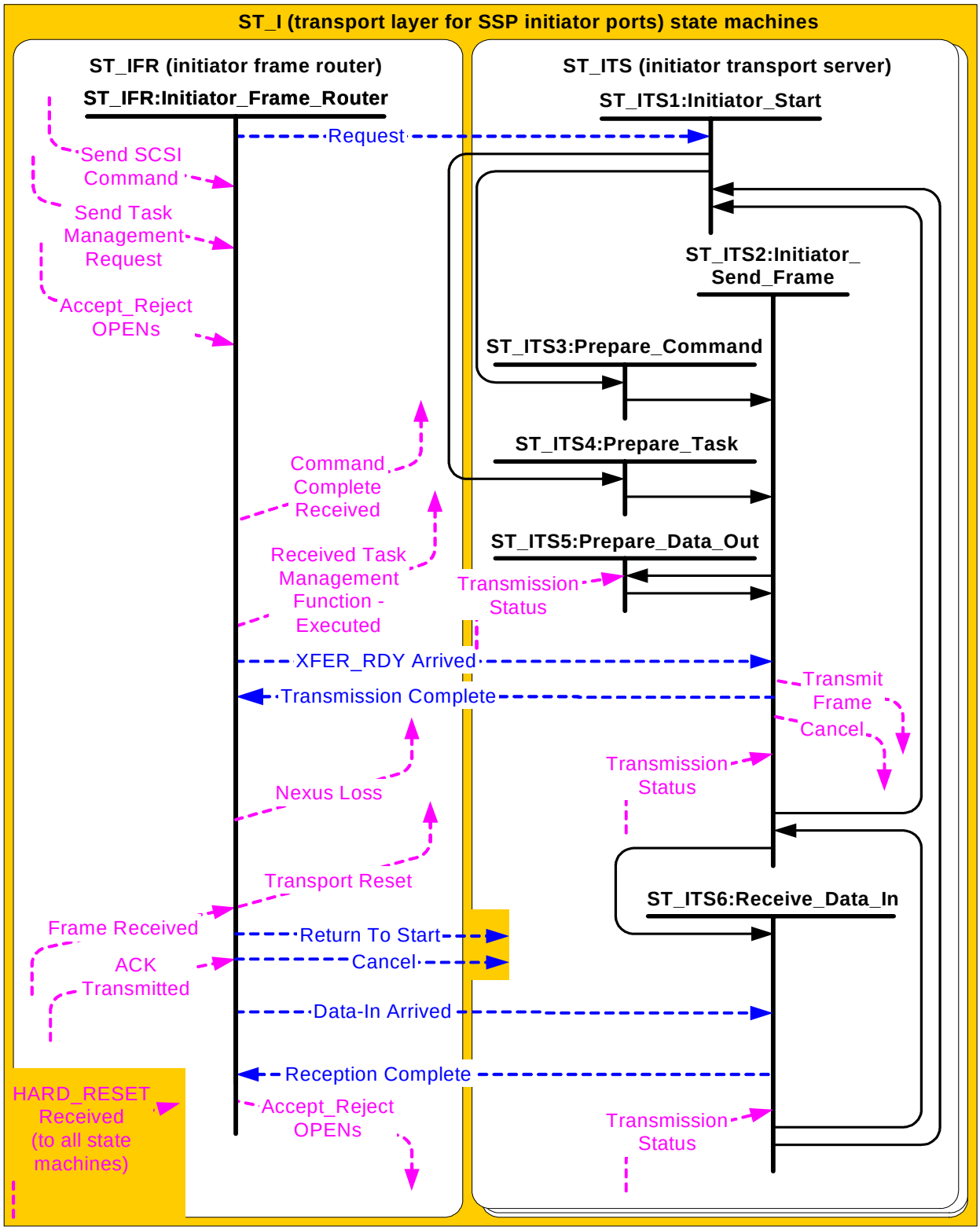

Figure 149 — ST_I (transport layer for SSP initiator ports) state machines

Editor's Note 14: Added Data-In Arrived message into ST_ITS7 and Transmission Status confirmation into ST_ITS5 to allow for non-interlocked DATA frame transfers. Changed Cancel message to go to all states. Added a Return To Start message to all states. Deleted ST_ITS7. Added transition from ST_ITS1 to ST_ITS3 and ST_ITS4. Deleted transition from ST_ITS2 to ST_ITS3 and from ST_ITS2 to ST_ITS4.

8.2.4.2.2 ST_IFR (initiator frame router) state machine

The ST_IFR state machine performs the following functions:

a) receives Send SCSI Command and Send Task Management transport protocol service requests from the SCSI application layer;
b) sends messages to the ST_ITS state machine;
c) receives messages from the ST_ITS state machine;
d) receives confirmations from the port layer;
e) sends transport protocol service confirmations to the SCSI application layer;
f) receives vendor specific requests from the SCSI application layer;
g) sends vendor specific confirmations to the SCSI application layer;
h) receives Accept_Reject OPENs requests from the SCSI application layer;
i) sends Accept_Reject OPENs requests to the port layer;
j) sends I_T Nexus Loss event notifications to the SCSI application layer; and
k) sends Transport Reset event notifications to the SCSI application layer.

This state machine consists of one state.

This state machine shall be started after power on.

8.2.4.2.2.1 Processing transport protocol service requests

If this state machine receives a Send SCSI Command transport protocol service request then this state machine shall send a Request (Send Command) message with Command arguments and Buffer arguments to the ST_ITS state machine for the specified tag.

The following is the list of Command arguments:

a) connection rate;
b) initiator connection tag;
c) destination SAS address;
d) source SAS address set to the SAS address of the SSP initiator port;
e) tag;
f) logical unit number;
g) task priority;
h) task attribute;
i) additional CDB length;
j) CDB; and
k) additional CDB bytes, if any.

The following is the list of Buffer arguments:

a) data-in buffer size;
b) data-out buffer; and
c) data-out buffer size.

If the command is performing a write operations and first burst is enabled (see 9.2.2.1), then the Request (Send Command) message shall also include the Enable First Burst argument and the number of bytes for the First Burst Size argument.

If this state machine receives a Send Task Management Request transport protocol service request, then this state machine shall send a Request (Send Task) message with the following Task arguments to the ST_ITS state machine for the specified tag:

a) connection rate;
b) initiator connection tag;
c) destination SAS address;
d) retransmit bit;
e) tag;
f) logical unit number;
g) task management function; and
h) tag of task to be managed.

If the ST_ITS state machine for the tag specified in the Send Task Management Request is currently in use, then set the retransmit bit argument to one. If the ST_ITS state machine for the tag specified in the Send Task Management Request is not currently in use, then set the Retransmit Bit argument to zero.

8.2.4.2.2.2 Processing Frame Received confirmations

If this state machine receives a Frame Received (ACK/NAK Balanced) confirmation or Frame Received (ACK/NAK Not Balanced) confirmation, then this state machine shall compare the frame type of the frame received with the received confirmation (see table 104 in 9.2.1). 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. 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.

If the frame type is correct relative to the Frame Received 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 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:

a) discard the frame; and
b) may send a vendor-specific confirmation to the SCSI application layer to cause the command using that tag to be aborted.

If the frame type is XFER_RDY 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:

a) discard the frame; and
b) may send a vendor-specific confirmation to the SCSI application layer to cause the command using that tag to be aborted.

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

a) discard the frame;
b) send a Command Complete Received transport protocol service confirmation with the Delivery Result argument set to Service Delivery or Target Failure - DATA Not Expected to the SCSI application layer; and
c) if there is an ST_ITS state machine for the tag, send a Return To Start message to that state machine.

If the frame type is DATA and the tag is for a task with no read data, then this state machine shall:

a) discard the frame;
b) send a Command Complete Received transport protocol service confirmation with the Delivery Result argument set to Service Delivery or Target Failure - DATA Not Expected to the SCSI application layer; and
c) if there is an ST_ITS state machine for the tag, send a Return To Start message to that state machine.

If the frame type is RESPONSE then this state machine shall check the length of the information unit. If the length of the information unit is not correct and the RESPONSE frame was for a command, then this state shall discard the frame and send a Command Complete Received confirmation to the SCSI application layer with the Service Response argument set to Service Delivery or Target Failure. If the length of the information

unit is not correct and the RESPONSE frame was for a task management function, then this state shall discard the frame and send a Received Task Management Function – Executed confirmation to the SCSI application layer with the Service Response argument set to Service Delivery or Target Failure.

If the frame type is correct relative to the Frame Received confirmation, then this state machine shall check the tag. If the tag does not specify a valid ST_ITS state machine, then this state machine shall discard the frame and may send a vendor-specific confirmation to the SCSI application layer to cause the command using that tag to be aborted.

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

a) discard the frame;
b) send a Command Complete Received transport protocol service confirmation with the Delivery Result argument set to Service Delivery or Target Failure - XFER_RDY Not Expected to the SCSI application layer; and
c) if there is an ST_ITS state machine for the tag, send a Return To Start message to that state machine.

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

If the frame type is RESPONSE, the fields checked in the frame are correct, and this state machine has not received a RESPONSE frame for this I_T_L_Q nexus, then send a Return To Start message to that state machine and:

a) if the RESPONSE frame was for a command, then send a Command Complete Received protocol service confirmation to the SCSI application layer with the arguments set as specified in table xxx (see 10.2.1.5); or
b) if the RESPONSE frame was for a task management request, then send a Received Task Management Function Executed protocol service confirmation to the SCSI application layer with the arguments set as specified in table xxx (see 10.2.1.5).

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

If this state machine receives an ACK Transmitted confirmation for an XFER_RDY frame, then this state machine shall send an XFER_RDY Arrived message to ST_ITS state machine specified by the tag. The message shall include the following Xfer_Rdy arguments:

a) retry data frames;
b) retransmit bit;
c) target port transfer tag;
d) requested offset; and
e) write data length.

If the frame type is DATA and the fields checked in the frame are correct, then this state machine shall send a Data-In Arrived message to the ST_ITS state machine specified by the tag. The message shall include the following Read Data arguments:

a) changing data pointer;
b) number of fill bytes;
c) data offset; and
d) data.

8.2.4.2.2.3 Processing Transmission Complete and Reception Complete messages

If this state receives a Transmission Complete (I_T Nexus Loss), then this state machine shall send a Nexus Loss event notification to the SCSI application layer.

Table 103 defines the transport protocol service confirmation and its argument generated as a result of receiving a Transmission Complete message or a Reception Complete message.

Table 103 — Confirmations sent to the SCSI application layer

Message received from ST_ITS state machine	Protocol service confirmation and Delivery Result argument sent to the SCSI application layer
Transmission Complete (Command Failed, ACK/NAK Timeout)	Command Complete Received (Service Delivery or Target Failure - ACK/NAK Timeout)
Transmission Complete (Command Failed, NAK Received)	Command Complete Received (Service Delivery or Target Failure - NAK Received)
Transmission Complete (Task Failed, ACK/NAK Timeout)	Received Task Management Function - Executed (Service Delivery or Target Failure - ACK/NAK Timeout)
Transmission Complete (Task Failed, NAK Received)	Received Task Management Function - Executed (Service Delivery or Target Failure - NAK Received)
Transmission Complete (XFER_RDY Incorrect Write Data Length)	Command Complete Received (Service Delivery or Target Failure - XFER_RDY Incorrect Write Data Length)
Transmission Complete (XFER_RDY Requested Offset Error)	Command Complete Received (Service Delivery or Target Failure - XFER_RDY Requested Offset Error)
Transmission Complete (Cancel Acknowledged)	Command Complete Received (Service Delivery or Target Failure - Cancel Acknowledged)
Reception Complete (Data Offset Error)	Command Complete Received (Service Delivery or Target Failure - DATA Offset Error)
Reception Complete (Too Much Read Data)	Command Complete Received (Service Delivery or Target Failure - DATA Too Much Read Data)
Reception Complete (Information Unit Too Short)	Command Complete Received (Service Delivery or Target Failure - DATA Information Unit Too Short)
Reception Complete (Command Failed, ACK/NAK Timeout)	Command Complete Received (Service Delivery or Target Failure - ACK/NAK Timeout)

The protocol service confirmation shall include the tag as an argument.

8.2.4.2.2.4 Processing miscellaneous requests

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

This state machine may receive vendor specific requests from the SCSI application layer that cause this state machine to send a Cancel message to an ST_ITS state machine.

8.2.4.2.3 ST_ITS (initiator transport server) state machine

8.2.4.2.3.1 ST_ITS state machine overview

The ST_ITS state machine performs the following functions:

a) receives and processes messages from the ST_IFR state machine;
b) sends messages to the ST_IFR state machine;
c) sends request to the port layer regarding frame transmission;

d) receives confirmations from the port layer regarding frame transmission; and
e) receives HARD_RESET Received confirmations from the port layer.

This state machine consists of the following states:

a) ST_ITS1:Initiator_Start state (see 8.2.4.2.3.2) (initial state);
b) ST_ITS2:Initiator_Send_Frame state (see 8.2.4.2.3.3);
c) ST_ISF3:Prepare_Command state (see 8.2.4.2.3.4);
d) ST_ITS4:Prepare_Task state (see 8.2.4.2.3.5);
e) ST_ITS5:Prepare_Data_Out state (see 8.2.4.2.3.6); and
f) ST_ITS6:Receive_Data_In state (see 8.2.4.2.3.7).

This state machine shall start in the ST_ITS1:Initiator_Start state after power on.

If this state machine receives a HARD_RESET Received confirmation, then this state machine shall transition to the ST_ITS1:Initiator_Start state from any other state.

This state machine shall maintain the state machine variables defined in table 104.

Table 104 — ST_ITS state machine variables

State machine variable	Description
Data-In Buffer Offset	Current offset in the data-in buffer for read data
Data-Out Buffer Offset	Current offset in the data-out buffer for write data
Previous Requested Offset	Data offset from the last XFER_RDY frame received
Previous Write Data Length	Write data length from the last XFER_RDY frame received

This state machine shall maintain the state machine arguments defined in table 105.

Table 105 — ST_ITS state machine arguments

State machine argument	Description
Command	Consists of the Command arguments received in the Request (Send Command) message
Task	Consists of the arguments received in the Request (Send Task) message
Xfer_Rdy	Consists of the arguments received in the XFER_RDY Arrived message
Data-Out Buffer	The location of the write data buffer
Data-Out Buffer size	The size in bytes of the write data buffer
Data-In Buffer size	The size in bytes of the read data buffer

8.2.4.2.3.2 ST_ITS1:Initiator_Start state

8.2.4.2.3.2.1 State description

This state is the initial state of an ST_ITS state machine.

This state shall set the following state machine variables to zero:

a) Data-In Buffer Offset; and
b) Data-Out Buffer Offset.

8.2.4.2.3.2.2 Transition ST_ITS1:Initiator_Start to ST_ITS3:Prepare_Command

This transition shall occur after this state receives a Request (Send Command) message.

8.2.4.2.3.2.3 Transition ST_ITS1:Initiator_Start to ST_ITS4:Prepare_Task

This transition shall occur after this state receives a Request (Send Task) message.

8.2.4.2.3.3 ST_ITS2:Initiator_Send_Frame state

8.2.4.2.3.3.1 State description

If this state is entered from the ST_ITS3:Prepare_Command state for transmission of a COMMAND frame, then this state shall send a Transmit Frame (Interlocked) request to the port layer.

If this state is entered from the ST_ITS6:Receive_Data_In state, and the vendor-specific number of retries has not been reached for the COMMAND frame requesting a read operation, then this state shall send a Transmit Frame (Interlocked) request to the port layer.

If this state is entered from the ST_ITS4:Prepare_Task state for transmission of an TASK frame, then this state shall send a Transmit Frame (Interlocked) request to the port layer.

If this state is entered from the ST_ITS5:Prepare_Data_Out state for transmission of a write DATA frame, then this state shall send a Transmit Frame (Non-Interlocked) request to the port layer if:

a) this state has received an XFER_RDY Arrived message; or
b) first burst is enabled and this state has received a Transmission Status (Frame Transmitted) confirmation and a Transmission Status (ACK Received) confirmation for the COMMAND frame.

A Transmit Frame request shall include the COMMAND frame from the ST_ITS3:Prepare_Command state or from the ST_ITS6:Receive_Data_In state, the TASK frame from the ST_ITS4:Prepare_Task state, or the write DATA frame from the ST_ITS5:Prepare_Data_Out state and the following arguments to be used for any OPEN address frame:

a) 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 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_IFR state machine. This Transmission Complete message shall include the tag as an argument.

If the confirmation is not Transmission Status (Frame Transmitted) or Transmission Status (I_T Nexus Loss) (see table xxx in 8.2.2.3.4), and the Transmit Frame request was for a COMMAND frame or a DATA frame, then this state shall send a Transmission Complete (Command Failed, Connection Failed) message to the ST_IFR 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 xxx in 8.2.2.3.4), and the Transmit Frame request was for a TASK frame, then this state shall send a Transmission Complete (Task Failed, Connection Failed) message to the ST_IFR state machine. The message shall include the tag.

If the confirmation is Transmission Status (Frame Transmitted), and the Transmit Frame request was for a COMMAND frame not requesting a read operation (see 8.2.4.2.3.7), a COMMAND frame not requesting a write operation, a TASK frame, or a write DATA frame where the number of data bytes that have been transmitted equal the request byte count, 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).

If the confirmation is Transmission Status (Frame Transmitted), and the Transmit Frame request was for a COMMAND frame requesting a write operation, or a write DATA frame where the number of data bytes that have been transmitted is less than the request byte count and the write data length from the previous XFER_RDY frame, 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);
d) Transmission Status (Connection Lost Without ACK/NAK); or
e) XFER_RDY Arrived message (i.e., the ST_IFR assumes a Transmission Status (ACK Received) was received).

If a XFER_RDY Arrived message is received, then the ST_ITS shall respond to the XFER_RDY frame as if a Transmission Status (ACK Received) was received.

NOTE 44 - If the number of data bytes requested to be transmitted for the Send SCSI Command protocol service request are fewer than the number of bytes in the service request, then this state may send additional Transmit Frame requests for write DATA frames for the protocol service 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 write DATA frames sent for the I_T_L_Q nexus.

After a Transmission Status (Frame Transmitted) is received, if a confirmation of Transmission Status (NAK Received) is received, the Transmit Frame request was for a COMMAND frame, and the vendor specific number of retries has not been reached, then this state shall send a Transmit Frame (interlocked) request (i.e., the last COMMAND frame is retransmitted) to the port layer.

After a Transmission Status (Frame Transmitted) is received, if a confirmation of Transmission Status (NAK Received) is received, the Transmit Frame request was for a TASK frame, and the vendor specific number of retries has not been reached, then this state shall send a Transmit Frame (interlocked) request (i.e., the last TASK frame is retransmitted) to the port layer.

Table 130 defines the messages that this state shall send to the ST_IFR state machine upon receipt of the listed confirmations, based on the conditions under which each confirmation was received.

Table 106 — Messages sent to the ST_IFR state machine

Confirmation received from the port layer	Conditions under which confirmation was received	Message sent to ST_IFR state machine
Transmission Status (ACK/NAK Timeout) or Transmission Status (Connection Lost Without ACK/NAK)	The Transmit Frame request was for a COMMAND frame.	Transmission Complete (Command Failed, ACK/NAK Timeout)
	The Transmit Frame request was for a TASK frame.	Transmission Complete (Task Failed, ACK/NAK Timeout)
Transmission Status (NAK Received)	The Transmit Frame request was for a COMMAND frame and the vendor-specific number of retries has been reached.	Transmission Complete (Command Failed, NAK Received)
	The Transmit Frame request was for a TASK frame and the vendor-specific number of retries has been reached.	Transmission Complete (Task Failed, NAK Received)
Transmission Status (NAK Received)	The Transmit Frame request was for a write DATA frame and: a) the RETRY DATA FRAMES bit was set to zero in the XFER_RDY frame requesting the data; or b) the RETRY DATA FRAMES bit was set to one in the XFER_RDY frame requesting the data, and the vendor-specific number of retries has been reached.	Transmission Complete (Data-Out Failed, NAK Received)
Transmission Status (ACK/NAK Timeout) or Transmission Status (Connection Lost Without ACK/NAK)		Transmission Complete (Data-Out Failed, ACK/NAK Timeout)

After this state sends a Transmission Complete (Command Failed, ACK/NAK Timeout) this state shall continue processing messages and confirmations.

NOTE 45 - The application client may determine the command was received and is being processed by the device server and allow the command to complete.

If this state receives a Return to Start message or a Return to Start argument, 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.

If this state receives a Cancel message or a Cancel argument, 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_IFR state machine.

If this state receives a Cancel message or a Cancel argument, 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. The Cancel request shall include the following arguments:

a) destination SAS address; and
b) tag.

NOTE 46 - The Cancel message results from a vendor specific request from the SCSI application layer after the SCSI application layer has used a task management function to determine that the SAS target port did not receive the COMMAND frame.

