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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.

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 all deletes and adds marked

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) ~~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.

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).

Figure 149 shows the ST_I state machines.

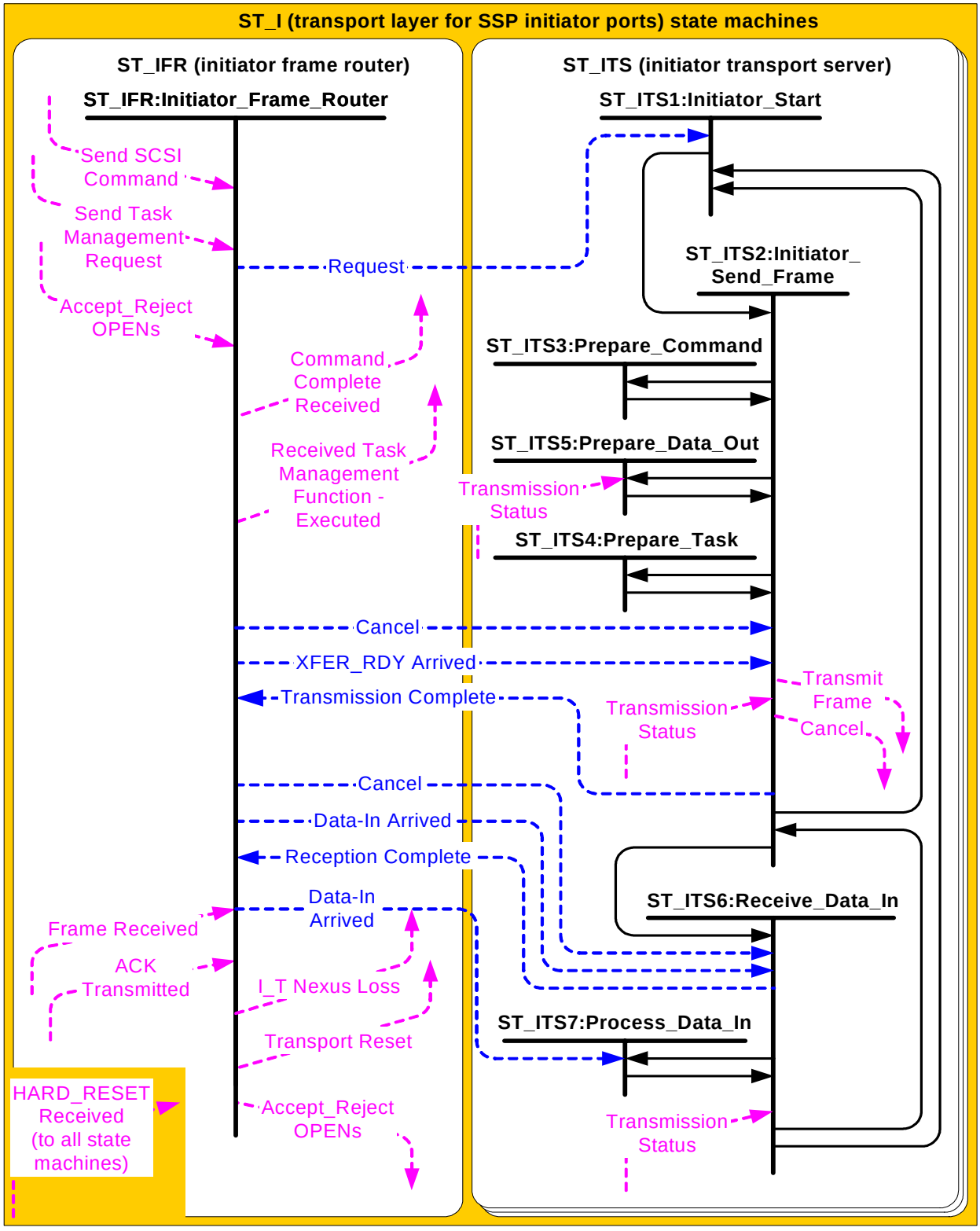

Figure 149 — ST_I (transport layer for SSP initiator ports) state machines

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Editor's Note 13: Added Data-In Arrived message into ST_ITS7 and Transmission Status

confirmation into ST_ITS5 to allow for non-interlocked DATA frame transfers.

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.

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 to the ST_ITS1:Initiator_Start state in an ST_ITS state machine that does not have an active task:

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

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

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 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 the frame type argument in the frame received ~~as an argument~~ with the 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 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 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.

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 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 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 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 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.~~then:

a) this state machine shall send a protocol service confirmation to the SCSI application layer based on the content of the DATAPRES and RESPONSE DATA fields; and
b) if there is an ST_ITS state machine for the tag associated with the RESPONSE, then send a Cancel message to that state machine.

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.

If the frame type is XFER_RDY and the items 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) retransmit;
d) ~~the~~ target port transfer tag; and
e) ~~the~~ information unit.

If the frame type is DATA and the items 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~~read DATA frame as an argument.

This state machine receives Transmission Complete messages and Reception Complete messages from the ST_ITS state machines that may result in this state machine sending one of the following 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 103 — 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)

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

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 Cancel messages to all the ST_ITS state machines.

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);
f) ST_ITS6:Receive_Data_In state (see 8.2.4.2.3.7); and
g) ST_ITS7:Process_Data_In state (see 8.2.4.2.3.8).

~~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.~~

This state machine shall transition to the ST_ITS1:Initiator_Start state from any other state after receiving a HARD_RESET Received confirmation.

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.

8.2.4.2.3.2.2 Transition ST_ITS1:Initiator_Start to ST_ITS2:Initiator_Send_Frame

This transition shall occur after this state receives a Request message from the ST_IFR state machine.

If a Request (Send Command) message was received this transition shall include all the Command arguments.

If a Request (Send Task) message was received this transition shall include all the Task arguments.

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~~frame performing 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: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~~ All Transmit Frame ~~request~~ requests shall include the SSP frame (e.g., COMMAND frame from ST_ITS3:Prepare_Command state or from ST_ITS6:Receive_Data_In, TASK frame from ST_ITS4:Prepare_Task state, DATA frame from ST_ITS7: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 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 ~~this state machine receives a~~ the confirmation ~~that~~ is not Transmission Status (Frame Transmitted) or Transmission Status (I_T Nexus Loss) (see ~~table 100~~ table xxx in 8.2.2.3.4), then this state shall send ~~a~~ the Transmission Complete ~~(Connection Failed)~~ message indicated in table 104 to the ST_IFR state machine. The message shall include the following arguments:

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 performing a read operation, a TASK ~~frame~~ 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).

NOTE 43 - 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.

If the confirmation is Transmission Status (NAK Received), the Transmit Frame request was for a COMMAND frame not performing a read operation or a TASK frame, and a vendor specific number of retries has not been reached, then this state shall process:

a) the COMMAND frame as if it was received from the ST_ITS3:Prepare_Command state; or
b) the TASK frame as if it was received from the ST_ITS4:Prepare_Task state.

Table 104 defines the confirmations received from the port layer after a Transmission Status (Frame Transmitted) and the message that shall be sent by this state to the ST_IFR state machine upon receipt of the confirmation based on the conditions under which the confirmation was received.

Table 104 — 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 and: a) the number of data bytes transmitted equal the request byte count; and b) 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 and if the vendor-specific number of retries has been reached.	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 and if 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 XFER_RDY had its RETRY DATA FRAMES bit set to zero; or b) the XFER_RDY had its RETRY DATA FRAMES bit set to one, 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)		Transmission Complete (Data Failed, Connection Failed)

~~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.~~

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

NOTE 44 - The application client may determine the command was received and is being processed by the device server and allow the command to complete.

NOTE 45 - 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 Cancel message from the ST_IFR state machine, and this state has received confirmations for all Transmit Frame requests sent to the port layer, then this state 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, 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.

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 the write data length is zero or exceeds the amount of write data remaining to be transferred for the command, then this state shall send a Transmission Complete (XFER_RDY Incorrect Write Data Length) message to the ~~ST_IPR~~ 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.~~

If this state machine receives an XFER_RDY Arrived message, does not support transport layer retries of DATA frames, the RETRY DATA FRAMES bit is set to zero, and the requested offset is not expected (e.g., the data offset is not set to a value in the DATA OFFSET field in the previous XFER_RDY information unit plus the number of bytes transferred as a result of the previous XFER_RDY information unit), then this state shall send a Transmission Complete (XFER_RDY Requested Offset Error) message to the ST_IFR state machine.

8.2.4.2.3.3.3 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:

a) a Transmission Complete (Command Delivered) message;
b) if the vendor-specific number of retries of the COMMAND frame has been reached, then a Transmission Complete (Command Failed, NAK Received) message;
c) if the vendor-specific number of retries of the TASK frame has been reached, then a Transmission Complete (~~Command~~ Task Failed, NAK Received) message;
d) a Transmission Complete (Command Failed, Connection failed) message and the command was for a non-data operation;
e) any Transmission Complete message for a TASK or write DATA frame; or
f) a Transmission Complete (Cancel Acknowledged~~)~~) message.

8.2.4.2.3.3.4 Transition ST_ITS2:Initiator_Send_Frame to ST_ITS3:Prepare_Command

This transition shall occur ~~after~~ if this state was entered from the ST_ITS1:Initiator_Start state ~~receives a Request (Send Command) message~~ with Command arguments.

This transition shall include all the Command arguments.

8.2.4.2.3.3.5 Transition ST_ITS2:Initiator_Send_Frame to ST_ITS4:Prepare_Task

This transition shall occur ~~after~~ if this state was entered from the ST_ITS1:Initiator _Start state ~~receives a Request (Send~~ with Task ~~message)~~arguments.

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

8.2.4.2.3.3.6 Transition ST_ITS2:Initiator_Send_Frame to ST_ITS5:Prepare_Data_Out

This transition shall include a No-retry argument and occur after this state receives:

a) a Transmission Status (Frame Transmitted) confirmation followed by a Transmission Status (ACK_Received) confirmation for a COMMAND frame for a write operation and first burst is enabled;
b) an XFER_RDY Arrived message~~;~~; or
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;

NOTE 46 - 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.

~~d) 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~~
~~e) 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 for a write DATA frame from the port layer or messages from the ST_ITS5:Prepare_Data_Out state:
   A) Transmission Status (NAK Received);
   B) Transmission Status (ACK/NAK Timeout); or
   C) Transmission Status (Connection Lost without ACK/NAK) confirmation;
b) the XFER_RDY frame contained a RETRY DATA FRAMES bit set to one; and
c) the vendor-specific number of retries, if any, for the write DATA frame has not been exceeded.

This transition shall include all the:

a) Xfer_Rdy arguments: and
b) Command arguments.

8.2.4.2.3.3.7 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 a read operation.

This transition shall include all the Command arguments.

NOTE 47 - 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 based on the ~~values received with the Request (Send Command) message~~Command arguments:

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 SAS address;
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;
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;
l) in the information unit, ENABLE FIRST BURST bit set to the specified enable first burst bit;
m) in the information unit, TASK PRIORITY field set to the specified task priority;
n) in the information unit, TASK ATTRIBUTE field set to the specified task attribute;
o) in the information unit, ADDITIONAL CDB LENGTH field set to the specified additional CDB length;
p) in the information unit, CDB field set to the specified CDB; and
q) in the information unit, ADDITIONAL CDB BYTES field set to the specified additional CDB bytes, if any.