If this state receives a Transmission Status (Cancel Acknowledged) confirmation, then this state shall send a Transmission Complete (Cancel Acknowledged) message to the ST_IFR state machine.

If this state receives an XFER_RDY Arrived message, then this state shall verify the Xfer_Rdy state machine argument as specified in table 107. If the verification fails, then this state sends the Transmission Complete message specified in table 107 to the ST_IFR state machine.

Table 107 — Transmission Complete messages for XFER_RDY frame verification failures

Message sent to ST_IFR [a]	Condition
Transmission Complete (XFER_RDY Incorrect Write Data Length)	The Write Data Length Xfer_Rdy state machine argument is zero.
	The value in the Requested Offset Xfer_Rdy state machine argument plus the Write Data Length Xfer_Rdy state machine argument is greater than the Data-Out Buffer Size state machine argument.
Transmission Complete (XFER_RDY Requested Offset Error)	First burst is not enabled, this is the first XFER_RDY frame for a command, and the value in the Requested Offset Xfer_Rdy state machine argument is not set to zero.
	First burst is enabled, this is the first XFER_RDY frame for a command, and the value in the Requested Offset Xfer_Rdy state machine argument is not equal to the value indicated by the FIRST BURST SIZE field in the Disconnect-Reconnect mode page (see 10.2.6.1.5).
	Retries are not supported and the Requested Offset Xfer_Rdy state machine argument is not equal to the Previous Requested Offset state machine variable plus the Previous Write Data Length Field state machine variable.
	Retries are supported, the Retransmit Bit Xfer_Rdy state machine argument is set to zero, and the Requested Offset Xfer_Rdy state machine argument is not equal to the Previous Requested Offset state machine variable plus the Previous Write Data Length state machine variable.
	Retries are supported, this is not the first XFER_RDY frame for the command, the Retransmit Bit Xfer_Rdy state machine argument is set to one, and: a) the Requested Offset Xfer_Rdy state machine argument is not equal to the Previous Requested Offset state machine variable; and b) the Requested Offset Xfer_Rdy state machine argument is not equal to the Previous Requested Offset state machine variable plus the Previous Write Data Length Field state machine variable.

[a] If more than one condition is true that result in a different messages, then the Transmission Complete (XFER_RDY Incorrect Write Data Length) message shall be sent to the ST_IFR state machine.

After this state verifies an XFER_RDY frame, it shall:

a) set the Data-Out Buffer Offset state machine variable to the Requested Offset Xfer_Rdy state machine argument;
b) set the Previous Requested Offset state machine variable to the Requested Offset Xfer_Rdy state machine argument; and
c) set the Previous Write Data Length state machine variable to the Requested Offset Xfer_Rdy state machine argument.

8.2.4.2.3.3.3 Transition ST_ITS2:Initiator_Send_Frame to ST_ITS1:Initiator_Start

This transition shall occur after:

a) this state has sent one of the following to the ST_IFR state machine:

A) a Transmission Complete (Command Failed, NAK Received) message;
B) a Transmission Complete (Task Failed, ACK/NAK Timeout) message;
C) a Transmission Complete (Task Failed, NAK Received) message;
D) a Transmission Complete (Command Failed, ACK/NAK Timeout) message and the command was for a non-data operation;
E) a Transmission Complete (Data-Out Failed, NAK Received) message;
F) a Transmission Complete (Data-Out Failed, ACK/NAK Timeout) message;
G) a Transmission Complete (XFER_RDY Incorrect Write Data Length) message;
H) a Transmission Complete (XFER_RDY Requested Offset Error) message; or
I) a Transmission Complete (Cancel Acknowledged) message;

or

b) this state has received a Return To Start message or Return To Start argument, and has received:
A) confirmations for all Transmit Frame requests sent to the port layer; or
B) a Transmission Status (Cancel Acknowledged) confirmation.

8.2.4.2.3.3.4 Transition ST_ITS2:Initiator_Send_Frame to ST_ITS5:Prepare_Data_Out

If first burst is enabled, this transition shall occur and include First Burst argument after this state receives:

a) a Transmission Status (Frame Transmitted) confirmation followed by a Transmission Status (ACK Received) for a COMMAND frame requesting a write operation; or
b) a Transmission Status (Frame Transmitted) confirmation for a Transmit Frame (Non-interlocked) request if the Data-Out Buffer Offset state machine variable is less than the first burst size (see x.x.x).

This transition shall occur after this state receives:

a) an XFER_RDY Arrived message; or
b) a Transmission Status (Frame Transmitted) confirmation for a Transmit Frame (Non-interlocked) request if the Data-Out Buffer Offset state machine variable is less than the Requested Offset Xfer_Rdy state machine argument plus the Write Data Length Xfer_Rdy state machine argument.

NOTE 47 - This transition occurs even if this state has not received a Transmission Status (ACK Received) for the write DATA frame.

This transition shall include a Retry argument and occur after:

a) this state receives one of the following confirmations or arguments for a write DATA frame:
A) Transmission Status (NAK Received);
B) Transmission Status (ACK/NAK Timeout); or
C) Transmission Status (Connection Lost without ACK/NAK);
b) the RETRY DATA FRAMES bit set to one in the XFER_RDY frame for the write operation
c) the Data-Out Buffer Offset state machine variable is set to the Requested Offset Xfer_Rdy state machine argument; and
d) the vendor-specific number of retries, if any, for the write DATA frame has not been reached.

8.2.4.2.3.3.5 Transition ST_ITS2:Initiator_Send_Frame to ST_ITS6:Receive_Data_In

This transition shall occur after this state receives a Transmission Status (Frame Transmitted) confirmation for a COMMAND frame for a command requesting a read operation.

NOTE 48 - This transition occurs even if this state has not received a Transmission Status (ACK Received) for the COMMAND frame.

8.2.4.2.3.4 ST_ITS3:Prepare_Command state

8.2.4.2.3.4.1 State description

This state shall construct a COMMAND frame using the Command arguments (see 8.2.4.2.2.1):

a) FRAME TYPE field set to 06h (i.e., COMMAND frame);

b) HASHED DESTINATION SAS ADDRESS field set to the hashed value of the Destination SAS Address Commands argument;
c) HASHED SOURCE SAS ADDRESS field set to the hashed value of the SSP initiator port's SAS address;
d) RETRY DATA FRAMES bit set to zero;
e) RETRANSMIT bit set to zero;
f) CHANGING DATA POINTER bit set to zero;
g) NUMBER OF FILL BYTES field set zero.
h) TAG field set to the Tag Command argument;
i) TARGET PORT TRANSFER TAG field set to zero;
j) DATA OFFSET field set to zero;
k) in the information unit, LOGICAL UNIT NUMBER field set to the Logical Unit Number Command argument;
l) in the information unit, ENABLE FIRST BURST bit set to the Enable First Burst Command argument;
m) in the information unit, TASK PRIORITY field set to the Task Priority Command argument;
n) in the information unit, TASK ATTRIBUTE field set to the Task Attribute Command argument;
o) in the information unit, ADDITIONAL CDB LENGTH field set to the Additional CDB Length Command argument;
p) in the information unit, CDB field set to the CDB Command argument;
q) in the information unit, ADDITIONAL CDB BYTES field set to the Additional CDB Bytes Command argument, if any; and
r) no fill bytes.

8.2.4.2.3.4.2 Transition ST_ITS3:Prepare_Command to ST_ITS2:Initiator_Send_Frame

This transition shall occur after this state:

a) constructs a COMMAND frame;
b) receives a Cancel message; or
c) receives a Return To Start message.

This transition shall include the:

a) COMMAND frame as an argument;
b) if a Cancel message was received, then a Cancel argument; or
c) if a Return To Start message was received, then a Return To Start argument.

8.2.4.2.3.5 ST_ITS4:Prepare_Task state

8.2.4.2.3.5.1 State description

This state shall construct a TASK frame using the Task arguments:

a) FRAME TYPE field set to 16h (i.e., TASK frame);
b) HASHED DESTINATION SAS ADDRESS field set to the hashed value of the Destination SAS Address Task argument;
c) HASHED SOURCE SAS ADDRESS field set to the hashed value of the SSP initiator port's SAS address;
d) RETRY DATA FRAMES bit set to zero;
e) RETRANSMIT bit set to the Retransmit Bit Task argument;
f) CHANGING DATA POINTER bit set to zero;
g) NUMBER OF FILL BYTES field set zero.
h) TAG field set to the Tag Task argument;
i) TARGET PORT TRANSFER TAG field set to zero;
j) DATA OFFSET field set to zero;
k) in the information unit, LOGICAL UNIT NUMBER field set to the Logical Unit Number Task argument;
l) in the information unit, TASK MANAGEMENT FUNCTION field set to the Task Management Function Task argument;
m) in the information unit, TAG OF TASK TO BE MANAGED field set to the Tag Task argument of task to be managed and
n) no fill bytes.

8.2.4.2.3.5.2 Transition ST_ITS4:Prepare_Task to ST_ITS2:Initiator_Send_Frame

This transition shall occur after this state:

a) constructs a TASK frame;
b) receives a Cancel message; or
c) receives a Return To Start message.

This transition shall include the:

a) TASK frame as an argument;
b) if a Cancel message was received, then a Cancel argument; or
c) if a Return To Start message was received, then a Return To Start argument.

8.2.4.2.3.6 ST_ITS5:Prepare_Data_Out state

8.2.4.2.3.6.1 State description

This state shall construct a write DATA frame using the following Xfer_Rdy state machine arguments and Command state machine arguments:

a) FRAME TYPE field set to 01h (i.e., DATA frame);
b) HASHED DESTINATION SAS ADDRESS field set to the hashed value of the Destination SAS Address Command argument;
c) HASHED SOURCE SAS ADDRESS field set to the hashed value of the SSP initiator port's SAS address;
d) RETRY DATA FRAMES bit set to zero;
e) RETRANSMIT bit set to zero;
f) CHANGING DATA POINTER bit set as specified in this subclause;
g) NUMBER OF FILL BYTES field set to the number of fill bytes, based on the length of the specified data;
h) TAG field set to the Tag Command argument;
i) TARGET PORT TRANSFER TAG field set to FFFFh if this state received a First Burst argument or the Target Port Transfer Tag Xfer_Rdy argument if this state did not receive a First Burst argument;
j) DATA OFFSET field set to the Data-Out Buffer Offset state machine variable;
k) in the information unit, DATA field set to the information that starts at the location in the Data-Out Buffer state machine argument pointed to by the Data-Out Buffer Offset state machine variable and shall contain the amount of data indicated by the Write Data Length Xfer_Rdy argument; and
l) fill bytes, if any.

If this state is entered without a Retry argument, then this state shall set the CHANGING DATA POINTER bit to zero.

If this state is entered with a Retry argument, then this state shall set the CHANGING DATA POINTER bit to one.

After constructing the write DATA frame, this state shall set the Data-Out Buffer Offset state machine variable to the value of the DATA OFFSET field plus the length of the DATA field in the information unit.

8.2.4.2.3.6.2 Transition ST_ITS5:Prepare_Data_Out to ST_ITS2:Intiator_Send_Frame

This transition shall occur after this state:

a) constructs a write DATA frame;
b) receives a Cancel message; or
c) receives a Return To Start message.

This transition shall include the received Transmission Status, if any, as an argument and the:

a) write DATA frame as an argument;
b) if a Cancel message was received, then a Cancel argument; or
c) if a Return To Start message was received, then a Return To Start argument.

8.2.4.2.3.7 ST_ITS6:Receive_Data_In state

8.2.4.2.3.7.1 State description

If this state receives a Data-In Arrived message, then this state shall verify the values in the read DATA frame received with the message as defined in table 108.

If the verification fails, then this state sends the Reception Complete message specified in table 107 to the ST_IFR state machine.

Table 108 — Reception Complete messages for read DATA frame verification failures

Message sent to ST_IFR [a]	Condition
Reception Complete (Data Offset Error)	Transport layer retries are not supported, and the DATA OFFSET field in the read DATA frame is not equal Data-In Buffer Offset state machine variable.
	The DATA OFFSET field in the read DATA frame is greater than the Data-In Buffer Size state machine argument.
Reception Complete (Too Much Read Data)	The number of bytes in the DATA field in the read DATA information unit plus the Data-In Buffer Offset state machine variable is greater than the Data-In Buffer Size state machine argument.
Reception Complete (Incorrect Data Length)	The number of bytes in the DATA field in the read DATA information unit is zero.

[a] If more than one condition is true that result in a different messages, then the state shall select which message to send to the ST_IFR state machine using the following order:
1) Reception Complete (Data Offset Error);
2) Reception Complete (Too Much Read Data); or
3) Reception Complete (Incorrect Data Length).

If:

a) transport layer retries are supported;
b) the CHANGING DATA POINTER bit is set to zero;
c) the DATA OFFSET field is not set to the Data-In Buffer Offset state machine variable;
d) the DATA OFFSET field is less than the Data-In Buffer Size state machine argument; and
e) the DATA OFFSET field plus the length of the Data information unit is less than or equal to the Data-In Buffer Size state machine argument,

then this state should discard all Data-In Arrived messages until a read DATA frame is received with the CHANGING DATA POINTER bit is set to one. This state shall resume processing additional Data-In Arrived messages when it receives a Data-In Arrived message with the CHANGING DATA POINTER bit set to one.

If the verification succeeds or after this state resumes processing Data-In Arrived messages, then this state shall process the data received in the read DATA frame and set the Data-In Buffer Offset state machine variable to the DATA OFFSET field plus the length of the Data information unit.

If this state receives Transmission Status (ACK/NAK Timeout) or Transmission Status (Connection Lost Without ACK/NAK), then this state shall send a Reception Complete (Command Failed, Connection Failed) to the ST_IFR state machine.

After this state sends a Reception Complete (Command Failed, Connection Failed) message, this state shall continue processing messages and confirmations.

NOTE 49 - The application client may determine the command was received and is being processed by the device server and allow the command to complete.

If this state receives a Cancel message, then this state shall send a Reception Complete (Cancel Acknowledged) message to the ST_IFR state machine. The Reception Complete message shall include the tag as an argument.

NOTE 50 - The Cancel message results from a vendor specific request from the SCSI application layer after the SCSI application layer has used a task management function to determine that the SAS target port did not receive the COMMAND frame.

8.2.4.2.3.7.2 Transition ST_ITS6:Receive_Data_In to ST_ITS1:Initiator_Start

This transition shall occur after this state:

a) sends one of the following to the ST_IFR state machine:
   A) a Reception Complete (Data Offset Error) message;
   B) a Reception Complete (Too Much Read Data) message;
   C) a Reception Complete (Incorrect Data Length) message; or
   D) a Transmission Complete (Cancel Acknowledged) message;

or

b) receives a Return To Start message.

8.2.4.2.3.7.3 Transition ST_ITS6:Receive_Data_In to ST_ITS2:Initiator_Send_Frame

This transition shall occur after this state receives a Transmission Status (NAK Received) confirmation for a COMMAND frame for a command requesting a read operation.

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

8.2.4.3.1 ST_T state machines overview

The ST_T state machines are as follows:

a) ST_TFR (target frame router) state machine (see 8.2.4.3.2); and
b) ST_TTS (target transport server) state machine (see 8.2.4.3.3).

The SAS target port includes:

a) one ST_TFR state machine; and
b) one ST_TTS state machine for each possible task and task management function (i.e., for each tag).

This state machine may 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 150 shows the ST_T state machines.

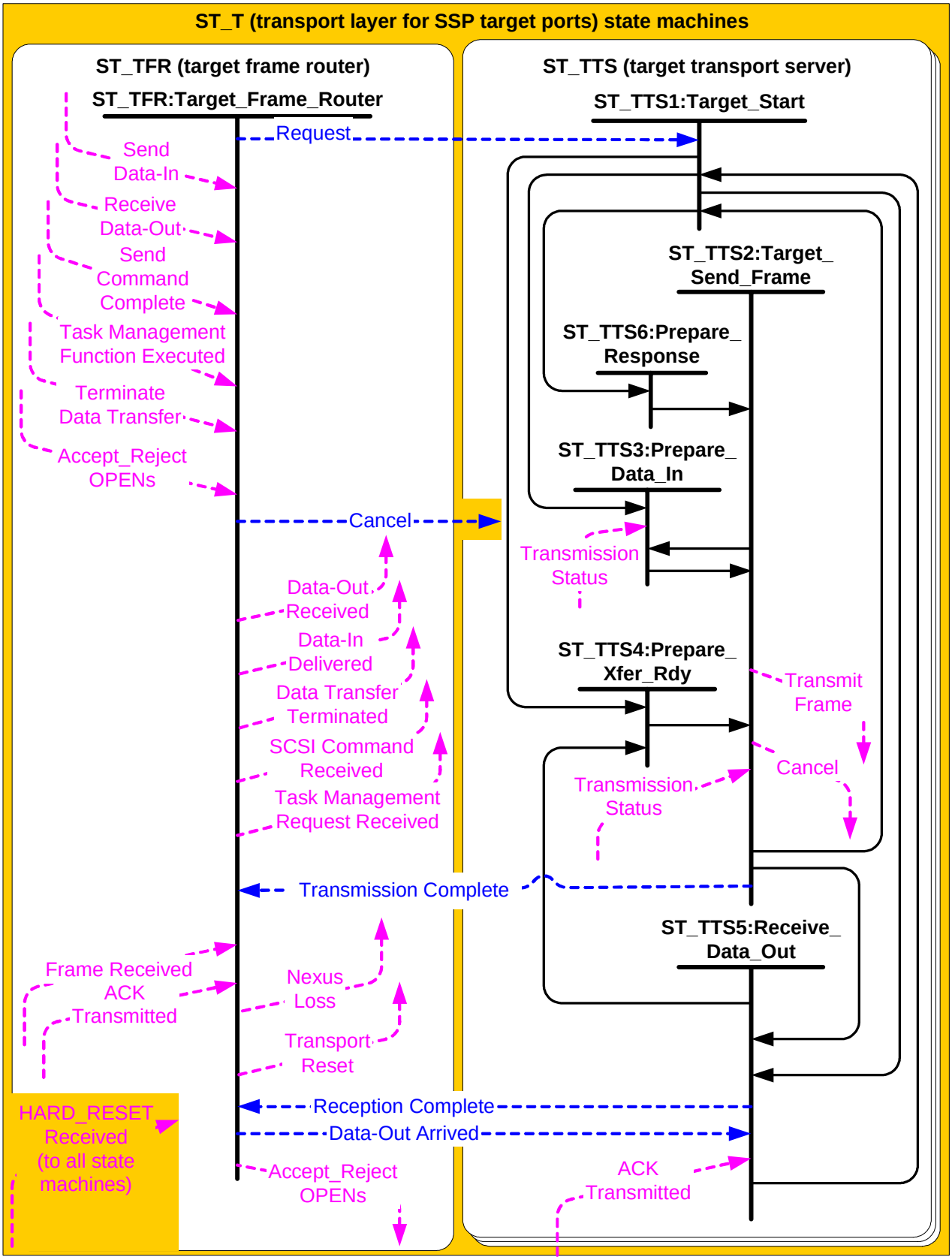

Figure 150 — ST_T (transport layer for SSP target ports) state machines

Editor's Note 15: Added Transmission Status confirmation into ST_TTS3 to allow for non-interlocked DATA frame transfers. Changed Cancel message to go to all states. Added ACK Transmitted to ST_TTS5. Deleted ST_TTS1 to ST_TTS2 transition, ST_TTS5 to ST_TTS2 transition, ST_TTS7 to ST_TTS2 transition, and ST_TTS4 to ST_TTS2 transition. Added ST_TTS1 to ST_TTS3 transition, ST_TTS1 to ST_TTS4 transition, ST_TTS1 to ST_TTS7 transition, and ST_TTS5 to ST_TTS4 transition. Change ST_TTS7 to ST_TTS6.

8.2.4.3.2 ST_TFR (target frame router) state machine

8.2.4.3.2.1 ST_TFR state machine overview

The ST_TFR state machine performs the following functions:

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 messages from the ST_TTS state machine;
f) receives Accept_Reject OPENs requests from the SCSI application layer;
g) sends Accept_Reject OPENs requests to the port layer;
h) sends Nexus Loss event notifications to the SCSI application layer; and
i) sends Transport Reset event notifications to the SCSI application layer.

This state machine consists of one state.

This state machine shall be started after power on.

8.2.4.3.2.2 Processing Frame Received confirmations

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 104 in 9.2.1). 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 checked and they are not set to zero, then this state machine shall send to an ST_TTS state machine that does not have an active task the following and discard the frame:

a) a Request (Send Transport Response) message with the Transport Response arguments;
b) the destination SAS address argument set to the SAS address from which the invalid frame was received; and
c) the Service Response argument set to Invalid Frame.