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 constructs a COMMAND frame.

This transition shall include the COMMAND frame as an argument.

This transition shall ~~occur after this state constructs a COMMAND frame~~include all the Command arguments.

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 based on ~~values received with 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 SAS address;
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;
f) CHANGING DATA POINTER bit set to zero;
g) NUMBER OF FILL BYTES field set zero.
h) TAG field set to the specified tag;
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;
l) in the information unit, TASK MANAGEMENT FUNCTION field set to the specified task management function; and
m) in the information unit, TAG OF TASK TO BE MANAGED field set to the specified tag of task to be managed.

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 constructs a TASK frame.

This transition shall include the TASK frame as an 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 based on ~~values either received with~~ the ~~Request (Send Command) message~~ Xfer_Rdy arguments or, if first burst is ~~enabled or with an XFER_RDY Arrived message~~enabled, the command 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 SAS address;
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;
i) TARGET PORT TRANSFER TAG field set to the specified target port transfer tag;
j) DATA OFFSET field set ~~to the specified data offset, unless otherwise~~ as specified in this subclause; and
k) in the information unit, DATA field set to the specified data.
l) fill bytes, if any.

If this state is ~~the first write DATA frame constructed by this state,~~ entered with a No-retry argument then this state shall set the CHANGING DATA POINTER bit to ~~zero.~~zero and;

~~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:~~

~~a) set the CHANGING DATA POINTER bit to zero; and~~
a) if this state was entered with Xfer_Rdy arguments, then 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~~.~~; or

~~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:~~

b) if this state was entered with Commands arguments, then set the DATA OFFSET field to zero.

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

a) if this state was entered with Xfer_Rdy arguments, then set the DATA OFFSET field to the data offset value associated with the XFER_RDY frame; or
b) if this state was entered with command arguments, then set the DATA OFFSET field to ~~the data offset value associated with the XFER_RDY frame~~zero.

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 constructs a write DATA frame.

This transition shall include:

a) all the Xfer_Rdy arguments:
b) all the Command arguments;
c) the DATA frame as an argument; and
d) the received Transmission Status, if any, as an 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 from the ST_IFR state ~~machine~~machine or a read Data-In Arrived argument from the ST_ITS7:Process_Data_In state, then this state shall verify the read DATA frame received with the ~~message~~ Data-In Arrived values as ~~follows~~specified in table 105:

~~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~~

~~3) If the length of the information unit DATA field (i.e., the length of the information unit) is zero, then this state shall send a Reception Complete (Incorrect Data Length) message to the ST_IFR state machine.~~

Table 105 — Reception Complete message sent on DATA frame verification failure

Verification [a]	Message sent to ST_IFR	Priority [b]
The transport layer retries of read DATA frames is not supported 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.	Reception Complete (Data Offset Error)	1
The transport layer retries of read DATA frames is supported, the CHANGING DATA POINTER bit is set to zero, and the value in the DATA OFFSET field is outside the range of the requested data.	Reception Complete (Data Offset Error)	1
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).	Reception Complete (Too Much Read Data)	2
The length of the information unit DATA field (i.e., the length of the information unit) is zero.	Reception Complete (Incorrect Data Length)	3

[a] If the verification tests true then the specified message is sent to ST_IFR.
[b] If more that one verification fails the message with the highest priority shall be sent to ST_IFR.

If:

a) transport layer retries of read DATA frames is supported;
b) the CHANGING DATA POINTER bit is set to zero;
c) 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; and
d) value in the DATA OFFSET field is within the range of the requested data,

then this state shall discard all Data-In Arrived messages until the CHANGING DATA POINTER bit is set to one. The Data-in Arrived message with the CHANGING DATA POINTER bit set to one, and any additional Data-in Arrived messages, shall be processed by this state.

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), ~~then~~ this state shall ~~wait to receive a Cancel message from the ST_IFR state machine. If this state receives a Data-In Arrived message after this state sends the Transmission Complete (Command Failed, Connection Failed), then this state shall discard the Data-In Arrived message~~continue processing messages and confirmations.

NOTE 48 - The application client may determine the command was received and is being processed by the device server and allow the command to complete.

NOTE 49 - 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~~ ST_IFR 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.

8.2.4.2.3.7.2 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:

a) a Reception Complete (Data-In Received) 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~~;~~;
d) a Reception Complete (~~Incorrect Data Length~~Cancel Acknowledged) message; or
e) a Reception Complete (~~Cancel Acknowledged~~Data Offset Error) 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 performing a read operation.

This transition shall include all the Command arguments.

8.2.4.2.3.7.4 Transition ST_ITS6:Receive_Data_In to ST_ITS7:Process_Data_In

This transition shall occur after this state receives and verifies ~~a~~ the read DATA frame received with the Data-In Arrived ~~message~~values.

This transition shall include:

a) all the Command arguments; and
b) the read DATA frame as an argument.

8.2.4.2.3.8 ST_ITS7:Process_Data_In state

8.2.4.2.3.8.1 State description

This state shall process the data received ~~with~~ in the ~~Data-In Arrived message~~read DATA frame argument.

8.2.4.2.3.8.2 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~~the read DATA frame argument.

This transition shall include:

a) all the Command arguments;
b) the read DATA frame as an argument; and
c) the received Data-In Arrived, if any, as an argument.

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).

This state machine may maintain the timers listed in table 106.

Table 106 — 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.