The check of reserved fields within the frame shall not apply to the reserved fields within the CDB in a COMMAND frame. Checking of reserved fields in a CDB is described in SPC-3.

The following is the list of Transport Response arguments:

a) connection rate;
b) initiator connection tag;
c) destination SAS address (i.e., the SAS address to which the RESPONSE frame is to be transmitted);
d) source SAS address set to the SAS address of the SAS port containing the state machine;
e) tag; and
f) service response.

If the frame type is correct relative to the Frame Received 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 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 to an ST_TTS state machine that does not have an active task the following and discard the frame:

a) a Request (Send Transport Response) message with the Transport Response arguments;
b) the destination SAS address set to the SAS address from which the invalid frame was received; and
c) the Service Response argument set to Invalid Frame.

If the frame type is TASK, this state machine checks tags, the RETRANSMIT bit in the new TASK frame is set to one, and the tag for the new TASK frame is the same as the tag for a previous TASK frame where the task management function for the previous TASK frame is not complete, then this state machine shall discard the new TASK frame and not send a Task Management Request Received confirmation to the port layer.

If the frame type is TASK and this state machine does not check tags, then this state machine shall ignore the RETRANSMIT bit.

If the frame type is COMMAND or TASK, then this state machine may check the target port transfer tag. If this state checks the target port transfer tag and the tag is set to a value other than FFFFh, then this state machine shall send to an ST_TTS state machine that does not have an active task the following and discard the frame:

a) a Request (Send Transport Response) message with the Transport Response arguments;
b) the destination SAS address set to the SAS address from which the invalid frame was received; and
c) the Service Response argument set to Invalid Frame.

If the frame type is TASK, then this state machine shall check the logical unit number. If the logical unit number is unknown, then this state machine shall send to an ST_TTS state machine that does not have an active task the following and discard the frame:

a) a Request (Send Transport Response) message with the Transport Response arguments;
b) the destination SAS address set to the SAS address from which the invalid frame was received; and
c) the Service Response argument set to Incorrect Logical Unit Number.

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 shall send to an ST_TTS state machine that does not have an active task the following and discard the frame:

a) a Request (Send Transport Response) message with the Transport Response arguments;
b) the destination SAS address set to the SAS address from which the invalid frame was received; and
c) the Service Response argument set to Invalid Frame.

If the frame type is COMMAND or TASK and the fields 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 fields 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 with the following arguments to the SCSI application layer:

a) source SAS address (i.e., the SAS address that transmitted the COMMAND frame);
b) tag;
c) logical unit number;
d) task attribute;
e) task priority;
f) CDB; and
g) additional CDB bytes, if any.

If the frame type is TASK, the fields 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 with the following arguments to the SCSI application layer:

a) source SAS address (i.e., the SAS address that transmitted the TASK frame);

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

If the frame type is DATA, and the tag does not match a tag for an outstanding command performing write operations, then this state machine shall discard the frame.

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

If the frame type is DATA and a target port transfer tag was received in a Transmission Complete (Xfer_Rdy Delivered) message, then this state machine shall check the target port transfer tag. If the target port transfer tag received in the DATA frame does not match the Target Transport Tag argument in the Transmission Complete (Xfer_Rdy Delivered) message, then this state machine shall discard the frame.

If the frame type is DATA and the fields 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 state machine for the request, then this state machine shall send a Data-Out Arrived message to the ST_TTS state machine specified by the tag in the frame. The message shall include the content of the write DATA frame.

8.2.4.3.2.3 Processing transport protocol service requests and responses

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 an ST_TTS state machine that does not have an active task. The message shall include the following Data-In arguments:

a) connection rate;
b) initiator connection tag;
c) destination SAS address (i.e., the SAS address to which the read DATA frame is to be transmitted);
d) tag;
e) device server buffer;
f) request byte count; and
g) application client buffer offset.

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 an ST_TTS state machine that does not have an active task. The message shall include the following Data-Out arguments:

a) connection rate;
b) initiator connection tag;
c) destination SAS address (i.e., the SAS address to which the XFER_RDY frame is to be transmitted);
d) tag;
e) device server buffer;
f) request byte count;
g) application client buffer offset; and
h) target port transfer tag.

If first burst is enabled (see x.x.x), then the Request (Receive Data_Out) message shall also include the Enable First Burst argument and First Burst Size argument. The First Burst Size argument shall be set to first burst size from the Disconnect-Reconnect mode page (see 10.2.6.1.5).

If this state machine receives a Send Command Complete transport protocol service response from the SCSI application layer with the Service Response argument set to TASK COMPLETE or LINKED COMMAND COMPLETE, then this state machine shall send a Request (Send Application Response) message to the ST_TTS state machine specified by the tag. The message shall include the following Application Response arguments:

a) connection rate;
b) initiator connection tag;
c) destination SAS address (i.e., the SAS address to which the RESPONSE frame is to be transmitted);

d) tag;
e) status; and
f) sense data, if any.

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 to the ST_TTS state machine specified by the tag the following:

a) a Request (Send Transport Response) message with the Transport Response arguments; and
b) the Service Response argument set as specified in table 110.

Table 110 specifies which argument to send with Request (Send Transport Response) based on the Service Response argument that was received.

Table 110 — Task Management Function Executed Service Response argument mapping to Service Response argument

Task Management Function Executed protocol service response Service Response argument received	**Request (Send Transport Response) message Service Response argument**
FUNCTION COMPLETE	Task Management Function Complete
FUNCTION SUCCEEDED	Task Management Function Succeeded
FUNCTION REJECTED	Task Management Function Not Supported
INCORRECT LOGICAL UNIT NUMBER	Incorrect Logical Unit Number
SERVICE DELIVERY OR TARGET FAILURE - Overlapped Tag Attempted	Overlapped Tag Attempted

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 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 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_TTS state machine specified by the tag and the Send Data-In protocol service request.

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 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_TTS state machine specified by the tag and the Receive Data-Out protocol service request.

This state machine receives Transmission Complete and Reception Complete messages that may result in this state machine sending a Nexus Loss event notification or a protocol service confirmation to the SCSI application layer. If this state machine receives a Transmission Complete (I_T Nexus Loss) message, then this state machine shall send a Nexus Loss event notification to the SCSI application layer. Table 111 defines

the received messages that require a protocol service confirmation and the corresponding service confirmations that shall be sent upon receipt of the message.

Table 111 — Confirmations sent to the SCSI application layer

Message received from ST_TTS state machine	Protocol service confirmation sent to SCSI application layer
Transmission Complete (Xfer_Rdy Delivered)	None
Transmission Complete (Response Delivered)	None
Transmission Complete (Response Failed) [a]	None
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, ACK/NAK Timeout)	Data-Out Received with the Delivery Result argument set to DELIVERY FAILURE - CONNECTION FAILED
Transmission Complete (Data-In Failed, NAK Received)	Data-In Delivered with the Delivery Result argument set to DELIVERY FAILURE - NAK RECEIVED
Transmission Complete (Data-In Failed, ACK/NAK Timeout)	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
Reception Complete (Data Transfer Terminated)	Data Transfer Terminated

[a] SAM-3 does not define a mechanism for the device server to determine the result of its Send Command Complete and Task Management Function Executed transport protocol service response calls.

Each protocol service confirmation shall include the tag as an argument.

8.2.4.3.2.4 Processing miscellaneous requests and confirmations

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

8.2.4.3.3 ST_TTS (target transport server) state machine

8.2.4.3.3.1 ST_TTS state machine overview

The ST_TTS state machine performs the following functions:

a) receives and processes messages from the ST_TFR state machine;
b) sends messages to the ST_TFR state machine;
c) communicates with the port layer using 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:Target_Start (see 8.2.4.3.3.2) (initial state);
b) ST_TTS2:Target_Send_Frame (see 8.2.4.3.3.3);
c) ST_TTS3:Prepare_Data_In (see 8.2.4.3.3.4);
d) ST_TTS4:Prepare_Xfer_Rdy (see 8.2.4.3.3.5);
e) ST_TTS5:Receive_Data_Out (see 8.2.4.3.3.6); and
f) ST_TTS6:Prepare_Response (see 8.2.4.3.3.7).

This state machine shall start in the ST_TTS1:Target_Start state after power on.

If this state machine receives a HARD_RESET Received confirmation, then this state machine shall transition to the ST_TTS1:Initiator_Start state from any other state.

This state machine shall maintain the state machine variables defined in table 112.

Table 112 — ST_TTS state machine variables

State machine variable	Description
Read Data Offset	Offset into the application client buffer for read data
Balance Point Read Data Offset	Offset into the device server buffer for read data of last DATA frame to have received an ACK Transmitted confirmation
Requested Write Data Offset	Device server requested offset in the application client buffer for write data
Requested Write Data Length	Amount of write data requested by the Device server from the application client buffer

This state machine shall maintain the state machine arguments defined in table 113.

Table 113 — ST_TTS state machine arguments

State machine argument	Description
Data-In	The Data-In arguments received in the Request (Send Data-In) message
Data-Out	The Data-Out arguments received in the Request (Receive Data-Out) message

8.2.4.3.3.2 ST_TTS1:Target_Start state

8.2.4.3.3.2.1 State description

This state is the initial state of an ST_TTS state machine.

This state shall set the following state machine variables to zero:

a) Read Data Offset;
b) Balance Point Read Data Offset; and
c) Requested Write Data offset.

If this state was entered without an Enable First Burst argument, then the Requested Write Data Length state machine variable shall be set to the Request Byte Count Data-Out state machine argument.

If this state was entered with an Enable First Burst argument, then the Requested Write Data Length state machine variable shall be set to the First Burst Size argument.

8.2.4.3.3.2.2 Transition ST_TTS1:Target_Start to ST_TTS3:Prepare_Data_In

This transition shall occur after this state receives a Request (Send Data-In) message from the ST_TFR state machine.

8.2.4.3.3.2.3 Transition ST_TTS1:Target_Start to ST_TTS4:Prepare_Data_Xfer_Rdy

If this state was entered without an Enable First Burst argument, then this transition shall occur after a Request (Receive Data-Out) message is received.

8.2.4.3.3.2.4 Transition ST_TTS1:Target_Start to ST_TTS5:Receive_Data_Out

If this state was entered with an Enable First Burst argument, then this transition shall occur after a Request (Receive Data-Out) message is received.

8.2.4.3.3.2.5 Transition ST_TTS1:Target_Start to ST_TTS6:Prepare_Response

This transition shall occur after this state receives a Request (Send Transport Response) message from the ST_TFR state machine.

This transition shall include the Transport Response arguments.

8.2.4.3.3.3 ST_TTS2:Target_Send_Frame state

8.2.4.3.3.3.1 State description

If this state is entered from the ST_TTS3:Prepare_Data_In state for transmission of a read 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_TTS6:Prepare_Response state for transmission of a RESPONSE frame, then this state shall send a Transmit Frame (Interlocked) request to the port layer.

All Transmit Frame requests from this state shall include the read DATA frame from the ST_TTS3:Prepare_Data_In state, the XFER_RDY frame from the ST_TTS4:Prepare_Xfer_Rdy state, or the RESPONSE frame from the ST_TTS6:Prepare_Response state and the following arguments to be used for any OPEN address frame:

a) 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 or argument is Transmission Status (I_T Nexus Loss), then this state shall send a Transmission Complete (I_T Nexus Loss) message to the ST_TFR state machine. The Transmission Complete message shall include the tag as an argument.

If the confirmation or argument is not Transmission Status (Frame Transmitted) or Transmission Status (I_T Nexus Loss), then this state shall send the Transmission Complete message defined in table 114 to the ST_TFR state machine. The message shall include the following arguments:

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

If the confirmation is Transmission Status (Frame Transmitted) and the Transmit Frame request was for:

a) an XFER_RDY frame; or
b) a RESPONSE frame,

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).

If the confirmation or argument is Transmission Status (Frame Transmitted), the Transmit Frame request was for a read DATA frame, and the Read Data Offset state machine variable is equal to the Request Byte Count Data-In argument, then this state shall wait to receive:

a) Transmission Status (ACK Received) confirmations or arguments for each outstanding read DATA frame; or
b) one of the following:
   A) Transmission Status (NAK Received);
   B) Transmission Status (ACK/NAK Timeout); or
   C) Transmission Status (Connection Lost Without ACK/NAK).

NOTE 51 - If the number of data bytes that have been transmitted for a Request (Send Data-In) message are fewer than the Data-In Request Byte Count argument, then this state transitions to the ST_TTS3:Prepare_Data_In state to construct the additional read 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.

If a confirmation of Transmission Status (ACK Received) is received and the Transmit Frame request was for a read DATA frame, then this state shall set the Balance Point Read Data Offset state machine variable to the current balance point read data offset plus the Read Data Offset state machine variable.

If a confirmation of Transmission Status (Frame Transmitted) is received and the Transmit Frame request was for a read DATA frame, then this state shall set the Read Data Offset state machine variable to the current read data offset plus the number of read data bytes in the transmitted read DATA frame. The Read Data Offset state machine variable shall be adjusted before checking if the data transfer is complete.

If transport layer retries are enabled, the Transmit Frame request was for a RESPONSE frame, the vendor-specific number of retries has not been reached, and this state receives 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),

then this state shall:

a) set the RETRANSMIT bit to one; and
b) resend a Transmit Frame (Interlocked) request to the port layer for the failed RESPONSE frame.

If transport layer retries are enabled, the Transmit Frame request was for a XFER_RDY frame, the vendor-specific number of retries has not been reached, and this state receives 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),

then this state shall:

a) set the RETRANSMIT bit to one;
b) set the value in the TARGET PORT TRANSFER TAG field to a value that is different than the target port transfer tag in the previous XFER_RDY frame associated with the Data-out arguments and is different than any other target port transfer tag currently in use. If write 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; and
c) resend a Transmit Frame (Interlocked) request to the port layer for the failed XFER_RDY frame.

Table 114 defines the messages that this state shall send to the ST_TFR state machine upon receipt of the listed confirmations, based on the conditions under which each confirmation was received.

Table 114 — Messages sent to the ST_TFR state machine

Confirmation received from the port layer	Conditions under which confirmation was received	Message sent to the ST_TFR state machine
Transmission Status (ACK Received)	The Transmit Frame request was for an XFER_RDY frame.	Transmission Complete (Xfer_Rdy Delivered) with a Target Port Transfer Tag argument
	Transmit Frame request was for a RESPONSE frame	Transmission Complete (Response Delivered)
	The Transmit Frame request was for a read DATA frame and: a) the Read Data Offset state machine variable is equal to the Data-In Request Byte Count argument; and b) the Read Data Offset state machine variable is equal to the Balance Point Read Data Offset state machine variable.	Transmission Complete (Data-In Delivered)
Transmission Status (NAK Received), Transmission Status (ACK/NAK Timeout), or Transmission Status (Connection Lost Without ACK/NAK)	The Transmit Frame request was for a RESPONSE frame and the vendor-specific number of retries has been reached.	Transmission Complete (Response Failed)
Transmission Status (NAK Received)	The Transmit Frame request was for an XFER_RDY frame and: a) if transport layer retries is disabled (see x.x.x); or b) if transport layer retries is enabled and 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)		Transmission Complete (Xfer_Rdy Failed, Connection Failed)
Transmission Status (NAK Received)	The Transmit Frame request was for a read DATA frame and: a) if transport layer retries is disabled (see x.x.x); or b) if transport layer retries is enabled and the vendor-specific number of retries has been reached.	Transmission Complete (Data-In Failed, NAK Received)
Transmission Status (ACK/NAK Timeout) or Transmission Status (Connection Lost Without ACK/NAK)		Transmission Complete (Data-In Failed, Connection Failed)

If this state receives a Cancel message or a Cancel argument and this state has received confirmations for all Transmit Frame requests sent to the port layer, then this state shall send a Transmission Complete (Data Transfer Terminated) message to the ST_TFR state machine.

If this state receives a Cancel message or a Cancel argument 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. The Cancel request shall include the following arguments:

a) destination SAS address; and
b) tag.

Upon receipt of a Transmission Status (Cancel Acknowledged) confirmation this state shall send a Transmission Complete (Data Transfer Terminated) message to the ST_TFR state machine.

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

a) destination SAS address; and
b) tag.

8.2.4.3.3.3.3 Transition ST_TTS2:Target_Send_Frame to ST_TTS1:Target_Start

This transition shall occur after this state has sent a Transmission Complete message other than Transmission Complete (Xfer_Rdy Delivered) to the ST_TFR state machine.

8.2.4.3.3.3.4 Transition ST_TTS2:Target_Send_Frame to ST_TTS3:Prepare_Data_In

This transition shall occur after this state receives a Transmission Status (Frame Transmitted) confirmation for a read DATA frame and Read Data Offset state machine variable is less than the Request Byte Count Data-In argument.

If transport layer retries is enabled and the vendor-specific number of retries, if any, for the read DATA frame has not been reached, this transition shall occur and include a Retry argument after this state receives one of the following confirmations for a read DATA frame:

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

8.2.4.3.3.3.5 Transition ST_TTS2:Target_Send_Frame to ST_TTS5:Receive_Data_Out

This transition shall occur after this state sends a Transmission Complete (Xfer_Rdy Delivered) message to the ST_TFR state machine.

8.2.4.3.3.4 ST_TTS3:Prepare_Data_In state

8.2.4.3.3.4.1 State description

This state retrieves the data from the Device Server Buffer and constructs a read DATA frame.

This state shall construct a read DATA frame using the Data-In arguments (see 8.2.4.3.2) as follows:

a) FRAME TYPE field set to 01h (i.e., DATA frame);
b) HASHED DESTINATION SAS ADDRESS field set to the hashed value of the Destination SAS Address Data-In argument;
c) HASHED SOURCE SAS ADDRESS field set to the hashed value of the SSP target port's SAS address;
d) RETRY DATA FRAMES bit set to zero;
e) RETRANSMIT bit set to zero;
f) CHANGING DATA POINTER set as specified in this subclause;
g) NUMBER OF FILL BYTES field set to the number of fill bytes needed for the specified read data;
h) TAG field set to the Tag Data-In argument;
i) TARGET PORT TRANSFER TAG field set to zero;
j) DATA OFFSET field set as specified in this subclause; and
k) in the information unit, DATA field set as specified in this subclause; and
l) fill bytes, if required.

If this state is entered without a Retry argument then this state shall:

a) set the CHANGING DATA POINTER bit set to zero; and
b) set the DATA OFFSET field to the Read Data Offset state machine variable;
c) in the information unit, set the DATA field to the data at the pointed to by the Read Data Offset state machine variable in the specified device server buffer with the length being the lesser of:
   A) the Data-In Request Byte Count argument minus the Read Data Offset state machine variable; and
   B) the maximum size of the DATA information unit.

If this state is entered with a Retry argument then this state shall:

a) set the CHANGING DATA POINTER bit in the frame to one; and
b) set the DATA OFFSET field to Balance Point Read Data Offset state machine variable
c) in the information unit, set the DATA field to the data at the pointed to by the Balance Point Read Data Offset state machine variable in the specified device server buffer with the length being the lesser of:
   A) the Data-In Request Byte Count argument minus the Balance Point Read Data Offset state machine variable; and
   B) the maximum size of the DATA information unit.

If a confirmation of Transmission Status (ACK Received) is received, then this state shall set the Balance Point Read Data Offset state machine variable to the current balance point read data offset plus the Read Data Offset state machine variable.

If a confirmation of Transmission Status (Frame Transmitted) is received, then this state shall set the Read Data Offset state machine variable to the current read data offset plus the number of read data bytes in the transmitted read DATA frame.

8.2.4.3.3.4.2 Transition ST_TTS3:Prepare_Data_In to ST_TTS2:Target_Send_Frame

This transition shall occur after this state:

a) constructs a read DATA frame; or
b) receives a Cancel message.

This transition shall include the received Transmission Status, if any, as an argument and the:

a) read DATA frame as an argument; or
b) if a Cancel message was received, then a Cancel argument.

8.2.4.3.3.5 ST_TTS4:Prepare_Xfer_Rdy state

8.2.4.3.3.5.1 State description

This state shall construct an XFER_RDY frame using the Data-Out state machine arguments:

a) FRAME TYPE field set to 05h (i.e., XFER_RDY frame);
b) HASHED DESTINATION SAS ADDRESS field set to the hashed value of the Destination SAS Data-Out address argument;
c) HASHED SOURCE SAS ADDRESS field set to the hashed value of the SSP target port's SAS address;
d) RETRY DATA FRAMES bit set to the value of the TRANSPORT LAYER RETRIES bit in the Protocol-Specific Logical Unit mode page (see 10.2.6.3);
e) set the RETRANSMIT bit set to zero;
f) CHANGING DATA POINTER bit set to zero;
g) NUMBER OF FILL BYTES field set to zero;
h) TAG field set to the Tag Data-Out argument;
i) TARGET PORT TRANSFER TAG field set to a vendor-specific value, unless the TRANSPORT LAYER RETRIES bit is set to one in the Protocol-Specific Logical Unit mode page (see x.x.x), then set the TARGET PORT TRANSFER TAG field to a value that is different than the target port transfer tag in the previous XFER_RDY frame associated with the Data-Out arguments and is different from any other target port transfer tag currently in use. If write 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;
j) DATA OFFSET field set to zero; and
k) in the information unit, REQUESTED OFFSET field set to the Requested Write Data Offset state machine variable;
l) in the information unit, WRITE DATA LENGTH field set as specified in this subclause; and
m) no fill bytes.

If the SSP target port determines all the write data indicated in the Requested Write Data Length state machine variable is able to be requested by this XFER_RDY frame, then set the WRITE DATA LENGTH field in the information unit to the Requested Write Data Length state machine variable.

If the SSP target port determines all the write data indicated in the Requested Write Data Length state machine variable is not able to be requested by this XFER_RDY frame (e.g., the SSP target port has a vender specific limit), then set the WRITE DATA LENGTH field in the information unit and the Requested Write Data Length state machine variable to a value representing the amount of write data that is able to be transferred.

8.2.4.3.3.5.2 Transition ST_TTS4:Prepare_Xfer_Rdy to ST_TTS2:Target_Send_Frame

This transition shall occur after this state:

a) constructs an XFER_RDY frame; or
b) receives a Cancel message.

This transition shall include the:

a) if a Cancel message was received, then a Cancel argument; or
b) XFER_RDY frame as an argument.

8.2.4.3.3.6 ST_TTS5:Receive_Data_Out state

8.2.4.3.3.6.1 State description

On entry into this state the Write Data Received variable is set to the Requested Write Data Offset state machine variable.

If this state receives a Data-Out Arrived message, then this state shall verify the write DATA frame received with the Data-Out Arrived values as specified in table 115. If the verification test fails, then this state sends the message specified in table 115 to the ST_TFR state machine.

Table 115 — Reception Complete message for write DATA frame verification failures

Message sent to ST_TFR [a]	Condition
Reception Complete (Data Offset Error)	Transport layer retries are not supported, and the DATA OFFSET field is not equal to the Write Data Received variable.
	The DATA OFFSET field is: a) less than the Requested Write Data Offset state machine variable; or b) greater than or equal to the Requested Write Data Offset state machine variable plus the Requested Write Data Length state machine variable.
Reception Complete (Too Much Write Data)	The number of bytes in the DATA field plus the Write Data Received variable is greater than the Request Byte Count Data-Out state machine argument.
Reception Complete (Information Unit Too Short)	The number of bytes in the DATA field is zero.

[a] If more than one condition is true that result in a different messages, then the state shall select which message to send to the ST_TFR state machine using the following order:
1) Reception Complete (Data Offset Error);
2) Reception Complete (Too Much Write Data); or
3) Reception Complete (Information Unit Too Short).

If:

a) transport layer retries are supported;
b) the CHANGING DATA POINTER bit is set to zero; and
c) the value in the DATA OFFSET field is not equal to the Write Data Received variable,

then this state should discard all Data-Out Arrived messages until the CHANGING DATA POINTER bit is set to one. This state shall resume processing additional Data-Out Arrived messages when it receives a Data-Out Arrived message with the CHANGING DATA POINTER bit set to one.

If the WRITE data frame is verification is successful and the Data-Out Arrived message in not discarded, then this state shall:

a) set the Write Data Received variable to the current Write Data Received variable plus the number of bytes received in the DATA field of the write information unit; and
b) process the write data as indicated in the Data-Out state machine arguments using the Device Server Buffer (e.g., logical block address) to which the write data is to be transferred.

If the WRITE data frame is verification is successful and the CHANGING DATA POINTER bit set to one, then this state shall:

a) set the Write Data Received variable to the Requested Write Data Offset state machine variable; and
b) process the write data as indicated in the Data-Out state machine arguments using the Device Server Buffer (e.g., logical block address) to which the write data is to be transferred.

If the Initiator Response Timeout timer is implemented, then this state shall initialize and start the Initiator Response Timeout timer:

a) upon entry into this state; and
b) when this state receives and verifies the write DATA frame received with the Data-Out Arrived values (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 state machine.

If Write Data Received variable equals the Request Byte Count Data-Out state machine argument, then this state shall send a Reception Complete (Data-Out Received) message to the ST_TFR state machine after a Reception Complete (ACK Transmitted) confirmation is received for each write DATA frame previously received.

If this state receives a Cancel message, then this state shall send a Reception Complete (Data Transfer Terminated) message to the ST_TFR state machine.

The Reception Complete message, if any, shall include the tag as an argument.

8.2.4.3.3.6.2 Transition ST_TTS5:Receive_Data_Out to ST_TTS1:Target_Start

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

8.2.4.3.3.6.3 Transition ST_TTS5:Receive_Data_Out to ST_TTS4:Prepare_Xfer_Rdy

This transition shall occur:

1) if the Write Data Received variable is less than Request Byte Count Data-Out state machine argument and equal to the Requested Write Data Offset state machine variable plus the Requested Write Data Length state machine variable;
2) a Reception Complete (ACK Transmitted) confirmation is received for each write DATA frame previously received;
3) setting the Requested Write Data Length state machine variable to the Request Byte Count Data-Out state machine argument minus the Requested Write Data Offset state machine variable; and
4) setting the Requested Write Data Offset state machine variable to the Write Data Received state machine variable.

8.2.4.3.3.7 ST_TTS6:Prepare_Response state

8.2.4.3.3.7.1 State description

This state shall construct a RESPONSE frame using the received Application Response arguments or the received Transport Response arguments as follows:

a) FRAME TYPE field set to 07h (i.e., RESPONSE frame);
b) HASHED DESTINATION SAS ADDRESS field set to the hashed value of the Application Response or Transport Response destination SAS address argument;
c) HASHED SOURCE SAS ADDRESS field set to the hashed value of the SSP target port's SAS address;
d) RETRY DATA FRAMES bit set to zero;
e) RETRANSMIT bit set to zero;
f) CHANGING DATA POINTER bit set to zero;
g) TAG field set to the Tag Application Response argument or the Tag Transport Response argument;
h) TARGET PORT TRANSFER TAG field set to zero;
i) DATA OFFSET field set to zero;
j) information unit set as specified in this subclause; and
k) fill bytes, if needed as specified in this subclause.

If this state was entered with the Transport Response arguments, then this state shall set the fields as follows:

a) NUMBER OF FILL BYTES field set to the number of fill bytes, based on the length of the response data, if any;
b) in the information unit, set the DATAPRES field to RESPONSE DATA;
c) in the information unit, set the STATUS field to zero;
d) in the information unit, set the SENSE DATA LENGTH field to zero;
e) in the information unit, set the RESPONSE DATA LENGTH field to 00000004h;
f) in the information unit, set the RESPONSE DATA field as specified in table 116;
g) in the information unit, do not include the SENSE DATA field; and
h) NUMBER OF FILL BYTES field set to the number of fill bytes, based on the length of the response data, if needed.

Table 116 specifies how the RESPONSE DATA field shall be set based on the arguments received with the Request (Send Transport Response) message.

Table 116 — Request argument to RESPONSE frame RESPONSE DATA field mapping

Request argument	RESPONSE frame RESPONSE DATA field
Invalid Frame	INVALID FRAME
Function Complete	TASK MANAGEMENT FUNCTION COMPLETE
Function Succeeded	TASK MANAGEMENT FUNCTION SUCCEEDED
Function Not Supported	TASK MANAGEMENT FUNCTION NOT SUPPORTED
Function Failed	TASK MANAGEMENT FUNCTION FAILED
Incorrect Logical Unit Number	INCORRECT LOGICAL UNIT NUMBER
Overlapped Tag Attempted	OVERLAPPED TAG ATTEMPTED

If this state was entered with the Application Response arguments, then this state shall set the fields as follows:

a) in the information unit, set the DATAPRES field to SENSE_DATA if sense data is specified or NO_DATA if sense data is not specified;
b) in the information unit, set the STATUS field to the specified status;
c) in the information unit, set the SENSE DATA LENGTH field to the length of the specified sense data, if any;
d) in the information unit, set the RESPONSE DATA LENGTH field to zero;

e) in the information unit, do not include the RESPONSE DATA field;
f) in the information unit, set the SENSE DATA field to the specified sense data, if any; and
g) NUMBER OF FILL BYTES field set to the number of fill bytes, based on the length of the specified sense data, if needed.

8.2.4.3.3.7.2 Transition ST_TTS6:Prepare_Response to ST_TTS2:Target_Send_Frame

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

This transition shall include:

a) the RESPONSE frame; or
b) if a Cancel message was received, then a Cancel argument.

Sections with all deletes and adds marked

8.2.5 ST (transport layer for SSP ports) state machines

8.2.5.1 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 following confirmations between the ST state machines and the port layer:

a) Transmission Status; and
b) Frame Received;

include the following as arguments:

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

and are used to route the confirmations to the correct ST state machines.

NOTE 52 - Although allowed by this standard, the ST state machines do not handle bidirectional commands that result in concurrent write DATA frames and read DATA frames.

8.2.5.2 ST_I (transport layer for SSP initiator ports) state machines

8.2.5.2.1 ST_I state machines overview

The ST_I state machines are as follows:

a) ST_IFR (initiator frame router) state machine (see 8.2.4.2.2); and
b) ST_ITS (initiator transport server) state machine (see 8.2.4.2.3).

The SAS initiator port shall include:

a) one ST_IFR state machine; and
b) one ST_ITS state machine for each possible task and task management function (i.e., for each tag).

Figure 149 shows the ST_I state machines.

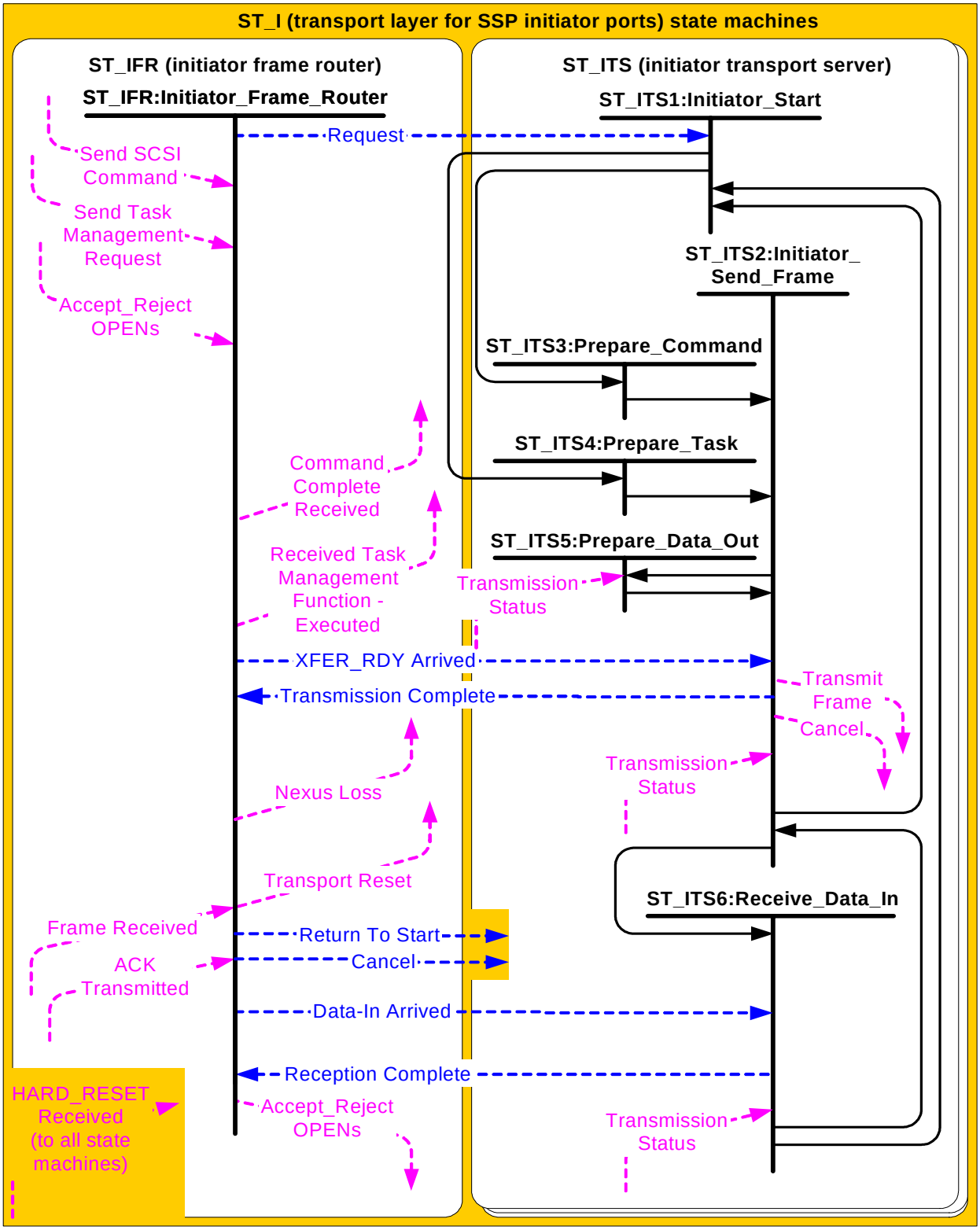

Figure 151 — ST_I (transport layer for SSP initiator ports) state machines

Editor's Note 16: Added Data-In Arrived message into ST_ITS7 and Transmission Status confirmation into ST_ITS5 to allow for non-interlocked DATA frame transfers. Changed Cancel

message to go to all states. Added a Return To Start message to all states. Deleted ST_ITS7. Added transition from ST_ITS1 to ST_ITS3 and ST_ITS4. Deleted transition from ST_ITS2 to ST_ITS3 and from ST_ITS2 to ST_ITS4.

8.2.5.2.2 ST_IFR (initiator frame router) state machine

The ST_IFR state machine performs the following functions:

a) receives Send SCSI Command and Send Task Management transport protocol service requests from the SCSI application layer;
b) sends messages to the ST_ITS state machine;
c) receives messages from the ST_ITS state machine;
d) receives confirmations from the port layer;
e) sends transport protocol service confirmations to the SCSI application layer;
f) receives vendor specific requests from the SCSI application layer;
g) sends vendor specific confirmations to the SCSI application layer;
h) receives Accept_Reject OPENs requests from the SCSI application layer;
i) sends Accept_Reject OPENs requests to the port layer;
j) sends I_T Nexus Loss event notifications to the SCSI application layer; and
k) sends Transport Reset event notifications to the SCSI application layer.

This state machine consists of one state.

This state machine shall be started after power on.

8.2.5.2.2.1 Processing transport protocol service requests

If this state machine receives a Send SCSI Command transport protocol service request then this state machine shall send a Request (Send Command) message with ~~the following~~ Command arguments and Buffer arguments to the ~~ST_ITS1:Initiator_Start state in an~~ ST_ITS state machine ~~that does not have an active task:~~ for the specified tag.

The following is the list of Command arguments:

a) connection rate;
b) initiator connection tag;
c) destination SAS address;
d) source SAS address set to the SAS address of the SSP initiator port;
e) tag;
f) logical unit number;
~~g)~~ ~~enable first burst value;~~
h) task priority;
i) task attribute;
j) additional CDB length;
k) CDB; and
l) additional CDB bytes, if any.

The following is the list of Buffer arguments:

a) data-in buffer size;
b) data-out buffer; and
c) data-out buffer size.

If the ~~message~~ command is ~~a Request (Send Command) message for~~ performing a ~~command performing~~ write operations and first burst is enabled (see 9.2.2.1), then the Request (Send Command) message shall also include the Enable First Burst argument and the number of bytes for the ~~first burst size as an~~ First Burst Size argument.

If this state machine receives a Send Task Management Request transport protocol service request, then this state machine shall send a Request (Send Task) message with the following Task arguments to the

~~ST_ITS1:Initiator_Start state in an~~ ST_ITS state machine ~~that does not have an active task~~for the specified tag:

a) connection rate;
b) initiator connection tag;
c) destination SAS address;
d) retransmit bit;
e) tag;
f) logical unit number;
g) task management function; and
h) tag of task to be managed.

If the ST_ITS state machine for the tag specified in the Send Task Management Request is currently in use, then set the retransmit bit argument to one. If the ST_ITS state machine for the tag specified in the Send Task Management Request is not currently in use, then set the Retransmit Bit argument to zero.

8.2.5.2.2.2 Processing Frame Received confirmations

If this state machine receives a Frame Received (ACK/NAK Balanced) confirmation or Frame Received (ACK/NAK Not Balanced) confirmation, then this state machine shall ~~check~~ compare the frame type ~~in~~ of the frame received ~~as an argument~~ with the received confirmation (see table 104 in 9.2.1). 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. 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.

If the frame type is correct relative to the Frame Received 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 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.~~shall:

a) discard the frame; and
b) may send a vendor-specific confirmation to the SCSI application layer to cause the command using that tag to be aborted.

If the frame type is XFER_RDY 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 discard the frame.~~shall:

a) discard the frame; and
b) may send a vendor-specific confirmation to the SCSI application layer to cause the command using that tag to be aborted.

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

a) discard the frame;
b) send a Command Complete Received transport protocol service confirmation with the Delivery Result argument set to Service Delivery or Target Failure - DATA Not Expected to the SCSI application layer; and
c) if there is an ST_ITS state machine for the tag, send a Return To Start message to that state machine.

If the frame type is DATA and the tag is for a task with no read data, then this state machine shall:

a) discard the frame;
b) send a Command Complete Received transport protocol service confirmation with the Delivery Result argument set to Service Delivery or Target Failure - DATA Not Expected to the SCSI application layer; and
c) if there is an ST_ITS state machine for the tag, send a Return To Start message to that state machine.

If the frame type is RESPONSE then this state machine shall check the length of the information unit. If the length of the information unit is not correct and the RESPONSE frame was for a command, then this state shall discard the frame and send a Command Complete Received confirmation to the SCSI application layer with the Service Response argument set to Service Delivery or Target Failure. If the length of the information unit is not correct and the RESPONSE frame was for a task management function, then this state shall

discard the frame and send a Received Task Management Function – Executed confirmation to the SCSI application layer with the Service Response argument set to Service Delivery or Target Failure.

If the frame type is correct relative to the Frame Received confirmation, then this state machine shall check the tag. If the tag does not specify a valid ST_ITS state machine, then this state machine shall discard the frame and may send a vendor-specific confirmation to the SCSI application layer to cause the command using that tag to be aborted.

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

a) discard the frame;
b) send a Command Complete Received transport protocol service confirmation with the Delivery Result argument set to Service Delivery or Target Failure - XFER_RDY Not Expected to the SCSI application layer; and
c) if there is an ST_ITS state machine for the tag, send a ~~Cancel~~ Return To Start message to that state machine.

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

If the frame type is RESPONSE, the ~~items~~ fields checked in the frame are correct, and this state machine has not received a RESPONSE frame for this I_T_L_Q nexus, then ~~this state machine shall~~ send a ~~protocol service confirmation~~ Return To Start message to ~~the SCSI application layer based on the content of the DATAPRES and RESPONSE DATA fields. If the RESPONSE frame was for a command, then the delivery result and other arguments sent with the Command Complete Received protocol service confirmation are defined in 10.2.1.5. If the RESPONSE frame was for a task management request, then the delivery result and other arguments sent with the Received Task Management Function – Executed protocol service confirmation are defined in 10.2.1.14.~~ that state machine and:

a) if the RESPONSE frame was for a command, then send a Command Complete Received protocol service confirmation to the SCSI application layer with the arguments set as specified in table xxx (see 10.2.1.5); or
b) if the RESPONSE frame was for a task management request, then send a Received Task Management Function Executed protocol service confirmation to the SCSI application layer with the arguments set as specified in table xxx (see 10.2.1.5).

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

If this state machine receives an ACK Transmitted confirmation for an XFER_RDY frame, then this state machine shall send an XFER_RDY Arrived message to ~~the ST_ITS2:Initiator_Send_Frame state in the~~ ST_ITS state machine specified by the tag. The message shall include the following Xfer_Rdy arguments:

a) ~~the~~ retry data ~~frames bit~~frames;
b) ~~the~~ retransmit bit;
c) target port transfer tag;
d) ~~the target port transfer tag~~requested offset; and
~~e) the information unit.~~
f) write data length.

If the frame type is DATA and the ~~items~~ fields checked in the frame are correct, then this state machine shall send a Data-In Arrived message to ~~the ST_ITS6:Receive_Data_In state in~~ the ST_ITS state machine specified by the tag. The message shall include the ~~content of the SSP frame.~~following Read Data arguments:

a) changing data pointer;
b) number of fill bytes;
c) data offset; and
d) data.