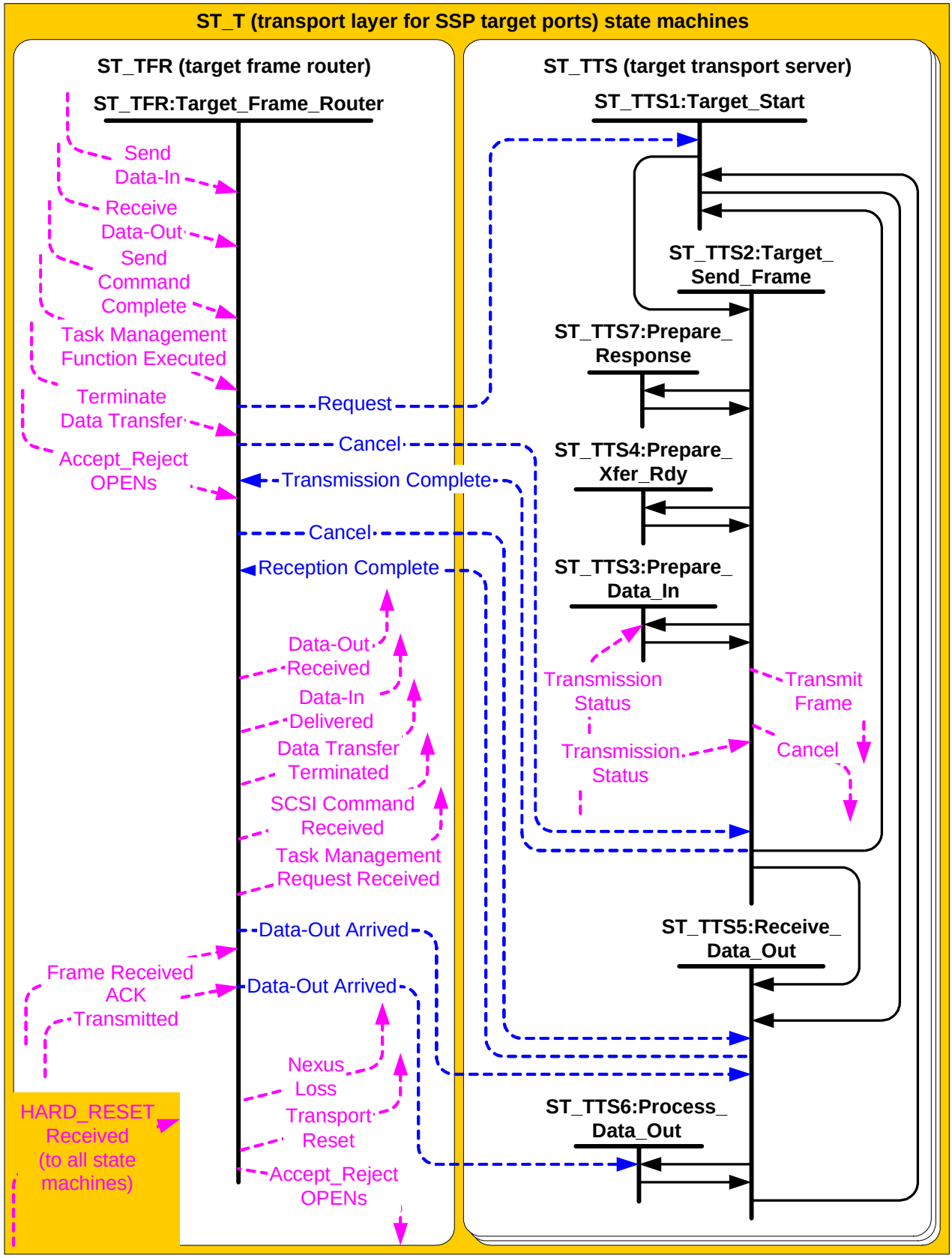

Figure 150 — ST_T (transport layer for SSP target ports) state machines

Editor's Note 14: Added Data-Out Arrived message into ST_TTS6 and Transmission Status confirmation into ST_TTS3 to allow for non-interlocked DATA frame transfers. Also removed the ST_TTS5 to ST_TTS2 transition which was not defined in SAS 1.1. rev 9 and is not needed.

8.2.4.3.2 ST_TFR (target frame router) state machine

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.

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 the reserved fields within the CDB in a COMMAND frame. Checking of reserved fields in a CDB is described in SPC-3.

If the frame type is correct relative to the confirmation, then this state machine may check that the hashed source SAS address matches the SAS address of the SAS port that transmitted the frame and that the hashed destination SAS address 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.

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.

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.

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

If this state machine sends a Request (Send Transport Response) message with an argument of Invalid Frame to ST_TTS1:Target_Start state in an ST_TTS state machine, then this state machine shall discard the frame and shall include the following Transport Response arguments in the message:

a) connection rate;
b) initiator connection tag;
c) destination SAS address set to the SAS address from which the invalid frame was received;
d) source SAS address set to the SAS address of the SAS port containing the state machine; and
e) tag.

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

If the frame type is COMMAND, the items checked in the frame are correct, and this state machine receives an ACK Transmitted confirmation, then this state machine shall send a SCSI Command Received transport protocol service indication 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 checked in the frame are correct, and this state machine receives an ACK Transmitted confirmation, then this state machine shall send a Task Management Request Received transport protocol service indication to the SCSI application layer. The indication shall include:

a) 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 in an XFER_RDY frame for the request, then this state machine shall check the target port transfer tag. If the target port transfer tag does not specify a valid state machine, then this state machine shall discard the frame.

If the frame type is DATA and the items checked in the frame are correct, and there is first burst data enabled or this state machine has received a Transmission Complete (Xfer_Rdy Delivered) from the ST_TTS 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.

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.

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.

A Request (Send Data-In) 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 counts; and
g) application client buffer offset.

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

If this state machine receives a Send Command Complete transport protocol service response from the SCSI application layer 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 Command Complete 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 the argument specified in table 107 and the following Task Complete 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); and
d) tag.

Table 107 specifies which argument to send with Request (Send Transport Response) based on the Service Response argument that was received.