8.2.5.2.2.3 Processing Transmission Complete and Reception Complete messages

~~This~~ If this state ~~machine~~ receives a Transmission Complete ~~messages and Reception Complete messages from the ST_ITS state machines that may result in~~ (I_T Nexus Loss), then this state machine ~~sending one of the following~~ shall send a Nexus Loss event notification to the SCSI application layer~~:~~.

~~a) an I_T Nexus Loss event notification;~~
~~b) a Command Complete protocol service confirmation; or~~
~~c) a Received Task Management Function - Executed protocol service confirmation.~~

~~If this state receives a Transmission Complete (I_T Nexus Loss) from an ST_ITS state machine, then this state machine shall send an I_T Nexus Loss event notification to the SCSI application layer.~~

Table 103 defines other messages received from ST_ITS state machines that require a protocol service confirmation and the Delivery Result argument sent with the corresponding service confirmation that shall be sent upon receipt of the message.

Table 117 — Arguments sent with confirmations based on messages received

Message received from ST_ITS state machine	Protocol service confirmation and Delivery Result argument sent to the SCSI application layer
Transmission Complete (Command Delivered)	Command Complete Received (Task Complete)
Transmission Complete (Data-Out Delivered)	Command Complete Received (Task Complete)
Transmission Complete (Command Failed, Connection Failed)	Command Complete Received (Service Delivery or Target Failure - Connection Failed)
Transmission Complete (Command Failed, NAK Received)	Command Complete Received (Service Delivery or Target Failure - NAK Received)
Transmission Complete (Task Delivered)	Received Task Management Function - Executed with the service response argument based on the content of the corresponding RESPONSE frame (see 10.2.1.14)
Transmission Complete (Task Failed, Connection Failed)	Received Task Management Function - Executed (Service Delivery or Target Failure - Connection Failed)
Transmission Complete (Task Failed, NAK Received)	Received Task Management Function - Executed (Service Delivery or Target Failure - NAK Received)
Transmission Complete (XFER_RDY Incorrect Write Data Length)	Command Complete Received (Service Delivery or Target Failure - XFER_RDY Incorrect Write Data Length)
Transmission Complete (XFER_RDY Requested Offset Error)	Command Complete Received (Service Delivery or Target Failure - XFER_RDY Requested Offset Error)
Reception Complete (Data-In Received)	Command Complete Received (Task Complete)
Reception Complete (Data Offset Error)	Command Complete Received (Service Delivery or Target Failure - DATA Offset Error)
Reception Complete (Too Much Read Data)	Command Complete Received (Service Delivery or Target Failure - DATA Too Much Read Data)
Reception Complete (Incorrect Data Length)	Command Complete Received (Service Delivery or Target Failure - DATA Incorrect Data Length)
Reception Complete (Command Failed, Connection Failed)	Command Complete Received (Service Delivery or Target Failure - Connection Failed)

Table 103 defines the transport protocol service confirmation and its argument generated as a result of receiving a Transmission Complete message or a Reception Complete message.

Table 118 — Confirmations sent to the SCSI application layer

Message received from ST_ITS state machine	Protocol service confirmation and Delivery Result argument sent to the SCSI application layer
Transmission Complete (Command Failed, ACK/NAK Timeout)	Command Complete Received (Service Delivery or Target Failure - ACK/NAK Timeout)
Transmission Complete (Command Failed, NAK Received)	Command Complete Received (Service Delivery or Target Failure - NAK Received)
Transmission Complete (Task Failed, ACK/NAK Timeout)	Received Task Management Function - Executed (Service Delivery or Target Failure - ACK/NAK Timeout)
Transmission Complete (Task Failed, NAK Received)	Received Task Management Function - Executed (Service Delivery or Target Failure - NAK Received)
Transmission Complete (XFER_RDY Incorrect Write Data Length)	Command Complete Received (Service Delivery or Target Failure - XFER_RDY Incorrect Write Data Length)
Transmission Complete (XFER_RDY Requested Offset Error)	Command Complete Received (Service Delivery or Target Failure - XFER_RDY Requested Offset Error)
Transmission Complete (Cancel Acknowledged)	Command Complete Received (Service Delivery or Target Failure - Cancel Acknowledged)
Reception Complete (Data Offset Error)	Command Complete Received (Service Delivery or Target Failure - DATA Offset Error)
Reception Complete (Too Much Read Data)	Command Complete Received (Service Delivery or Target Failure - DATA Too Much Read Data)
Reception Complete (Information Unit Too Short)	Command Complete Received (Service Delivery or Target Failure - DATA Information Unit Too Short)
Reception Complete (Command Failed, ACK/NAK Timeout)	Command Complete Received (Service Delivery or Target Failure - ACK/NAK Timeout)

The protocol service confirmation shall include the tag as an argument.

8.2.5.2.2.4 Processing miscellaneous requests

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

This state machine may receive vendor specific requests from the SCSI application layer that cause this state machine to send a Cancel ~~messages~~ message to an ST_ITS state ~~machines~~machine.

8.2.5.2.3 ST_ITS (initiator transport server) state machine

8.2.5.2.3.1 ST_ITS state machine overview

The ST_ITS state machine performs the following functions:

a) receives and processes messages from the ST_IFR state machine;
b) sends messages to the ST_IFR state machine;
c) sends request to the port layer regarding frame transmission;

d) receives confirmations from the port layer regarding frame transmission; and
e) receives HARD_RESET Received confirmations from the port layer.

This state machine consists of the following states:

a) ST_ITS1:Initiator_Start state (see 8.2.4.2.3.2) (initial state);
b) ST_ITS2:Initiator_Send_Frame state (see 8.2.4.2.3.3);
c) ST_ISF3:Prepare_Command state (see 8.2.4.2.3.4);
d) ST_ITS4:Prepare_Task state (see 8.2.4.2.3.5);
e) ST_ITS5:Prepare_Data_Out state (see 8.2.4.2.3.6)~~;~~; and
f) ST_ITS6:Receive_Data_In state (see 8.2.4.2.3.7)~~; and~~.
~~g) ST_ITS7:Process_Data_In state (see 8.2.5.2.3.8).~~

~~All ST_ITS~~ This state ~~machines~~ machine shall ~~be started~~ start in the ST_ITS1:Initiator_Start state after power on~~. There shall be one ST_ITS state machine for each possible task or task management function for the SAS initiator port~~.

~~If transport layer retries are enabled, this state machine shall retain the data offset for the last XFER_RDY frame received, for use as the restart point in case of a retry for write DATA frames.~~

If this state machine receives a HARD_RESET Received confirmation, then this state machine shall transition to the ST_ITS1:Initiator_Start state from any other state.

This state machine shall maintain the state machine variables defined in table 104.

Table 119 — ST_ITS state machine variables

State machine variable	Description
Data-In Buffer Offset	Current offset in the data-in buffer for read data
Data-Out Buffer Offset	Current offset in the data-out buffer for write data
Previous Requested Offset	Data offset from the last XFER_RDY frame received
Previous Write Data Length	Write data length from the last XFER_RDY frame received

This state machine shall maintain the state machine arguments defined in table 105.

Table 120 — ST_ITS state machine arguments

State machine argument	Description
Command	Consists of the Command arguments received in the Request (Send Command) message
Task	Consists of the arguments received in the Request (Send Task) message
Xfer_Rdy	Consists of the arguments received in the XFER_RDY Arrived message
Data-Out Buffer	The location of the write data buffer
Data-Out Buffer size	The size in bytes of the write data buffer
Data-In Buffer size	The size in bytes of the read data buffer

8.2.5.2.3.2 ST_ITS1:Initiator_Start state

8.2.5.2.3.2.1 State description

This state is the initial state of an ST_ITS state machine.

This state shall set the following state machine variables to zero:

a) Data-In Buffer Offset; and
b) Data-Out Buffer Offset.

8.2.5.2.3.2.2 Transition ST_ITS1:Initiator_Start to ST_ITS3:Prepare_Command

This transition shall occur after this state receives a Request (Send Command) message.

8.2.5.2.3.2.3 Transition ST_ITS1:Initiator_Start to ~~ST_ITS2~~ST_ITS4:~~Initiator_Send_Frame~~Prepare_Task

This transition shall occur after this state receives a Request ~~message from the ST_IFR state machine~~(Send Task) message.

8.2.5.2.3.3 ST_ITS2:Initiator_Send_Frame state

8.2.5.2.3.3.1 State description

If this state is entered from the ST_ITS3:Prepare_Command state for transmission of a COMMAND frame, then this state shall send a Transmit Frame (Interlocked) request to the port layer.

If this state is entered from the ST_ITS6:Receive_Data_In state, and the vendor-specific number of retries has not been reached for the COMMAND ~~frame~~frame requesting a read operation, then this state shall send a Transmit Frame (Interlocked) request to the port layer.

If this state is entered from the ST_ITS4:Prepare_Task state for transmission of an TASK frame, then this state shall send a Transmit Frame (Interlocked) request to the port layer.

If this state is entered from the ~~ST_ITS7~~ST_ITS5:Prepare_Data_Out state for transmission of a write DATA frame, then this state shall send a Transmit Frame (Non-Interlocked) request to the port layer if:

a) this state has received an XFER_RDY Arrived message; or
b) first burst is enabled and this state has received a Transmission Status (Frame Transmitted) confirmation and a Transmission Status (ACK Received) confirmation for the COMMAND frame.

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

A Transmit Frame request shall include the COMMAND frame from the ST_ITS3:Prepare_Command state or from the ST_ITS6:Receive_Data_In state, the TASK frame from the ST_ITS4:Prepare_Task state, or the write DATA frame from the ST_ITS5:Prepare_Data_Out state and the following arguments to be used for any OPEN address frame:

a) 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 this state shall wait ~~for~~ 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_IFR state machine. This Transmission Complete message shall include the tag as an argument.

If the confirmation is not Transmission Status (Frame Transmitted) or Transmission Status (I_T Nexus Loss) (see table xxx in 8.2.2.3.4), and the Transmit Frame request was for a COMMAND frame or a DATA frame, then this state shall send a Transmission Complete (~~I_T Nexus Loss~~Command Failed, Connection Failed)

message to the ST_IFR state machine. ~~This Transmission Complete~~ The message shall include the ~~tag as an argument~~tag.

If ~~this state machine receives a~~ the confirmation ~~that~~ is not Transmission Status (Frame Transmitted) or Transmission Status (I_T Nexus Loss) (see ~~table 105~~ table xxx in ~~8.2.2.3.4~~8.2.2.3.4), and the Transmit Frame request was for a TASK frame, then this state shall send a Transmission Complete (Task Failed, Connection Failed) message to the ST_IFR state machine. The message shall include the ~~following arguments:~~tag.

~~a) any argument received with the Transmission Status confirmation; and~~
~~b) the tag.~~

If the confirmation is Transmission Status (Frame Transmitted), and the Transmit Frame request was for a COMMAND frame not requesting a read operation (see 8.2.4.2.3.7), a COMMAND frame not requesting a write operation, a TASK frame, or a write DATA frame where the number of data bytes that have been transmitted equal the request byte count, 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).

If the confirmation is Transmission Status (Frame Transmitted~~)~~), and the Transmit Frame request was for a ~~TASK~~ COMMAND frame requesting a write operation, or a write DATA frame where the number of data bytes that have been transmitted ~~equal~~ is less than the request byte ~~count~~count and the write data length from the previous XFER_RDY frame, 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)~~.~~; or
e) XFER_RDY Arrived message (i.e., the ST_IFR assumes a Transmission Status (ACK Received) was received).

If a XFER_RDY Arrived message is received, then the ST_ITS shall respond to the XFER_RDY frame as if a Transmission Status (ACK Received) was received.

NOTE 53 - If the number of data bytes ~~that have been~~ requested to be transmitted for the Send SCSI Command ~~or Send Task Management transport~~ protocol service request are fewer than the number of bytes in the service request, then this state may send additional Transmit Frame requests for write DATA frames for the protocol service 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 write DATA frames sent for the I_T_L_Q nexus.

After a Transmission Status (Frame Transmitted) is received, if a confirmation of Transmission Status (NAK Received) is received, the Transmit Frame request was for a COMMAND frame, and the vendor specific number of retries has not been reached, then this state shall send a Transmit Frame (interlocked) request (i.e., the last COMMAND frame is retransmitted) to the port layer.

After a Transmission Status (Frame Transmitted) is received, if a confirmation of Transmission Status (NAK Received) is received, the Transmit Frame request was for a TASK frame, and the vendor specific number of retries has not been reached, then this state shall send a Transmit Frame (interlocked) request (i.e., the last TASK frame is retransmitted) to the port layer.

~~Table 106~~ Table 130 defines the ~~confirmations received from the port layer after a Transmission Status (Frame Transmitted) and the message~~ messages that ~~shall be sent by~~ this state shall send to the ST_IFR state

machine upon receipt of the ~~confirmation~~ listed confirmations, based on the conditions under which ~~the~~ each confirmation was received.

~~Table 121 — Messages sent to the ST_IFR state machine based on port layer confirmations~~

~~Confirmation received from the port layer~~	~~Conditions under which confirmation was received~~	~~Message sent to ST_IFR~~
~~Transmission Status (ACK Received~~	~~The Transmit Frame request was for a COMMAND frame, and there is no data to transfer for the command.~~	~~Transmission Complete (Command Delivered)~~
~~Transmission Status (ACK Received)~~	~~The Transmit Frame request was for a TASK frame.~~	~~Transmission Complete (Task Delivered)~~
~~Transmission Status (ACK Received)~~	~~The Transmit Frame request was for a write DATA frame; the number of data bytes transmitted equal the request byte count, and this state has received a Transmission Status (ACK Received) confirmation for each write DATA frame transmitted for the request.~~	~~Transmission Complete (Data Out Delivered)~~
~~Transmission Status (ACK/NAK Timeout) or Transmission Status (Connection Lost Without ACK/NAK)~~	~~The Transmit Frame request was for a COMMAND frame.~~	~~Transmission Complete (Command Failed, Connection Failed)~~
~~Transmission Status (NAK Received)~~	~~The Transmit Frame request was for a COMMAND frame.~~	~~Transmission Complete (Command Failed, NAK Received)~~
~~Transmission Status (ACK/NAK Timeout) or Transmission Status (Connection Lost Without ACK/NAK)~~	~~The Transmit Frame request was for a TASK frame.~~	~~Transmission Complete (Task Failed, Connection Failed)~~
~~Transmission Status (NAK Received)~~	~~The Transmit Frame request was for a TASK frame.~~	~~Transmission Complete (Task Failed, NAK Received)~~
~~Transmission Status (NAK Received)~~	~~The Transmit Frame request was for a write DATA frame, and 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)~~	~~The Transmit Frame request was for a write DATA frame, and the vendor-specific number of retries has been reached.~~	~~Transmission Complete (Data Failed, Connection Failed)~~

Table 122 — Messages sent to the ST_IFR state machine

Confirmation received from the port layer	Conditions under which confirmation was received	Message sent to ST_IFR state machine
Transmission Status (ACK/NAK Timeout) or Transmission Status (Connection Lost Without ACK/NAK)	The Transmit Frame request was for a COMMAND frame.	Transmission Complete (Command Failed, ACK/NAK Timeout)
	The Transmit Frame request was for a TASK frame.	Transmission Complete (Task Failed, ACK/NAK Timeout)
Transmission Status (NAK Received)	The Transmit Frame request was for a COMMAND frame and the vendor-specific number of retries has been reached.	Transmission Complete (Command Failed, NAK Received)
	The Transmit Frame request was for a TASK frame and the vendor-specific number of retries has been reached.	Transmission Complete (Task Failed, NAK Received)
Transmission Status (NAK Received)	The Transmit Frame request was for a write DATA frame and: a) the RETRY DATA FRAMES bit was set to zero in the XFER_RDY frame requesting the data; or b) the RETRY DATA FRAMES bit was set to one in the XFER_RDY frame requesting the data, and the vendor-specific number of retries has been reached.	Transmission Complete (Data-Out Failed, NAK Received)
Transmission Status (ACK/NAK Timeout) or Transmission Status (Connection Lost Without ACK/NAK)		Transmission Complete (Data-Out Failed, ACK/NAK Timeout)

~~After this state sends a Transmission Complete (Command Failed, Connection Failed) for a write operation when first burst is not enabled, then this state shall wait to receive a Cancel message from the ST_IFR state machine. If this state receives an XFER_RDY Arrived message after this state sends the Transmission Complete (Command Failed, Connection Failed), then this state shall discard the XFER_RDY Arrived message.~~

~~NOTE 54 - The Cancel message results from a vendor specific request from the SCSI application layer after the SCSI application layer has used a task management function to determine that the SAS target port did not receive the COMMAND frame.~~

After this state sends a Transmission Complete (Command Failed, ACK/NAK Timeout) this state shall continue processing messages and confirmations.

NOTE 55 - The application client may determine the command was received and is being processed by the device server and allow the command to complete.

If this state receives a Return to Start message or a Return to Start argument, 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.

If this state receives a Cancel message ~~from the ST_IFR state machine~~or a Cancel argument, 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_IFR state machine.

If this state receives a Cancel message ~~from the ST_IFR state machine~~or a Cancel argument, 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. The Cancel request shall include the following arguments:

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

NOTE 56 - The Cancel message results from a vendor specific request from the SCSI application layer after the SCSI application layer has used a task management function to determine that the SAS target port did not receive the COMMAND frame.

If this state receives a Transmission Status (Cancel Acknowledged) confirmation, then this state shall send a Transmission Complete (Cancel Acknowledged) message to the ST_IFR state machine.

If this state receives an XFER_RDY Arrived message, ~~and~~ then this state shall verify the ~~write data length is zero or exceeds~~ Xfer_Rdy state machine argument as specified in table 107. If the ~~amount of write data remaining to be transferred for the command~~verification fails, then this state ~~shall send a~~ sends the Transmission Complete ~~(XFER_RDY Incorrect Write Data Length)~~ message specified in table 107 to the ~~ST_IPR~~ ST_IFR state machine.

Table 123 — Transmission Complete messages for XFER_RDY frame verification failures

Message sent to ST_IFR [a]	Condition
Transmission Complete (XFER_RDY Incorrect Write Data Length)	The Write Data Length Xfer_Rdy state machine argument is zero.
	The value in the Requested Offset Xfer_Rdy state machine argument plus the Write Data Length Xfer_Rdy state machine argument is greater than the Data-Out Buffer Size state machine argument.
Transmission Complete (XFER_RDY Requested Offset Error)	First burst is not enabled, this is the first XFER_RDY frame for a command, and the value in the Requested Offset Xfer_Rdy state machine argument is not set to zero.
	First burst is enabled, this is the first XFER_RDY frame for a command, and the value in the Requested Offset Xfer_Rdy state machine argument is not equal to the value indicated by the FIRST BURST SIZE field in the Disconnect-Reconnect mode page (see 10.2.6.1.5).
	Retries are not supported and the Requested Offset Xfer_Rdy state machine argument is not equal to the Previous Requested Offset state machine variable plus the Previous Write Data Length Field state machine variable.
	Retries are supported, the Retransmit Bit Xfer_Rdy state machine argument is set to zero, and the Requested Offset Xfer_Rdy state machine argument is not equal to the Previous Requested Offset state machine variable plus the Previous Write Data Length state machine variable.
	Retries are supported, this is not the first XFER_RDY frame for the command, the Retransmit Bit Xfer_Rdy state machine argument is set to one, and: a) the Requested Offset Xfer_Rdy state machine argument is not equal to the Previous Requested Offset state machine variable; and b) the Requested Offset Xfer_Rdy state machine argument is not equal to the Previous Requested Offset state machine variable plus the Previous Write Data Length Field state machine variable.

[a] If more than one condition is true that result in a different messages, then the Transmission Complete (XFER_RDY Incorrect Write Data Length) message shall be sent to the ST_IFR state machine.

~~If this state machine receives an XFER_RDY Arrived message and the requested offset is not expected, then this state shall send a Transmission Complete (XFER_RDY Requested Offset Error) message to the ST_IPR state machine.~~

After this state verifies an XFER_RDY frame, it shall:

a) set the Data-Out Buffer Offset state machine variable to the Requested Offset Xfer_Rdy state machine argument;
b) set the Previous Requested Offset state machine variable to the Requested Offset Xfer_Rdy state machine argument; and
c) set the Previous Write Data Length state machine variable to the Requested Offset Xfer_Rdy state machine argument.

8.2.5.2.3.3.3 Transition ST_ITS2:Initiator_Send_Frame to ST_ITS1:Initiator_Start

This transition shall occur ~~after this state has sent one of the following to the ST_IFR state machine~~after:

a) ~~This transition shall occur after~~ this state has sent one of the following to the ST_IFR state machine:
   A) a Transmission Complete (Command ~~Delivered~~Failed, NAK Received) message;
   B) a Transmission Complete (~~Command~~ Task Failed, ACK/NAK ~~Received~~Timeout) message;
   C) a Transmission Complete (~~Command~~ Task Failed, ~~Connection failed~~NAK Received) ~~message and the command was for a non-data operation~~message;
   D) a Transmission Complete (Command Failed, ACK/NAK Timeout) message and the command was for a non-data operation;
   E) a Transmission Complete (Data-Out Failed, NAK Received) message;
   F) a Transmission Complete (Data-Out Failed, ACK/NAK Timeout) message;
   G) a Transmission Complete (XFER_RDY Incorrect Write Data Length) message;
   H) ~~any~~ a Transmission Complete ~~message for a TASK or write DATA frame~~(XFER_RDY Requested Offset Error) message; or
   I) a Transmission Complete (Cancel Acknowledged~~).~~) message;

or

b) this state has received a Return To Start message or Return To Start argument, and has received:
   A) confirmations for all Transmit Frame requests sent to the port layer; or
   B) a Transmission Status (Cancel Acknowledged) confirmation.

8.2.5.2.3.3.4 Transition ST_ITS2:Initiator_Send_Frame to ~~ST_ITS3~~ST_ITS5:~~Prepare_Command~~Prepare_Data_Out

~~This transition shall occur after this state receives a Request (Send Command) message.~~

~~**8.2.5.2.3.3.5 Transition ST_ITS2:Initiator_Send_Frame to ST_ITS4:Prepare_Task**~~

~~This transition shall occur after this state receives a Request (Send Task message).~~

~~**8.2.5.2.3.3.6 Transition ST_ITS2:Initiator_Send_Frame to ST_ITS5:Prepare_Data_Out**~~

If first burst is enabled, this transition shall occur and include First Burst argument after this state receives:

a) a Transmission Status (Frame Transmitted) confirmation followed by a Transmission Status (ACK Received) for a COMMAND frame requesting a write operation; or
b) a Transmission Status (Frame Transmitted) confirmation for a Transmit Frame (Non-interlocked) request if the Data-Out Buffer Offset state machine variable is less than the first burst size (see x.x.x).

This transition shall occur after this state receives:

~~a) a Transmission Status (Frame Transmitted) confirmation for a COMMAND frame for a write operation and first burst is enabled;~~
a) an XFER_RDY Arrived message~~;~~; or
b) a Transmission Status (Frame Transmitted) confirmation for a Transmit Frame (Non-interlocked) request if the Data-Out Buffer Offset state machine variable is less than the Requested Offset Xfer_Rdy state machine argument plus the Write Data Length Xfer_Rdy state machine argument.

NOTE 57 - This transition occurs even if this state has not received a Transmission Status (ACK Received) for the ~~COMMAND frame for the~~ write ~~operation~~DATA frame.

~~c) a Transmission Status (Frame Transmitted) confirmation for a Transmit Frame (Non-Interlocked) request if the number of data bytes that has been transmitted for the request is less than the first burst size or the write data length specified in the XFER_RDY; or~~

~~d) a Transmission Status (Frame Transmitted) confirmation and a confirmation other than Transmission Status (ACK Received) for a write DATA frame for which a Transmission Complete message was not sent to the ST_IFR state machine (i.e., in order to retry transmitting the frame when the vendor-specific number of retries has not been reached).~~

This transition shall include a Retry argument and occur after:

a) this state receives one of the following confirmations or arguments for a write DATA frame:
   A) Transmission Status (NAK Received);
   B) Transmission Status (ACK/NAK Timeout); or
   C) Transmission Status (Connection Lost without ACK/NAK);
b) the RETRY DATA FRAMES bit set to one in the XFER_RDY frame for the write operation
c) the Data-Out Buffer Offset state machine variable is set to the Requested Offset Xfer_Rdy state machine argument; and
d) the vendor-specific number of retries, if any, for the write DATA frame has not been reached.

8.2.5.2.3.3.7 Transition ST_ITS2:Initiator_Send_Frame to ST_ITS6:Receive_Data_In

This transition shall occur after this state receives a Transmission Status (Frame Transmitted) confirmation for a COMMAND frame for a command ~~performing~~ requesting a read operation.

NOTE 58 - This transition occurs even if this state has not received a Transmission Status (ACK Received) for the COMMAND frame.

8.2.5.2.3.4 ST_ITS3:Prepare_Command state

8.2.5.2.3.4.1 State description

This state shall construct a COMMAND frame ~~based on~~ using the ~~values received with the Request~~ Command arguments (~~Send Command) message~~see 8.2.4.2.2.1):

a) FRAME TYPE field set to 06h (i.e., COMMAND frame);
b) HASHED DESTINATION SAS ADDRESS field set to the hashed value of the ~~specified destination~~ Destination SAS ~~address~~Address Commands argument;
c) HASHED SOURCE SAS ADDRESS field set to the hashed value of the SSP initiator port's SAS address;
d) RETRY DATA FRAMES bit set to zero;
e) RETRANSMIT bit set to zero;
f) CHANGING DATA POINTER bit set to zero;
g) NUMBER OF FILL BYTES field set zero.
h) TAG field set to the ~~specified tag~~Tag Command argument;
i) TARGET PORT TRANSFER TAG field set to zero;
j) DATA OFFSET field set to zero;
k) in the information unit, LOGICAL UNIT NUMBER field set to the ~~specified logical unit number~~Logical Unit Number Command argument;
l) in the information unit, ENABLE FIRST BURST bit set to the ~~specified enable first burst bit~~Enable First Burst Command argument;
m) in the information unit, TASK PRIORITY field set to the ~~specified task priority~~Task Priority Command argument;
n) in the information unit, TASK ATTRIBUTE field set to the ~~specified task attribute~~Task Attribute Command argument;
o) in the information unit, ADDITIONAL CDB LENGTH field set to the ~~specified additional~~ Additional CDB ~~length~~Length Command argument;
p) in the information unit, CDB field set to the ~~specified CDB; and~~CDB Command argument;

q) in the information unit, ADDITIONAL CDB BYTES field set to the ~~specified additional~~ Additional CDB ~~bytes~~Bytes Command argument, if any~~.~~; and
r) no fill bytes.

8.2.5.2.3.4.2 Transition ST_ITS3:Prepare_Command to ST_ITS2:Initiator_Send_Frame

This transition shall occur after this ~~state constructs a COMMAND frame.~~state:

a) ~~This transition shall occur after this state~~ constructs a COMMAND frame~~.~~;
b) receives a Cancel message; or
c) receives a Return To Start message.

This transition shall include the:

a) COMMAND frame as an argument;
b) if a Cancel message was received, then a Cancel argument; or
c) if a Return To Start message was received, then a Return To Start argument.

8.2.5.2.3.5 ST_ITS4:Prepare_Task state

8.2.5.2.3.5.1 State description

This state shall construct a TASK frame ~~based on values received with~~ using the ~~Request (Send Task) message~~Task arguments:

a) FRAME TYPE field set to 16h (i.e., TASK frame);
b) HASHED DESTINATION SAS ADDRESS field set to the hashed value of the ~~specified destination~~ Destination SAS ~~address~~Address Task argument;
c) HASHED SOURCE SAS ADDRESS field set to the hashed value of the SSP initiator port's SAS address;
d) RETRY DATA FRAMES bit set to zero;
e) RETRANSMIT bit set to the ~~specified retransmit bit~~Retransmit Bit Task argument;
f) CHANGING DATA POINTER bit set to zero;
g) NUMBER OF FILL BYTES field set zero.
h) TAG field set to the ~~specified tag~~Tag Task argument;
i) TARGET PORT TRANSFER TAG field set to zero;
j) DATA OFFSET field set to zero;
k) in the information unit, LOGICAL UNIT NUMBER field set to the ~~specified logical unit number~~Logical Unit Number Task argument;
l) in the information unit, TASK MANAGEMENT FUNCTION field set to the ~~specified task management function; and~~Task Management Function Task argument;
m) in the information unit, TAG OF TASK TO BE MANAGED field set to the ~~specified tag~~ Tag Task argument of task to be ~~managed.~~managed and
n) no fill bytes.

8.2.5.2.3.5.2 Transition ST_ITS4:Prepare_Task to ST_ITS2:Initiator_Send_Frame

This transition shall occur after this ~~state constructs a TASK frame.~~state:

a) ~~This transition shall occur after this state~~ constructs a TASK frame~~.~~;
b) receives a Cancel message; or
c) receives a Return To Start message.

This transition shall include the:

a) TASK frame as an argument;
b) if a Cancel message was received, then a Cancel argument; or
c) if a Return To Start message was received, then a Return To Start argument.

8.2.5.2.3.6 ST_ITS5:Prepare_Data_Out state

8.2.5.2.3.6.1 State description

This state shall construct a write DATA frame ~~based on values either received with~~ using the ~~Request (Send Command) message if first burst is enabled or with an XFER_RDY Arrived message~~following Xfer_Rdy state machine arguments and Command state machine arguments:

a) FRAME TYPE field set to 01h (i.e., DATA frame);
b) HASHED DESTINATION SAS ADDRESS field set to the hashed value of the ~~specified destination~~ Destination SAS ~~address~~Address Command argument;
c) HASHED SOURCE SAS ADDRESS field set to the hashed value of the SSP initiator port's SAS address;
d) RETRY DATA FRAMES bit set to zero;
e) RETRANSMIT bit set to zero;
f) CHANGING DATA POINTER bit set ~~to zero, unless otherwise~~ as specified in this subclause;
g) NUMBER OF FILL BYTES field set to the number of fill bytes, based on the length of the specified data;
h) TAG field set to the ~~specified tag~~Tag Command argument;
~~i) TARGET PORT TRANSFER TAG field set to the specified target port transfer tag;~~
j) TARGET PORT TRANSFER TAG field set to FFFFh if this state received a First Burst argument or the Target Port Transfer Tag Xfer_Rdy argument if this state did not receive a First Burst argument;
k) DATA OFFSET field set to the ~~specified data offset, unless otherwise specified in this subclause; and~~Data-Out Buffer Offset state machine variable;
~~l) in the information unit, DATA field set to the specified data.~~
m) in the information unit, DATA field set to the information that starts at the location in the Data-Out Buffer state machine argument pointed to by the Data-Out Buffer Offset state machine variable and shall contain the amount of data indicated by the Write Data Length Xfer_Rdy argument; and
n) fill bytes, if any.

If this state is ~~the first write DATA frame constructed by this state~~entered without a Retry argument, then this state shall set the CHANGING DATA POINTER bit to zero~~.~~.

~~If this state is entered after the ST_ISF2:Initiator_Send_Frame state receives a Transmission Status (Frame Transmitted) confirmation for a write DATA frame and that state has only received confirmations of Transmission Status (Frame Transmitted) and Transmission Status (ACK Received), then this state shall:~~

If this state is entered with a Retry argument, then this state shall set the CHANGING DATA POINTER bit to ~~zero; and~~one.

~~o) set the DATA OFFSET field to the value in the DATA OFFSET field in the previous write DATA frame plus the number of bytes in the previous write DATA information unit.~~

~~If this state is entered after the ST_ISF2:Initiator_Send_Frame state receives a Transmission Status (Frame Transmitted) confirmation and a confirmation other than Transmission Status (ACK Received) for a write DATA frame for which a Delivery Failure message was not sent to the ST_IFR state machine (i.e., in order to retry transmitting the frame), then this state shall:~~

~~a) set the CHANGING DATA POINTER bit in the frame to one; and~~
~~b) set the DATA OFFSET field to the data offset value associated with the XFER_RDY frame.~~

After constructing the write DATA frame, this state shall set the Data-Out Buffer Offset state machine variable to the value of the DATA OFFSET field plus the length of the DATA field in the information unit.

8.2.5.2.3.6.2 Transition ST_ITS5:Prepare_Data_Out to ST_ITS2:Intiator_Send_Frame

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

a) constructs a write DATA frame;
b) receives a Cancel message; or
c) receives a Return To Start message.

This transition shall include the received Transmission Status, if any, as an argument and the:

a) write DATA frame as an argument;

b) if a Cancel message was received, then a Cancel argument; or
c) if a Return To Start message was received, then a Return To Start argument.

8.2.5.2.3.7 ST_ITS6:Receive_Data_In state

8.2.5.2.3.7.1 State description

If this state receives a Data-In Arrived ~~message from the ST_IFR state machine~~message, then this state shall verify the values in the read DATA frame received with the message as ~~follows:~~defined in table 108.

~~1) If the data offset was not expected (e.g., 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_IFR state machine;~~
~~2) If the length of the information unit DATA field (i.e., the length of the information unit) plus the length of read data previously received is greater than that specified by the command (i.e., by the CDB delivered in the COMMAND frame), then this state shall send a Reception Complete (Too Much Read Data) message to the ST_IFR state machine; and~~

If the ~~length of the information unit DATA field (i.e.~~verification fails, ~~the length of the information unit) is zero,~~ then this state ~~shall send a~~ sends the Reception Complete ~~(Incorrect Data Length)~~ message specified in table 107 to the ST_IFR state machine.

Table 124 — Reception Complete messages for read DATA frame verification failures

Message sent to ST_IFR [a]	Condition
Reception Complete (Data Offset Error)	Transport layer retries are not supported, and the DATA OFFSET field in the read DATA frame is not equal Data-In Buffer Offset state machine variable.
	The DATA OFFSET field in the read DATA frame is greater than the Data-In Buffer Size state machine argument.
Reception Complete (Too Much Read Data)	The number of bytes in the DATA field in the read DATA information unit plus the Data-In Buffer Offset state machine variable is greater than the Data-In Buffer Size state machine argument.
Reception Complete (Incorrect Data Length)	The number of bytes in the DATA field in the read DATA information unit is zero.

[a] If more than one condition is true that result in a different messages, then the state shall select which message to send to the ST_IFR state machine using the following order:
1) Reception Complete (Data Offset Error);
2) Reception Complete (Too Much Read Data); or
3) Reception Complete (Incorrect Data Length).

If:

a) transport layer retries are supported;
b) the CHANGING DATA POINTER bit is set to zero;
c) the DATA OFFSET field is not set to the Data-In Buffer Offset state machine variable;
d) the DATA OFFSET field is less than the Data-In Buffer Size state machine argument; and
e) the DATA OFFSET field plus the length of the Data information unit is less than or equal to the Data-In Buffer Size state machine argument,

then this state should discard all Data-In Arrived messages until a read DATA frame is received with the CHANGING DATA POINTER bit is set to one. This state shall resume processing additional Data-In Arrived messages when it receives a Data-In Arrived message with the CHANGING DATA POINTER bit set to one.

If the verification succeeds or after this state resumes processing Data-In Arrived messages, then this state shall process the data received in the read DATA frame and set the Data-In Buffer Offset state machine variable to the DATA OFFSET field plus the length of the Data information unit.

If this state receives Transmission Status (ACK/NAK Timeout) or Transmission Status (Connection Lost Without ACK/NAK), then this state shall send a Reception Complete (Command Failed, Connection Failed) to the ST_IFR state machine.

After this state sends a Reception Complete (Command Failed, Connection Failed) message, this state shall continue processing messages and confirmations.

NOTE 59 - The application client may determine the command was received and is being processed by the device server and allow the command to complete.

~~After~~ ~~If~~ this state ~~sends~~ receives a ~~Reception Complete (Command Failed, Connection Failed)~~Cancel message, then this state shall ~~wait to receive~~ send a Reception Complete (Cancel Acknowledged) message ~~from~~ to the ST_IFR state machine. ~~If this state receives a Data-In Arrived~~ The Reception Complete message ~~after this state sends the Transmission Complete (Command Failed, Connection Failed), then this state~~ shall ~~discard~~ include the ~~Data-In Arrived message~~tag as an argument.

NOTE 60 - The Cancel message results from a vendor specific request from the SCSI application layer after the SCSI application layer has used a task management function to determine that the SAS target port did not receive the COMMAND frame.

~~If this state is entered from the ST_ITS7:Process_Data_In state and number of bytes moved for the data in command equals the request byte count, then this state shall send a Reception Complete (Data-In Received) message to the ST_TFR state machine.~~

~~If this state receives a Cancel message from the ST_IFR state machine, then this state shall send a Reception Complete (Cancel Acknowledged) message to the ST_IFR state machine. The Reception Complete message shall include the tag as an argument.~~

8.2.5.2.3.7.2 Transition ST_ITS6:Receive_Data_In to ST_ITS1:Initiator_Start

This transition shall occur after this ~~state sends one of the following to the ST_IFR state machine~~state:

a) sends one of the following to the ST_IFR state machine:
   A) a Reception Complete (~~Data-In Received~~Data Offset Error) message;
   B) a Reception Complete (~~Data Offset Error~~Too Much Read Data) message;
   C) a Reception Complete (~~Too Much Read Data~~Incorrect Data Length) message~~;~~; or
   D) a ~~Reception~~ Transmission Complete (~~Incorrect Data Length~~Cancel Acknowledged) message; ~~or~~ or

b) receives a ~~Reception Complete (Cancel Acknowledged)~~ Return To Start message.

8.2.5.2.3.7.3 Transition ST_ITS6:Receive_Data_In to ST_ITS2:Initiator_Send_Frame

This transition shall occur after this state receives a Transmission Status (NAK Received) confirmation for a COMMAND frame for a command ~~performing~~ requesting a read operation.

~~**8.2.5.2.3.7.4 Transition ST_ITS6:Receive_Data_In to ST_ITS7:Process_Data_In**~~

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

~~**8.2.5.2.3.8 ST_ITS7:Process_Data_In state**~~

~~**8.2.5.2.3.8.1 State description**~~

~~This state shall process the data received with the Data-In Arrived message.~~

~~**8.2.5.2.3.8.2 Transition ST_ITS7:Process_Data_In to ST_ITS6:Receive_Data_In**~~

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

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

8.2.5.3.1 ST_T state machines overview

The ST_T state machines are as follows:

a) ST_TFR (target frame router) state machine (see 8.2.4.3.2); and
b) ST_TTS (target transport server) state machine (see 8.2.4.3.3).

The SAS target port includes:

a) one ST_TFR state machine; and
b) one ST_TTS state machine for each possible task and task management function (i.e., for each tag).

This state machine may maintain the timers listed in table 109.

Table 125 — 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 150 shows the ST_T state machines.

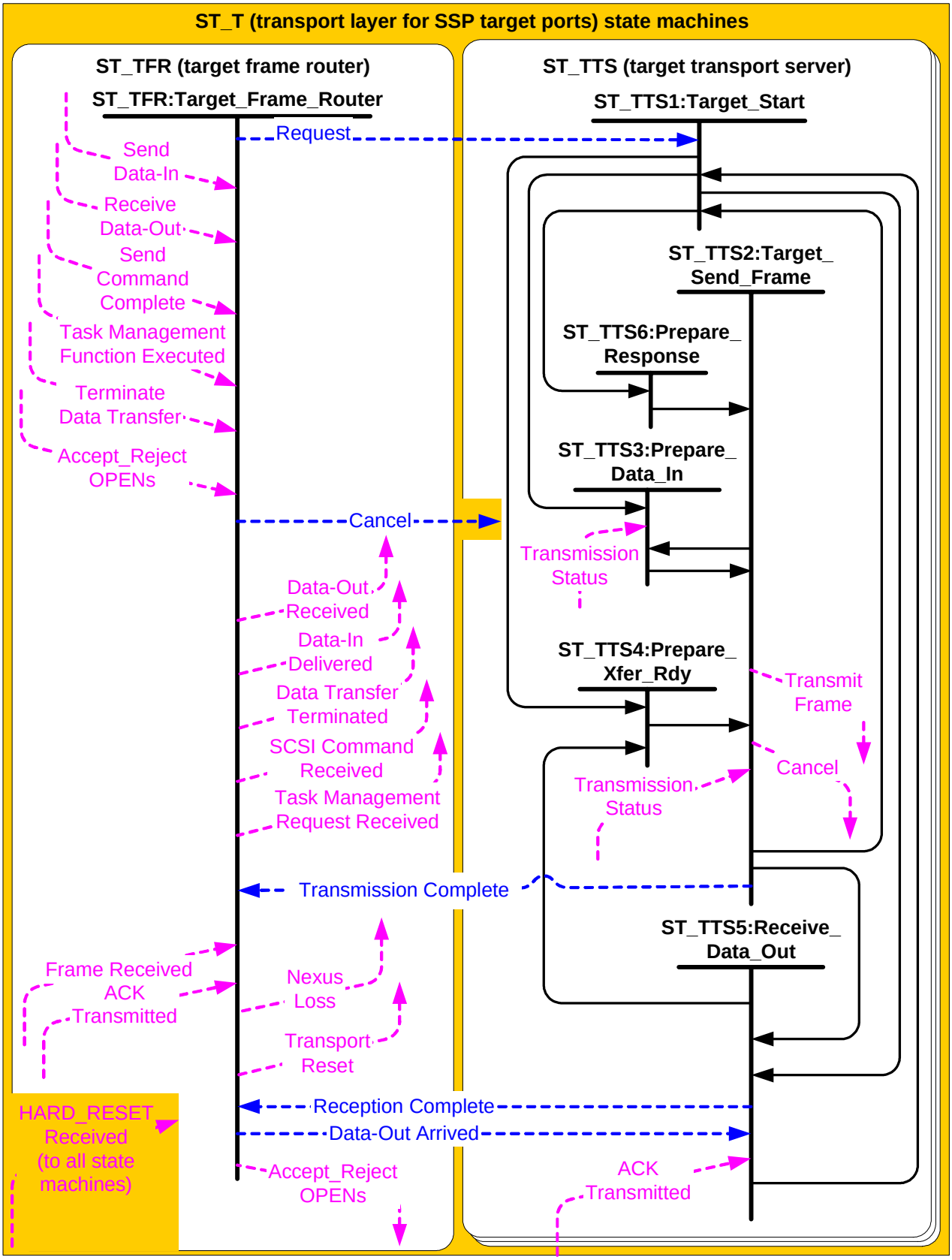

Figure 152 — ST_T (transport layer for SSP target ports) state machines

Editor's Note 17: Added Transmission Status confirmation into ST_TTS3 to allow for non-interlocked DATA frame transfers. Changed Cancel message to go to all states. Added ACK Transmitted to ST_TTS5. Deleted ST_TTS1 to ST_TTS2 transition, ST_TTS5 to ST_TTS2 transition, ST_TTS7 to ST_TTS2 transition, and ST_TTS4 to ST_TTS2 transition. Added ST_TTS1 to ST_TTS3 transition, ST_TTS1 to ST_TTS4 transition, ST_TTS1 to ST_TTS7 transition, and ST_TTS5 to ST_TTS4 transition. Change ST_TTS7 to ST_TTS6.