Table 107 — Task Management Function Executed Service Response argument mapping

Task Management Function Executed protocol service response Service Response argument received	Request (Send Transport Response) argument to send
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 108 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 108 — 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

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

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);
f) ST_TTS6:Process_Data_Out (see 8.2.4.3.3.7); and
g) ST_TTS7:Prepare_Response (see 8.2.4.3.3.8).

~~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~~ place the data offset into the DATA OFFSET field of the retransmitted 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 state.~~

This state machine shall transition to the ST_TTS1:Target_Start state from any other state after receiving a HARD_RESET Received confirmation.

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.

8.2.4.3.3.2.2 Transition ST_TTS1:Target_Start to ST_TTS2:Target_Send_Frame

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

If a Request (Send Transport Response) message was received this transition shall include all the Transport Response arguments.

If a Request (Send Data-in) message was received this transition shall include all the Data-in arguments.

If a Request (Send Data-out) message was received this transition shall include all the Data-out arguments.

If a Request (Send Application Response) was received this transition shall include all the received arguments (i.e., the Command Complete arguments or the Task Complete arguments).

8.2.4.3.3.2.3 Transition ST_TTS1:Target_Start to ST_TTS5:Receive_Data_Out

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

This transition shall include all the Data-out 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_TTS7:Prepare_Response state for transmission of a RESPONSE frame, then this state shall send a Transmit Frame (Interlocked) request to the port layer.

NOTE 50 - 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 SSP frame (e.g., DATA frame from the ST_TTS3:Prepare_Data_In state, XFER_RDY frame from the ST_TTS4:Prepare_Xfer_Rdy state, RESPONSE frame from the ST_TTS7: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 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 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 indicated in table 109 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 an XFER_RDY frame, a RESPONSE frame, or a read DATA frame where the number of bytes that have been transmitted equal the request byte count (i.e., all data has been transferred for the request), then this state shall wait to receive one of the following confirmations:

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

NOTE 51 - 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).

Table 109 defines the confirmations to be received from the port layer after a Transmission Status (Frame Transmitted) and the message that shall be sent by this state to the ST_TFR state machine upon receipt of the confirmation based on the conditions under which the confirmation was received.

Table 109 — 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)	The Transmit Frame request was for a read DATA frame and: a) the number of data bytes transmitted equal the request byte count; and b) 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)	The Transmit Frame request was for a RESPONSE frame and the vendor-specific number of retries has been reached.	Transmission Complete (Response Delivery Failed)
Transmission Status (NAK Received)	The Transmit Frame request was for an XFER_RDY frame and: a) the TRANSPORT LAYERS RETRIES bit is set to zero in the Protocol-Specific Logical Unit mode page (see x.x.x); or 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)		Transmission Complete (Xfer_Rdy Failed, Connection Failed)
Transmission Status (NAK Received)	The Transmit Frame request was for a read DATA frame and: a) the TRANSPORT LAYERS RETRIES bit is set to zero in the Protocol-Specific Logical Unit mode page (see x.x.x); or 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)		Transmission Complete (Data Failed, Connection Failed)

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

If this state receives a Cancel message from the ST_TFR state machine and this state has not received confirmations for all Transmit Frame requests sent to the port layer, then this state shall send a Cancel

request to the port layer to cancel previous Transmit Frame requests. 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) 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.

8.2.4.3.3.3.3 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 include a No-retry argument and occur:

a) if this state was entered from the ST_TTS1:Target_Start state with Data-in arguments; or
b) after this state 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.

This transition shall include a Retry argument and occur ~~after this state~~after:

a) this state receives one of the following confirmations for a read DATA frame from the port layer or messages from the ST_TTS3:Prepare_Data_In state:
   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).~~
   A) Transmission Status (ACK/NAK Timeout); or
   B) Transmission Status (Connection Lost without ACK/NAK) confirmation;
d) the TRANSPORT LAYERS RETRIES bit is set to one in the Protocol-Specific Logical Unit mode page (see x.x.x); and
e) the vendor-specific number of retries, if any, for the read DATA frame has not been exceeded.

This transition shall include all the Data-in arguments.

If this state was entered from the ST_TTS1:Target_Start state, then this transition shall include the First Frame argument.

If this state receives a Transmission Status from the port layer or from the ST_TTS3:Prepare_Data_In state, then this transition shall include the Next Frame argument.

8.2.4.3.3.3.5 Transition ST_TTS2:Target_Send_Frame to ST_TTS4:Prepare_Xfer_Rdy

This transition shall include a No-retry argument and occur ~~after~~ if this state was entered from the ST_TTS1:Target_Start state ~~machine has received a Request (Receive~~ with Data-~~Out) message~~ out arguments and:

a) first burst is enabled, all first burst data has been received, and there is more data associated with the Data-out arguments to ~~transfer for the message~~transfer;
b) first burst is not enabled and no XFER_RDY has been transmitted ~~for~~ associated with the ~~message;~~Data-out arguments; or

c) all data for a previous XFER_RDY has been received and there is more data associated with the Data-out arguments to ~~transfer for the message; or~~transfer.

~~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.~~

This transition shall include a Retry argument and occur after:

a) this state receives one of the following confirmation for a XFER_RDY frame:
   A) Transmission Status (NAK Received);
   B) Transmission Status (ACK/NAK Timeout); or
   C) Transmission Status (Connection Lost without ACK/NAK) confirmation;
b) the TRANSPORT LAYERS RETRIES bit is set to one in the Protocol-Specific Logical Unit mode page (see x.x.x); and
c) the vendor-specific number of retries, if any, for the XFER_RDY frame has not been exceeded.

This transition shall include all the Data-out arguments.

If this state was entered from the ST_TTS1:Target_Start state, then this transition shall include the First Xfer_Rdy argument.

If this receives a Transmission Status, then this transition shall include the Next Xfer_Rdy argument.

8.2.4.3.3.3.6 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.