8.2.5.3.2 ST_TFR (target frame router) state machine

8.2.5.3.2.1 ~~The~~ ST_TFR state machine ~~performs the following functions:~~**overview**

The ST_TFR state machine performs the following functions:

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 messages from the ST_TTS state machine;
f) receives Accept_Reject OPENs requests from the SCSI application layer;
g) sends Accept_Reject OPENs requests to the port layer;
h) sends Nexus Loss event notifications to the SCSI application layer; and
i) sends Transport Reset event notifications to the SCSI application layer.

This state machine consists of one state.

This state machine shall be started after power on.

8.2.5.3.2.2 Processing Frame Received confirmations

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 104 in 9.2.1). 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 checked and they are not set to zero, then this state machine shall send ~~a Request (Send Transport Response) message with an argument of Invalid Frame~~ to ~~the ST_TTS1:Target_Start state in~~ an ST_TTS state machine that does not have an active ~~task. The check of reserved fields described above shall not apply to~~ task the ~~reserved fields within~~ following and discard the ~~CDB in a COMMAND~~ frame~~. Checking of reserved fields in a CDB is described in SPC-3.~~:

a) a Request (Send Transport Response) message with the Transport Response arguments;
b) the destination SAS address argument set to the SAS address from which the invalid frame was received; and
c) the Service Response argument set to Invalid Frame.

The check of reserved fields within the frame shall not apply to the reserved fields within the CDB in a COMMAND frame. Checking of reserved fields in a CDB is described in SPC-3.

The following is the list of Transport Response arguments:

a) connection rate;
b) initiator connection tag;
c) destination SAS address (i.e., the SAS address to which the RESPONSE frame is to be transmitted);
d) source SAS address set to the SAS address of the SAS port containing the state machine;
e) tag; and
f) service response.

If the frame type is correct relative to the Frame Received 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 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 with an argument of Invalid Frame~~ to ~~the ST_TTS1:Target_Start state in~~ an ST_TTS state machine that does not have an active ~~task.~~task the following and discard the frame:

a) a Request (Send Transport Response) message with the Transport Response arguments;
b) the destination SAS address set to the SAS address from which the invalid frame was received; and
c) the Service Response argument set to Invalid Frame.

If the frame type is TASK, this state machine checks tags, the RETRANSMIT bit in the new TASK frame is set to one, and the tag for the new TASK frame is the same as the tag for a previous TASK frame where the task management function for the previous TASK frame is not complete, then this state machine shall discard the new TASK frame and not send a Task Management Request Received confirmation to the port layer.

If the frame type is TASK and this state machine does not check tags, then this state machine shall ignore the RETRANSMIT bit.

If the frame type is COMMAND or TASK, then this state machine may check the target port transfer tag. If this state checks the target port transfer tag and the tag is set to a value other than FFFFh, then this state machine shall send ~~a Request (Send Transport Response) message with an argument of Invalid Frame~~ to ~~the ST_TTS1:Target_Start state in~~ an ST_TTS state machine that does not have an active ~~task.~~task the following and discard the frame:

a) ~~A~~ a Request (~~Receive Data Out~~Send Transport Response) message ~~shall also include~~ with the ~~target port transfer tag.~~Transport Response arguments;
b) the destination SAS address set to the SAS address from which the invalid frame was received; and
c) the Service Response argument set to Invalid Frame.

If the frame type is 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 Incorrect Logical Unit Number~~ to ~~the ST_TTS1:Target_Start state in~~ an ST_TTS state machine that does not have an active ~~task.~~task the following and discard the frame:

a) a Request (Send Transport Response) message with the Transport Response arguments;
b) the destination SAS address set to the SAS address from which the invalid frame was received; and
c) the Service Response argument set to Incorrect Logical Unit Number.

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~~ shall send ~~a Request (Send Transport Response) message with an argument of Invalid Frame~~ to ~~the ST_TTS1:Target_Start state in~~ an ST_TTS state machine that does not have an active ~~task.~~task the following and discard the frame:

~~If this state machine sends a Request (Send Transport Response) message with an argument of Invalid Frame to an ST_TTS state machine, then this state machine shall discard the frame and shall include the following arguments in the message:~~

~~a) connection rate;~~
~~b) initiator connection tag;~~
a) a Request (Send Transport Response) message with the Transport Response arguments;
b) the destination SAS address set to the SAS address from which the invalid frame was received~~;~~; and
~~c) source SAS address set to the SAS address of the SAS port containing the state machine; and~~
~~d) tag.~~
e) the Service Response argument set to Invalid Frame.

If the frame type is COMMAND or TASK and the ~~items~~ fields 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~~ fields 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 with the following arguments to the SCSI application layer:

a) source SAS address (i.e., the SAS address that transmitted the COMMAND frame);
b) tag;
c) logical unit number;
d) task attribute;
e) task priority;
f) CDB; and
g) additional CDB bytes, if any.

If the frame type is TASK, the ~~items~~ fields 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 with the following arguments to the SCSI application layer~~. The indication shall include~~:

a) source SAS address (i.e., the SAS address that transmitted the TASK frame);
b) tag;
c) logical unit number;
d) task management function; and
e) tag of the task to be managed.

If the frame type is DATA, and the tag does not match a tag for an outstanding command performing write operations, then this state machine shall discard the frame.

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

If the frame type is DATA and a target port transfer tag was ~~assigned~~ received in ~~an XFER_RDY frame for the request~~a Transmission Complete (Xfer_Rdy Delivered) message, then this state machine shall check the target port transfer tag. If the target port transfer tag received in the DATA frame does not ~~specify a valid state machine~~match the Target Transport Tag argument in the Transmission Complete (Xfer_Rdy Delivered) message, then this state machine shall discard the frame.

If the frame type is DATA and the ~~items~~ fields 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 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 ~~SSP~~ write DATA frame.

8.2.5.3.2.3 Processing transport protocol service requests and responses

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:Target_Start state in~~ an ST_TTS state machine that does not have an active task~~.~~. The message shall include the following Data-In arguments:

a) connection rate;
b) initiator connection tag;
c) destination SAS address (i.e., the SAS address to which the read DATA frame is to be transmitted);
d) tag;
e) device server buffer;
f) request byte count; and
g) application client buffer offset.

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:Target_Start state in~~ an ST_TTS state machine that does not have an active task~~.~~. The message shall include the following Data-Out arguments:

~~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) destination SAS address (i.e., the SAS address to which the XFER_RDY frame ~~or read DATA frame~~ is to be transmitted);
d) tag;
e) device server buffer~~; and~~;
f) request byte count~~.~~;
g) application client buffer offset; and
h) ~~A Request (Receive Data-Out) message shall also include the~~ target port transfer tag.

If first burst is enabled (see x.x.x), then the Request (Receive Data_Out) message shall also include the Enable First Burst argument and First Burst Size argument. The First Burst Size argument shall be set to first burst size from the Disconnect-Reconnect mode page (see 10.2.6.1.5).

If this state machine receives a Send Command Complete transport protocol service response from the SCSI application layer with the Service Response argument set to TASK COMPLETE or LINKED COMMAND COMPLETE, then this state machine shall send a Request (Send Application Response) message to the ~~ST_TTS1:Target_Start state in the~~ ST_TTS state machine specified by the tag. The message shall include the following Application Response arguments:

a) connection rate;
b) initiator connection tag;
c) destination SAS address (i.e., the SAS address to which the RESPONSE frame is to be transmitted);
d) tag;
e) status; and
f) sense data, if any.

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 Transport Response) message~~ to the ~~ST_TTS1:Target_Start state in an~~ ST_TTS state machine ~~that does not have an active task with~~ specified by the ~~argument specified in table 110 and~~ tag the ~~following arguments~~following:

~~a) connection rate;~~
~~b) initiator connection tag;~~
~~c) destination SAS address (i.e., the SAS address to which the RESPONSE frame is to be transmitted); and~~
~~d) tag.~~
a) a Request (Send Transport Response) message with the Transport Response arguments; and
b) the Service Response argument set as specified in table 110.

Table 110 specifies which argument to send with Request (Send Transport Response) based on the Service Response argument that was received.

Table 126 — Task Management Function Executed Service Response argument ~~mapping~~mapping to Service Response argument

Task Management Function Executed protocol service response Service Response argument received	Request (Send Transport Response) ~~argument to send~~message Service Response argument
FUNCTION COMPLETE	Task Management Function Complete
FUNCTION SUCCEEDED	Task Management Function Succeeded
FUNCTION REJECTED	Task Management Function Not Supported
INCORRECT LOGICAL UNIT NUMBER	Incorrect Logical Unit Number
SERVICE DELIVERY OR TARGET FAILURE - Overlapped Tag Attempted	Overlapped Tag Attempted

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 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 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:Target_Send_Frame state in the~~ ST_TTS state machine specified by the tag and the Send Data-In protocol service request.

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 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 state machine specified by the tag and the Receive Data-Out protocol service request.

This state machine receives Transmission Complete and Reception Complete messages ~~from the ST_TTS state machines~~ that may result in this state machine sending a Nexus Loss event notification or a protocol service confirmation to the SCSI application layer. If this state machine receives a Transmission Complete (I_T Nexus Loss) message, then this state machine shall send a Nexus Loss event notification to the SCSI

application layer. Table 111 defines the received messages that require a protocol service confirmation and the corresponding service confirmations that shall be sent upon receipt of the message.

Table 127 — Confirmations sent to the SCSI application layer

Message received from ST_TTS state machine	Protocol service confirmation sent to SCSI application layer
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

Table 128 — Confirmations sent to the SCSI application layer

Message received from ST_TTS state machine	Protocol service confirmation sent to SCSI application layer
Transmission Complete (Xfer_Rdy Delivered)	None
Transmission Complete (Response Delivered)	None
Transmission Complete (Response Failed) [a]	None
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, ACK/NAK Timeout)	Data-Out Received with the Delivery Result argument set to DELIVERY FAILURE - CONNECTION FAILED
Transmission Complete (Data-In Failed, NAK Received)	Data-In Delivered with the Delivery Result argument set to DELIVERY FAILURE - NAK RECEIVED
Transmission Complete (Data-In Failed, ACK/NAK Timeout)	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
Reception Complete (Data Transfer Terminated)	Data Transfer Terminated

[a] SAM-3 does not define a mechanism for the device server to determine the result of its Send Command Complete and Task Management Function Executed transport protocol service response calls.

Each protocol service confirmation shall include the tag as an argument.

8.2.5.3.2.4 Processing miscellaneous requests and confirmations

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

8.2.5.3.3 ST_TTS (target transport server) state machine

8.2.5.3.3.1 ST_TTS state machine overview

The ST_TTS state machine performs the following functions:

a) receives and processes messages from the ST_TFR state machine;
b) sends messages to the ST_TFR state machine;
c) communicates with the port layer using 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:Target_Start (see 8.2.4.3.3.2) (initial state);
~~b) ST_TTS2:Target_Send_Frame (see 8.2.4.3.3.3);~~
c) ~~ST_TTS3~~ST_TTS2:~~Prepare_Data_In (see 8.2.4.3.3.4)~~Target_Send_Frame (see 8.2.4.3.3.3);
d) ~~ST_TTS4~~ST_TTS3:~~Prepare_Xfer_Rdy (see 8.2.4.3.3.5)~~Prepare_Data_In (see 8.2.4.3.3.4);
e) ~~ST_TTS5~~ST_TTS4:~~Receive_Data_Out (see 8.2.4.3.3.6)~~Prepare_Xfer_Rdy (see 8.2.4.3.3.5);
f) ~~ST_TTS6~~ST_TTS5:~~Process_Data_Out (see 8.2.5.3.3.7)~~Receive_Data_Out (see 8.2.4.3.3.6); and
g) ~~ST_TTS7~~ST_TTS6:Prepare_Response (see 8.2.4.3.3.7).

~~Each ST_TTS~~ This state ~~machines~~ machine shall ~~be started~~ start in the ST_TTS1:Target_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:~~

~~a) shall retain the data offset for a read DATA frame transmitted for which ACK/NAK Balance was achieved (i.e., when the number of read DATA frames sent matches the number of ACK Received confirmations received) for use as the restart point in case of a retry for read DATA frames; and~~
~~b) shall retain the data offset for the last XFER_RDY frame transmitted, for use in these cases:~~
~~A) if this state machine retries the XFER_RDY frame, to retransmit the XFER_RDY frame; or~~
~~B) if the SSP initiator port retries write DATA frames, to help reestablish the write data context.~~

If this state machine receives a HARD_RESET Received confirmation, then this state machine shall transition to the ST_TTS1:~~Target_Start~~ Initiator_Start state from any other state.

This state machine shall maintain the state machine variables defined in table 112.

Table 129 — ST_TTS state machine variables

State machine variable	Description
Read Data Offset	Offset into the application client buffer for read data
Balance Point Read Data Offset	Offset into the device server buffer for read data of last DATA frame to have received an ACK Transmitted confirmation
Requested Write Data Offset	Device server requested offset in the application client buffer for write data
Requested Write Data Length	Amount of write data requested by the Device server from the application client buffer

This state machine shall maintain the state machine arguments defined in table 113.

Table 130 — ST_TTS state machine arguments

State machine argument	Description
Data-In	The Data-In arguments received in the Request (Send Data-In) message
Data-Out	The Data-Out arguments received in the Request (Receive Data-Out) message

8.2.5.3.3.2 ST_TTS1:Target_Start state

8.2.5.3.3.2.1 State description

This state is the initial state of an ST_TTS state machine.

This state shall set the following state machine variables to zero:

a) Read Data Offset;
b) Balance Point Read Data Offset; and
c) Requested Write Data offset.

If this state was entered without an Enable First Burst argument, then the Requested Write Data Length state machine variable shall be set to the Request Byte Count Data-Out state machine argument.

If this state was entered with an Enable First Burst argument, then the Requested Write Data Length state machine variable shall be set to the First Burst Size argument.

8.2.5.3.3.2.2 Transition ST_TTS1:Target_Start to ~~ST_TTS2~~ST_TTS3:~~Target_Send_Frame~~Prepare_Data_In

This transition shall occur after this state receives a Request (Send Data-In) message from the ST_TFR state ~~machine other than a Request (Receive Data-Out) message if first burst is enabled~~machine.

8.2.5.3.3.2.3 Transition ST_TTS1:Target_Start to ST_TTS4:Prepare_Data_Xfer_Rdy

If this state was entered without an Enable First Burst argument, then this transition shall occur after a Request (Receive Data-Out) message is received.

8.2.5.3.3.2.4 Transition ST_TTS1:Target_Start to ST_TTS5:Receive_Data_Out

If this state was entered with an Enable First Burst argument, then this transition shall occur after a Request (Receive Data-Out) message is received.

8.2.5.3.3.2.5 Transition ST_TTS1:Target_Start to ~~ST_TTS5~~ST_TTS6:~~Receive_Data_Out~~Prepare_Response

This transition shall occur after this state receives a Request (~~Receive Data-Out~~Send Transport Response) message from the ST_TFR state ~~machine and first burst is enabled~~machine.

This transition shall include the Transport Response arguments.

8.2.5.3.3.3 ST_TTS2:Target_Send_Frame state

8.2.5.3.3.3.1 State description

If this state is entered from the ST_TTS3:Prepare_Data_In state for transmission of a read 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~~ST_TTS6:Prepare_Response state for transmission of a RESPONSE frame, then this state shall send a Transmit Frame (Interlocked) request to the port layer.

~~NOTE 61 - 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~~ All Transmit Frame ~~request~~ requests from this state shall include the read DATA frame from the ST_TTS3:Prepare_Data_In state, the XFER_RDY frame from the ~~SSP~~ ST_TTS4:Prepare_Xfer_Rdy state, or the RESPONSE frame from the ST_TTS6:Prepare_Response state and the following arguments to be used for any OPEN address frame:

a) 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 or argument is Transmission Status (I_T Nexus Loss), then this state shall send a Transmission Complete (I_T Nexus Loss) message to the ST_TFR state machine. The Transmission Complete message shall include the tag as an argument.

If the confirmation or argument is not Transmission Status (Frame Transmitted) or Transmission Status (I_T Nexus Loss)~~, and the Transmit Frame request was for an XFER_RDY, DATA, or RESPONSE frame~~, then this state shall send ~~a~~ the Transmission Complete ~~(Connection Failed)~~ message defined in table 114 to the ST_TFR 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:

a) an XFER_RDY frame; or
b) a RESPONSE frame,

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).

If the confirmation or argument is Transmission Status (Frame Transmitted), the Transmit Frame request was for a read DATA frame, and the Read Data Offset state machine variable is equal to the Request Byte Count Data-In argument, then this state shall wait to receive:

a) Transmission Status (ACK Received) confirmations or arguments for each outstanding read DATA frame; or
b) one of the following:
   A) Transmission Status (NAK Received);
   B) Transmission Status (ACK/NAK Timeout); or
   C) Transmission Status (Connection Lost Without ACK/NAK).

NOTE 62 - If the number of data bytes that have been transmitted for a Request (Send Data-In) message are fewer than the Data-In Request Byte Count argument, then this state transitions to the ST_TTS3:Prepare_Data_In state to construct the additional read 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.

If a confirmation of Transmission Status (ACK Received) is received and the Transmit Frame request was for a read DATA frame, then this state shall set the Balance Point Read Data Offset state machine variable to the current balance point read data offset plus the Read Data Offset state machine variable.

If a confirmation of Transmission Status (Frame Transmitted) is received and the Transmit Frame request was for a read DATA frame, then this state shall set the Read Data Offset state machine variable to the current read data offset plus the number of read data bytes in the transmitted read DATA frame. The Read Data Offset state machine variable shall be adjusted before checking if the data transfer is complete.

If transport layer retries are enabled, the Transmit Frame request was for a RESPONSE frame, the vendor-specific number of retries has not been reached, and this state receives 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).

then this state shall:

a) set the RETRANSMIT bit to one; and
b) resend a Transmit Frame (Interlocked) request to the port layer for the failed RESPONSE frame.

If ~~the confirmation is Transmission Status (Frame Transmitted) and~~ transport layer retries are enabled, the Transmit Frame request was for ~~an~~ a XFER_RDY ~~frame, a RESPONSE~~ frame, ~~or a read DATA frame where~~ the vendor-specific number of ~~bytes that have been transmitted equal the request byte count (i.e., all data retries~~ has not been ~~transferred for the request)~~reached, ~~then~~ and this state ~~shall wait to receive~~ receives 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 63 - 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 read 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 read DATA frames sent for the I_T_L_Q nexus (see 8.2.4.3.3.3.4).~~

then this state shall:

a) set the RETRANSMIT bit to one;
b) set the value in the TARGET PORT TRANSFER TAG field to a value that is different than the target port transfer tag in the previous XFER_RDY frame associated with the Data-out arguments and is different than any other target port transfer tag currently in use. If write 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; and
c) resend a Transmit Frame (Interlocked) request to the port layer for the failed XFER_RDY frame.

Table 114 defines the ~~confirmations to be received from the port layer after a Transmission Status (Frame Transmitted) and the message~~ messages that ~~shall be sent by~~ this state shall send to the ST_TFR state

machine upon receipt of the ~~confirmation~~ listed confirmations, based on the conditions under which ~~the~~ each confirmation was received.