This transition shall include all the Data-out arguments.

8.2.4.3.3.3.7 Transition ST_TTS2:Target_Send_Frame to ST_TTS7:Prepare_Response

This transition shall include a No-retry argument and occur if this state:

a) was entered from the ST_TTS1:Target_Start state with Command Complete arguments; or
b) was entered from the ST_TTS1:Target_Start state with Task Complete arguments.

This transition shall include a Retry argument and the previous RESPONSE frame, and occur if this state:

a) receives one of the following confirmations for a RESPONSE frame:
   A) Transmission Status (NAK Received);
   B) Transmission Status (ACK/NAK Timeout); or
   C) Transmission Status (Connection Lost without ACK/NAK) confirmation; and
b) the vendor-specific number of retries for the RESPONSE frame has not been exceeded. The number of retries for a RESPONSE frame shall be greater than or equal to one.

This transition shall ~~occur after~~include all the:

~~a) this state machine receives a Request (Send Transport Response) message from the ST_TFR state machine;~~
~~b) this state machine receives a Request (Send Application Response) message from the ST_TFR state machine; or~~
~~c) this state receives a Transmission Status (Frame Transmitted) confirmation for a RESPONSE frame followed by a Transmission Status (NAK Received), Transmission Status (ACK/NAK Timeout), or Transmission Status (Connection Lost Without ACK/NAK) confirmation for the frame, and the vendor-specific number of retries has not been reached. The number of retries for a RESPONSE frame shall be greater than or equal to one.~~

a) Command Compete arguments; or
b) Task Compete arguments.

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 use ~~arguments received in~~ the ~~Request (Send~~ Data-~~In) message~~ in arguments to construct the frame (see 8.2.4.3.2).

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

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 SAS address;
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 data;
h) TAG field set to the specified tag;
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 specified data; and
l) fill bytes, if any.

~~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~~ with 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),~~ No-retry argument then this state shall generate the following values when constructing the frame:

a) set the CHANGING DATA POINTER bit set to zero; and
b) if this state is entered with the:
   A) First Frame argument, then set the DATA OFFSET field to the specified application client buffer offset; or
   B) Next Frame argument, then 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 read DATA information unit.

If this state is entered ~~after the ST_TTS2:Target_Send_Frame state received~~ with 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),~~ Retry argument then this state shall generate the following values when constructing the frame:

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.

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 constructs a read DATA frame.

This transition shall include:

a) all the Data-in arguments; and
b) the read DATA frame as an argument; and
c) the received Transmission Status, if any, as an 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 ~~arguments received in~~ the ~~Request (Receive~~ Data-~~Out) message~~ out arguments (see 8.2.4.3.2):

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 SAS address;
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) RETRANSMIT bit set ~~to zero, unless otherwise~~ as 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;
i) TARGET PORT TRANSFER TAG field set to a vendor-specific value, unless otherwise specified in this subclause;
j) DATA OFFSET field set to zero; and
k) in the information unit, REQUESTED OFFSET field set ~~to the~~ as specified ~~data offset~~in this subclause; and
l) in the information unit, WRITE DATA LENGTH field set to the specified write data length.

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:~~

If this state is entered with a No-retry argument then this state shall generate the following values when constructing the XFER_RDY frame:

a) set the RETRANSMIT bit set to zero;
b) if the TRANSPORT LAYER RETRIES bit is set to one in the Protocol-Specific Logical Unit mode page (see x.x.x), then the target port transfer tag value shall be set to a different value for the TARGET PORT TRANSFER TAG field in each XFER_RDY frame than that used in the previous XFER_RDY frame; and
c) if this state is entered with the:
   A) First Xfer_Rdy argument, then set the REQUESTED OFFSET field to the specified application client buffer offset; or
   B) Next Xfer_Rdy argument, then set the REQUESTED OFFSET field to the value in the REQUESTED OFFSET field in the previous XFER_RDY information unit plus the WRITE DATA LENGTH field of the previous XFER_RDY information unit.

If this state is entered with a Retry argument then this state shall generate the following values when constructing the frame:

a) set the RETRANSMIT bit ~~shall be set~~ in the frame 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~~.~~; and
c) set the REQUESTED OFFSET field to a data offset value associated with a previous XFER_RDY information unit.

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 constructs an XFER_RDY frame.

This transition shall include:

a) all the Data-out arguments; and
b) the 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

If this state receives a Data-Out Arrived message from the ST_TFR state ~~machine~~machine or a read Data-Out Arrived argument from the ST_TTS6:Process_Data_Out state, then this state shall verify the write DATA frame received with the ~~message~~ Data-Out Arrived values as ~~follows~~specified in table 110:

~~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 10.2.6.1.5), 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.~~

Table 110 — Reception Complete message sent on DATA frame verification failure

Verification [a]	Message sent to ST_TFR	Priority [b]
The transport layer retries of write DATA frames is supported, 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.	Reception Complete (Data Offset Error)	1
The transport layer retries of write DATA frames is supported, the CHANGING DATA POINTER bit is set to zero, and the value in the DATA OFFSET field is outside the range of the requested data.	Reception Complete (Data Offset Error)	1
The transport layer retries of write DATA frames is not supported 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.	Reception Complete (Data Offset Error)	1
The 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 10.2.6.1.5).	Reception Complete (Too Much Write Data)	2
A 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.	Reception Complete (Too Much Write Data)	2
The length of the information unit DATA field is zero.	Reception Complete (Information Unit Too Short)	3

[a] If the verification tests true then the specified message is sent to ST_TFR.
[b] If more that one verification fails the message with the highest priority shall be sent to ST_TFR.

If transport layer retries of write DATA frames is supported, 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 discard all Data-out Arrived messages until the CHANGING DATA POINTER bit is set to one. The Data-out Arrived message with the CHANGING DATA POINTER bit set to one, and any additional Data-out Arrived messages, shall be processed by this state.

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

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

a) this state is entered from the ST_TTS1: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
c) this state is entered from the ST_TTS6:Process_Data_Out state (i.e., Data-Out data was received and processed).

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

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

If this state is entered from the ST_TTS6:Process_Data_Out state and number of bytes ~~moved for~~ received argument equals the ~~Request (Receive~~ Data-~~Out) message equals the~~ out arguments (i.e., request byte count), then this state shall send a Reception Complete (Data-Out Received) 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.

8.2.4.3.3.6.2 Transition ST_TTS5:Receive_Data_Out to ST_TTS6:Process_Data_Out

This transition shall occur after this state receives and verifies ~~a~~ the write DATA frame received with the Data-Out Arrived ~~message~~values.

This transition shall include the write DATA frame as an argument.

8.2.4.3.3.6.3 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.

8.2.4.3.3.7 ST_TTS6:Process_Data_Out state

8.2.4.3.3.7.1 State description

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

8.2.4.3.3.7.2 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~~the write DATA frame argument.

This transition shall include:

a) the write DATA frame as an arguments;
b) the number of bytes received argument; and
c) the received Data-Out Arrived, if any, as an argument.

8.2.4.3.3.8 ST_TTS7:Prepare_Response state

8.2.4.3.3.8.1 State description

If this state was entered ~~as~~ with a ~~result of this state machine receiving a Request (Send Transport Response) or a Request (Send Application Response) message~~No-retry argument, then this state shall construct a RESPONSE frame using the received Command Complete arguments or the received ~~with the Request message (see 8.2.4.3.2)~~Task Complete 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 destination SAS address;
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 specified tag;
h) TARGET PORT TRANSFER TAG field set to zero;
i) DATA OFFSET field set to zero.

If this state was entered ~~as~~ with a ~~result of this state machine receiving a Request (Send Transport Response)~~No-retry argument and Task Complete arguments, then this state shall set the fields relating to the information unit using the received Task Complete arguments 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, DATAPRES field set to ~~RESPONSE_DATA~~RESPONSE DATA;
c) in the information unit, STATUS field set to zero;
d) in the information unit, SENSE DATA LENGTH field set to zero;
e) in the information unit, RESPONSE DATA LENGTH field set to 00000004h;
f) in the information unit, RESPONSE DATA field set as specified in table 111;
g) in the information unit, SENSE DATA field not included; and
h) fill bytes, if any.

Table 111 specifies how the RESPONSE DATA field shall be set based on the arguments received with the Request (Send Transport Response) message.

Table 111 — 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~~ with a ~~result of this state machine receiving a Request (Send Application Response) message~~No-retry argument and Command Complete arguments, then this state ~~shall~~ shall set the fields relating to the information unit using the received Command Complete arguments 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;
b) in the information unit, DATAPRES field set to SENSE_DATA if sense data is specified or NO_DATA if sense data is not specified;

c) in the information unit, STATUS field set to the specified status;
d) in the information unit, SENSE DATA LENGTH field set to the length of the specified sense data, if any;
e) in the information unit, RESPONSE DATA LENGTH field set to zero;
f) in the information unit, RESPONSE DATA field not included;
g) in the information unit, SENSE DATA field set to the specified sense data, if any; and
h) fill bytes, if any.

If this state was entered ~~as the result of the ST_TTS2:Target_Send_Frame state receiving something other than~~ with 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)~~Retry argument, 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.

8.2.4.3.3.8.2 Transition ST_TTS7:Prepare_Response to ST_TTS2:Target_Send_Frame

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

This transition shall include the RESPONSE frame and all the:

a) Command Complete arguments; or
b) Task Complete arguments.

Sections with changed bars only

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

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

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).

Figure 149 shows the ST_I state machines.