~~Table 131 — Messages sent to the ST_TFR state machine based on port layer confirmations~~

~~Confirmation received from the port layer~~	~~Conditions under which confirmation was received~~	~~Message sent to the ST_TFR state machine~~
~~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 read 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 read 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 a read 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 a read DATA frame; and~~ ~~b) the vendor-specific number of retries has been reached~~	~~Transmission Complete (Data Failed, Connection Failed)~~

Table 132 — Messages sent to the ST_TFR state machine

Confirmation received from the port layer	Conditions under which confirmation was received	Message sent to the ST_TFR state machine
Transmission Status (ACK Received)	The Transmit Frame request was for an XFER_RDY frame.	Transmission Complete (Xfer_Rdy Delivered) with a Target Port Transfer Tag argument
	Transmit Frame request was for a RESPONSE frame	Transmission Complete (Response Delivered)
	The Transmit Frame request was for a read DATA frame and: a) the Read Data Offset state machine variable is equal to the Data-In Request Byte Count argument; and b) the Read Data Offset state machine variable is equal to the Balance Point Read Data Offset state machine variable.	Transmission Complete (Data-In Delivered)
Transmission Status (NAK Received), Transmission Status (ACK/NAK Timeout), or Transmission Status (Connection Lost Without ACK/NAK)	The Transmit Frame request was for a RESPONSE frame and the vendor-specific number of retries has been reached.	Transmission Complete (Response Failed)
Transmission Status (NAK Received)	The Transmit Frame request was for an XFER_RDY frame and: a) if transport layer retries is disabled (see x.x.x); or b) if transport layer retries is enabled and 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)		Transmission Complete (Xfer_Rdy Failed, Connection Failed)
Transmission Status (NAK Received)	The Transmit Frame request was for a read DATA frame and: a) if transport layer retries is disabled (see x.x.x); or b) if transport layer retries is enabled and the vendor-specific number of retries has been reached.	Transmission Complete (Data-In Failed, NAK Received)
Transmission Status (ACK/NAK Timeout) or Transmission Status (Connection Lost Without ACK/NAK)		Transmission Complete (Data-In Failed, Connection Failed)

If this state receives a Cancel message ~~from the ST_TFR state machine~~ or a Cancel argument 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~~Data Transfer Terminated) message to the ST_TFR state machine.

If this state receives a Cancel message ~~from the ST_TFR state machine~~ or a Cancel argument 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. The 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~~Data Transfer Terminated) message to the ST_TFR state machine.

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

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

8.2.5.3.3.3.3 Transition ST_TTS2:Target_Send_Frame to ST_TTS1:Target_Start

This transition shall occur after this state has sent a Transmission Complete message other than Transmission Complete (Xfer_Rdy Delivered) to the ST_TFR state machine.

8.2.5.3.3.3.4 Transition ST_TTS2:Target_Send_Frame to ST_TTS3:Prepare_Data_In

~~This transition shall occur after this state:~~

This transition shall occur after this state receives a Transmission Status (Frame Transmitted) confirmation for a read DATA frame and Read Data Offset state machine variable is less than the Request Byte Count Data-In argument.

If transport layer retries is enabled and the vendor-specific number of retries, if any, for the read DATA frame has not been reached, this transition shall occur and include a Retry argument after this state receives one of the following confirmations for a read DATA frame:

a) ~~receives a~~ Transmission Status (~~ACK~~ NAK Received~~) confirmation for an XFER_RDY frame~~);
~~b) receives a Transmission Status (Frame Transmitted) confirmation for a read 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 read DATA frame for which a Transmission Complete message was not sent to the ST_TFR state machine (i.e., in order to retry transmitting the frame when the vendor-specific number of retries has not been reached).~~

~~**8.2.5.3.3.3.5 Transition ST_TTS2:Target_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.~~

~~**8.2.5.3.3.3.6 Transition ST_TTS2:Target_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.~~

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

8.2.5.3.3.3.7 Transition ST_TTS2:Target_Send_Frame to

~~ST_TTS7~~ST_TTS5:~~Prepare_Response~~Receive_Data_Out

~~This transition shall occur after:~~

~~a) this state machine receives a Request (Send Transport Response) message from the ST_TFR state machine;~~

This transition shall occur after this state ~~machine receives~~ sends a ~~Request~~ Transmission Complete (~~Send Application Response~~Xfer_Rdy Delivered) message ~~from~~ to the ST_TFR state machine~~; or~~.

~~b) 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 number of retries for a RESPONSE frame shall be greater than or equal to one.~~

8.2.5.3.3.4 ST_TTS3:Prepare_Data_In state

8.2.5.3.3.4.1 State description

This state retrieves the data from the Device Server Buffer and constructs a read DATA frame~~. This state shall use arguments received in the Request (Send Data-In) message to construct the frame (see 8.2.4.3.2)~~.

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

This state shall construct a read DATA frame using the Data-In arguments (see 8.2.4.3.2) as follows:

a) FRAME TYPE field set to 01h (i.e., DATA frame);
b) HASHED DESTINATION SAS ADDRESS field set to the hashed value of the ~~specified destination~~ Destination SAS ~~address~~Address Data-In argument;
c) HASHED SOURCE SAS ADDRESS field set to the hashed value of the SSP target port's SAS address;
d) RETRY DATA FRAMES bit set to zero;
e) RETRANSMIT bit set to zero;
f) CHANGING DATA POINTER ~~bit~~ set ~~to zero, unless otherwise~~ as specified in this subclause;
g) NUMBER OF FILL BYTES field set to the number of fill bytes needed for the specified read data;
h) TAG field set to the ~~specified tag~~Tag Data-In argument;
i) TARGET PORT TRANSFER TAG field set to zero;
j) DATA OFFSET field set as specified in this subclause; and
k) in the information unit, DATA field set ~~to the~~ as specified ~~data~~in this subclause; and
l) fill bytes, if ~~any~~required.

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

~~If this state is entered after the ST_TTS2:Target_Send_Frame state received a Transmission Status (Frame Transmitted) confirmation and ST_TTS2:Target_Send_Frame state has only received confirmations of Transmission Status (Frame Transmitted) and Transmission Status (ACK Received), then this state shall generate the following values when constructing the frame:~~

If this state is entered without a Retry argument then this state shall:

a) set the CHANGING DATA POINTER bit set to zero; and
~~b) set the DATA OFFSET field set to the value in the DATA OFFSET field in the previous read DATA frame plus the number of bytes in the previous DATA information unit.~~

~~If this state is entered after the ST_TTS2:Target_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 state machine (i.e., to retry transmitting a frame), then this state shall generate the following values when constructing the frame:~~

c) set the DATA OFFSET field to the Read Data Offset state machine variable;
d) in the information unit, set the DATA field to the data at the pointed to by the Read Data Offset state machine variable in the specified device server buffer with the length being the lesser of:

A) the Data-In Request Byte Count argument minus the Read Data Offset state machine variable; and
B) the maximum size of the DATA information unit.

If this state is entered with a Retry argument then this state shall:

a) set the CHANGING DATA POINTER bit in the frame to one; and
b) set the DATA OFFSET field to ~~a data offset value associated with a previous ACK/NAK balance.~~Balance Point Read Data Offset state machine variable
c) in the information unit, set the DATA field to the data at the pointed to by the Balance Point Read Data Offset state machine variable in the specified device server buffer with the length being the lesser of:
   A) the Data-In Request Byte Count argument minus the Balance Point Read Data Offset state machine variable; and
   B) the maximum size of the DATA information unit.

If a confirmation of Transmission Status (ACK Received) is received, then this state shall set the Balance Point Read Data Offset state machine variable to the current balance point read data offset plus the Read Data Offset state machine variable.

If a confirmation of Transmission Status (Frame Transmitted) is received, then this state shall set the Read Data Offset state machine variable to the current read data offset plus the number of read data bytes in the transmitted read DATA frame.

8.2.5.3.3.4.2 Transition ST_TTS3:Prepare_Data_In to ST_TTS2:Target_Send_Frame

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

a) ~~This transition shall occur after this state~~ constructs a read DATA frame.; or
b) receives a Cancel message.

This transition shall include the received Transmission Status, if any, as an argument and the:

a) read DATA frame as an argument; or
b) if a Cancel message was received, then a Cancel argument.

8.2.5.3.3.5 ST_TTS4:Prepare_Xfer_Rdy state

8.2.5.3.3.5.1 State description

This state shall construct an XFER_RDY frame using ~~arguments received in~~ the ~~Request (Receive~~ Data-~~Out) message (see 8.2.4.3.2)~~Out state machine arguments:

a) FRAME TYPE field set to 05h (i.e., XFER_RDY frame);
b) HASHED DESTINATION SAS ADDRESS field set to the hashed value of the ~~specified destination~~ Destination SAS ~~address~~Data-Out address argument;
c) HASHED SOURCE SAS ADDRESS field set to the hashed value of the SSP target port's SAS address;
d) RETRY DATA FRAMES bit set to the value of the TRANSPORT LAYER RETRIES bit in the Protocol-Specific Logical Unit mode page (see 10.2.6.3);
e) set the RETRANSMIT bit set to zero~~, unless otherwise specified in this subclause~~;
f) CHANGING DATA POINTER bit set to zero;
g) NUMBER OF FILL BYTES field set to zero;
h) TAG field set to the ~~specified tag~~Tag Data-Out argument;
~~i) TARGET PORT TRANSFER TAG field set to a vendor-specific value, unless otherwise specified in this subclause;~~
j) TARGET PORT TRANSFER TAG field set to a vendor-specific value, unless the TRANSPORT LAYER RETRIES bit is set to one in the Protocol-Specific Logical Unit mode page (see x.x.x), then set the TARGET PORT TRANSFER TAG field to a value that is different than the target port transfer tag in the previous XFER_RDY frame associated with the Data-Out arguments and is different from any other target port transfer tag currently in use. If write 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;
k) DATA OFFSET field set to zero; and

l) in the information unit, REQUESTED OFFSET field set to the ~~specified data offset~~Requested Write Data Offset state machine variable; ~~and~~
m) in the information unit, WRITE DATA LENGTH field set ~~to the~~ as specified ~~write data length.~~in this subclause; and

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

~~If this state is entered after the ST_TTS2:Target_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 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 write 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.~~
c) no fill bytes.

If the SSP target port determines all the write data indicated in the Requested Write Data Length state machine variable is able to be requested by this XFER_RDY frame, then set the WRITE DATA LENGTH field in the information unit to the Requested Write Data Length state machine variable.

If the SSP target port determines all the write data indicated in the Requested Write Data Length state machine variable is not able to be requested by this XFER_RDY frame (e.g., the SSP target port has a vender specific limit), then set the WRITE DATA LENGTH field in the information unit and the Requested Write Data Length state machine variable to a value representing the amount of write data that is able to be transferred.

8.2.5.3.3.5.2 Transition ST_TTS4:Prepare_Xfer_Rdy to ST_TTS2:Target_Send_Frame

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

a) constructs an XFER_RDY frame; or
b) receives a Cancel message.

This transition shall include the:

a) if a Cancel message was received, then a Cancel argument; or
b) XFER_RDY frame as an argument.

8.2.5.3.3.6 ST_TTS5:Receive_Data_Out state

8.2.5.3.3.6.1 State description

On entry into this state the Write Data Received variable is set to the Requested Write Data Offset state machine variable.

If this state receives a Data-Out Arrived ~~message from the ST_TFR state machine~~message, then this state shall verify the write DATA frame received with the Data-Out Arrived values as specified in table 115. If the

verification test fails, then this state sends the message ~~as follows:~~specified in table 115 to the ST_TFR state machine.

Table 133 — Reception Complete message for write DATA frame verification failures

Message sent to ST_TFR [a]	Condition
Reception Complete (Data Offset Error)	Transport layer retries are not supported, and the DATA OFFSET field is not equal to the Write Data Received variable.
	The DATA OFFSET field is: a) less than the Requested Write Data Offset state machine variable; or b) greater than or equal to the Requested Write Data Offset state machine variable plus the Requested Write Data Length state machine variable.
Reception Complete (Too Much Write Data)	The number of bytes in the DATA field plus the Write Data Received variable is greater than the Request Byte Count Data-Out state machine argument.
Reception Complete (Information Unit Too Short)	The number of bytes in the DATA field is zero.

[a] If more than one condition is true that result in a different messages, then the state shall select which message to send to the ST_TFR state machine using the following order:
1) Reception Complete (Data Offset Error);
2) Reception Complete (Too Much Write Data); or
3) Reception Complete (Information Unit Too Short).

~~1) If the data offset was not expected (i.e., the CHANGING DATA POINTER bit is set to one and the value in the DATA OFFSET field is not set to the data offset associated with the XFER_RDY frame, 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 write 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 state machine;~~
~~2) If first burst is enabled and the length of the information unit DATA field is greater than the amount indicated by the FIRST BURST SIZE field in the Disconnect-Reconnect mode page (see 10.2.7.1.5), or if an XFER_RDY frame was sent requesting the write data and the length of the information unit DATA field plus the length of the write data previously received is greater than that specified by the XFER_RDY frame, then this state shall send a Reception Complete (Too Much Write Data) message to the ST_TFR state machine; and~~
~~3) If the length of the information unit DATA field is zero, then this state shall send a Reception Complete (Information Unit Too Short) message to the ST_TFR state machine.~~

~~The Reception Complete message, if any, shall include the tag as an argument.~~

If:

a) transport layer retries are supported;
b) the CHANGING DATA POINTER bit is set to zero; and
c) the value in the DATA OFFSET field is not equal to the Write Data Received variable,

then this state should discard all Data-Out Arrived messages until the CHANGING DATA POINTER bit is set to one. This state shall resume processing additional Data-Out Arrived messages when it receives a Data-Out Arrived message with the CHANGING DATA POINTER bit set to one.

If the WRITE data frame is verification is successful and the Data-Out Arrived message in not discarded, then this state shall:

a) set the Write Data Received variable to the current Write Data Received variable plus the number of bytes received in the DATA field of the write information unit; and

b) process the write data as indicated in the Data-Out state machine arguments using the Device Server Buffer (e.g., logical block address) to which the write data is to be transferred.

If the WRITE data frame is verification is successful and the CHANGING DATA POINTER bit set to one, then this state shall:

a) set the Write Data Received variable to the Requested Write Data Offset state machine variable; and
b) process the write data as indicated in the Data-Out state machine arguments using the Device Server Buffer (e.g., logical block address) to which the write data is to be transferred.

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

~~a) this state is entered from the ST_TTS1:Target_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:Target_Send_Frame state (i.e., an XFER_RDY was successfully transmitted); or~~
a) upon entry into this state; and
b) when this state ~~is entered from~~ receives and verifies the write DATA frame received with the ~~ST_TTS6:Process_Data_Out state~~ Data-Out Arrived values (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 state machine.

If Write Data Received variable equals the Request Byte Count Data-Out state machine argument, then this state shall send a Reception Complete (Data-Out Received) message to the ST_TFR state machine after a Reception Complete (ACK Transmitted) confirmation is received for each write DATA frame previously received.

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~~receives a Cancel message, then this state shall send a Reception Complete (~~Data-Out Received~~Data Transfer Terminated) message to the ST_TFR state machine.

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

The Reception Complete message, if any, shall include the tag as an argument.

8.2.5.3.3.6.2 Transition ST_TTS5:Receive_Data_Out to ~~ST_TTS6~~ST_TTS1:~~Process_Data_Out~~Target_Start

This transition shall occur after this state ~~receives and verifies~~ sends a ~~Data-Out Arrived message~~Reception Complete message to the ST_TFR state machine.

8.2.5.3.3.6.3 Transition ST_TTS5:Receive_Data_Out to ~~ST_TTS1~~ST_TTS4:~~Target_Start~~Prepare_Xfer_Rdy

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

This transition shall occur:

1) if the Write Data Received variable is less than Request Byte Count Data-Out state machine argument and equal to the Requested Write Data Offset state machine variable plus the Requested Write Data Length state machine variable;
2) a Reception Complete (ACK Transmitted) confirmation is received for each write DATA frame previously received;
3) setting the Requested Write Data Length state machine variable to the Request Byte Count Data-Out state machine argument minus the Requested Write Data Offset state machine variable; and

4) setting the Requested Write Data Offset state machine variable to the Write Data Received state machine variable.

8.2.5.3.3.7 ST_TTS6:~~Process_Data_Out~~ Prepare_Response state

8.2.5.3.3.7.1 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.~~

~~8.2.5.3.3.7.2 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.~~

~~8.2.5.3.3.8 ST_TTS7:Prepare_Response state~~

~~8.2.5.3.3.8.1 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 using arguments received with the Request message (see 8.2.4.3.2):~~

This state shall construct a RESPONSE frame using the received Application Response arguments or the received Transport Response arguments as follows:

a) FRAME TYPE field set to 07h (i.e., RESPONSE frame);
b) HASHED DESTINATION SAS ADDRESS field set to the hashed value of the ~~specified~~ Application Response or Transport Response destination SAS ~~address~~address argument;
c) HASHED SOURCE SAS ADDRESS field set to the hashed value of the SSP target port's SAS address;
d) RETRY DATA FRAMES bit set to zero;
e) RETRANSMIT bit set to zero;
f) CHANGING DATA POINTER bit set to zero;
g) TAG field set to the Tag Application Response argument or the Tag Transport Response argument;
h) TARGET PORT TRANSFER TAG field set to ~~the specified tag~~zero;
i) ~~TARGET PORT TRANSFER TAG~~ DATA OFFSET field set to zero;
~~j) DATA OFFSET field set to zero.~~
k) information unit set as specified in this subclause; and
l) fill bytes, if needed as specified in this subclause.

If this state was entered ~~as a result of this state machine receiving a Request (Send~~ with the Transport ~~Response)~~Response arguments, then this state shall set the fields ~~relating to the information unit~~ as follows:

a) NUMBER OF FILL BYTES field set to the number of fill bytes, based on the length of the response data, if any;
b) in the information unit, set the DATAPRES field ~~set~~ to ~~RESPONSE_DATA~~RESPONSE DATA;
c) in the information unit, set the STATUS field ~~set~~ to zero;
d) in the information unit, set the SENSE DATA LENGTH field ~~set~~ to zero;
e) in the information unit, set the RESPONSE DATA LENGTH field ~~set~~ to 00000004h;
f) in the information unit, set the RESPONSE DATA field ~~set~~ as specified in table 116;
g) in the information unit, do not include the SENSE DATA ~~field not included~~field; and
~~h) fill bytes, if any.~~
i) NUMBER OF FILL BYTES field set to the number of fill bytes, based on the length of the response data, if needed.

Table 116 specifies how the RESPONSE DATA field shall be set based on the arguments received with the Request (Send Transport Response) message.

Table 134 — Request argument to RESPONSE frame RESPONSE DATA field mapping

Request argument	RESPONSE frame RESPONSE DATA field
Invalid Frame	INVALID FRAME
Function Complete	TASK MANAGEMENT FUNCTION COMPLETE
Function Succeeded	TASK MANAGEMENT FUNCTION SUCCEEDED
Function Not Supported	TASK MANAGEMENT FUNCTION NOT SUPPORTED
Function Failed	TASK MANAGEMENT FUNCTION FAILED
Incorrect Logical Unit Number	INCORRECT LOGICAL UNIT NUMBER
Overlapped Tag Attempted	OVERLAPPED TAG ATTEMPTED

If this state was entered ~~as a result of this state machine receiving a Request (Send~~ with the Application ~~Response) message~~Response arguments, then this state shall ~~shall~~ set the fields ~~relating to the information unit~~ as follows:

~~a) NUMBER OF FILL BYTES field set to the number of fill bytes, based on the length of the specified sense data, if any;~~

a) in the information unit, set the DATAPRES field ~~set~~ to SENSE_DATA if sense data is specified or NO_DATA if sense data is not specified;

b) in the information unit, set the STATUS field ~~set~~ to the specified status;

c) in the information unit, set the SENSE DATA LENGTH field ~~set~~ to the length of the specified sense data, if any;

d) in the information unit, set the RESPONSE DATA LENGTH field ~~set~~ to zero;

e) in the information unit, do not include the RESPONSE DATA ~~field not included~~field;

f) in the information unit, set the SENSE DATA field ~~set~~ to the specified sense data, if any; and

~~g) fill bytes, if any.~~

~~If this state was entered as the result of the ST_TTS2:Target_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.~~

h) NUMBER OF FILL BYTES field set to the number of fill bytes, based on the length of the specified sense data, if needed.

8.2.5.3.3.8.2 Transition ~~ST_TTS7~~ST_TTS6:Prepare_Response to ST_TTS2:Target_Send_Frame

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

This transition shall include:

a) the RESPONSE frame; or

~~This transition shall occur after this state constructs~~ if a Cancel message was received, then a ~~RESPONSE frame~~Cancel argument.