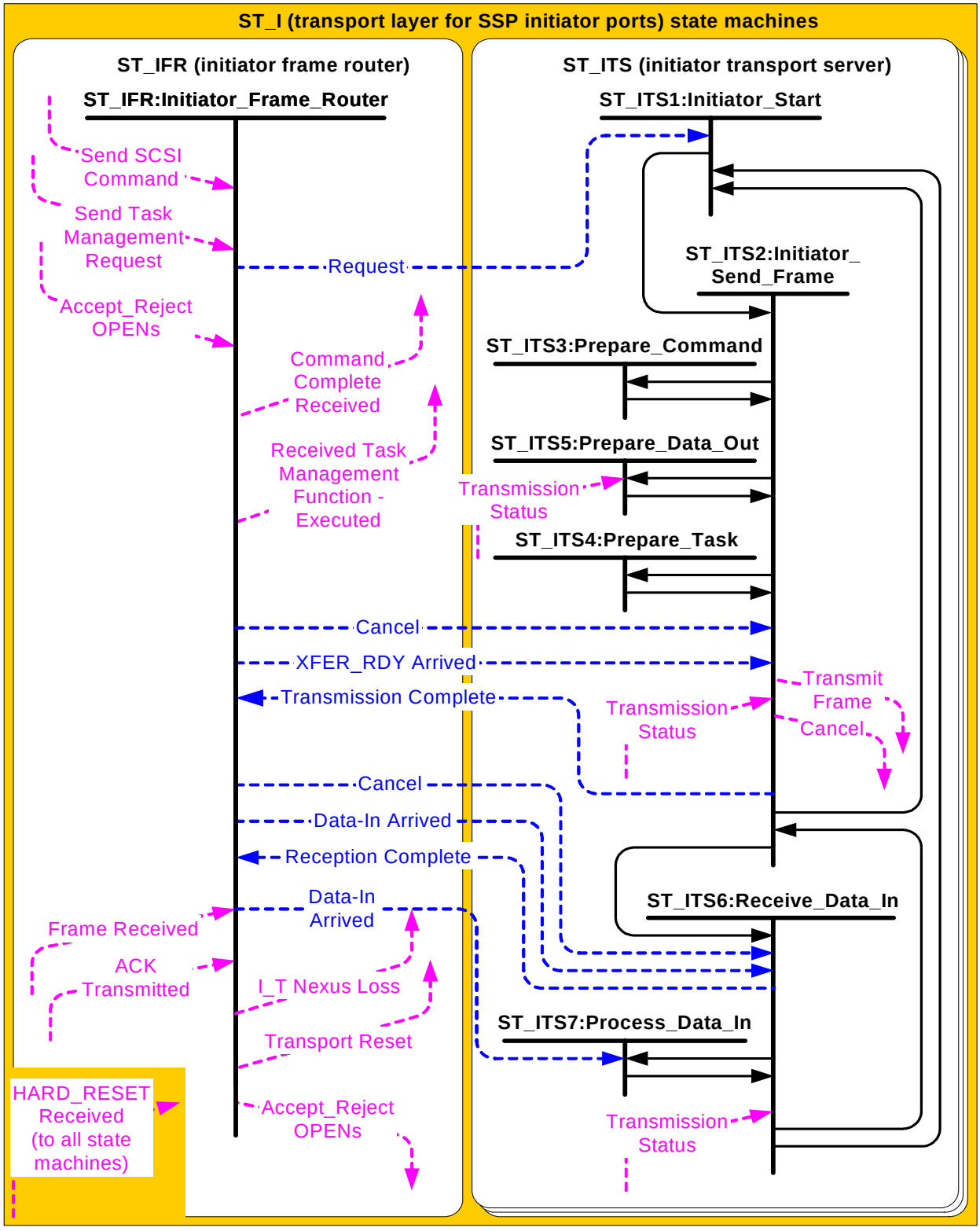

Figure 151 — ST_I (transport layer for SSP initiator ports) state machines

Editor's Note 15: Added Data-In Arrived message into ST_ITS7 and Transmission Status

confirmation into ST_ITS5 to allow for non-interlocked DATA frame transfers.

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.

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 to the ST_ITS1:Initiator_Start state in an ST_ITS state machine that does not have an active task:

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

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

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 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 the frame type argument in the frame received with the 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 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 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.

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 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 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 checked in the frame are correct, and this state machine has not received a RESPONSE frame for this I_T_L_Q nexus, then:

a) this state machine shall send a protocol service confirmation to the SCSI application layer based on the content of the DATAPRES and RESPONSE DATA fields; and
b) if there is an ST_ITS state machine for the tag associated with the RESPONSE, then send a Cancel message to that state machine.

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.

If the frame type is XFER_RDY and the items 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) retry data frames;
b) retransmit;
c) target port transfer tag; and
d) information unit.

If the frame type is DATA and the items 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 read DATA frame as an argument.

This state machine receives Transmission Complete messages and Reception Complete messages from the ST_ITS state machines that may result in this state machine sending one of the following 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 112 — 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)

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

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 Cancel messages to all the ST_ITS state machines.

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);
f) ST_ITS6:Receive_Data_In state (see 8.2.4.2.3.7); and
g) ST_ITS7:Process_Data_In state (see 8.2.4.2.3.8).

This state machine shall 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.

This state machine shall transition to the ST_ITS1:Initiator_Start state from any other state after receiving a HARD_RESET Received confirmation.

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.

8.2.5.2.3.2.2 Transition ST_ITS1:Initiator_Start to ST_ITS2:Initiator_Send_Frame

This transition shall occur after this state receives a Request message from the ST_IFR state machine.

If a Request (Send Command) message was received this transition shall include all the Command arguments.

If a Request (Send Task) message was received this transition shall include all the Task arguments.

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 performing 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: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.

All Transmit Frame requests shall include the SSP frame (e.g., COMMAND frame from ST_ITS3:Prepare_Command state or from ST_ITS6:Receive_Data_In, TASK frame from ST_ITS4:Prepare_Task state, DATA frame from ST_ITS7: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 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), then this state shall send the Transmission Complete message indicated in table 104 to the ST_IFR state machine. The message shall include the following arguments:

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

If the confirmation is Transmission Status (Frame Transmitted) and the Transmit Frame request was for a COMMAND frame not performing a read 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).

NOTE 52 - If the number of data bytes 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.

If the confirmation is Transmission Status (NAK Received), the Transmit Frame request was for a COMMAND frame not performing a read operation or a TASK frame, and a vendor specific number of retries has not been reached, then this state shall process:

a) the COMMAND frame as if it was received from the ST_ITS3:Prepare_Command state; or
b) the TASK frame as if it was received from the ST_ITS4:Prepare_Task state.

Table 104 defines the confirmations received from the port layer after a Transmission Status (Frame Transmitted) and the message that shall be sent by this state to the ST_IFR state machine upon receipt of the confirmation based on the conditions under which the confirmation was received.

Table 113 — 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 and: a) the number of data bytes transmitted equal the request byte count; and b) 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 and if the vendor-specific number of retries has been reached.	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 and if 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 XFER_RDY had its RETRY DATA FRAMES bit set to zero; or b) the XFER_RDY had its RETRY DATA FRAMES bit set to one, 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)		Transmission Complete (Data Failed, Connection Failed)

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

NOTE 53 - The application client may determine the command was received and is being processed by the device server and allow the command to complete.

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.

If this state receives a Cancel message from the ST_IFR state machine, and this state has received confirmations for all Transmit Frame requests sent to the port layer, then this state 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, 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.

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 the write data length is zero or exceeds the amount of write data remaining to be transferred for the command, then this state shall send a Transmission Complete (XFER_RDY Incorrect Write Data Length) message to the ST_IFR state machine.

If this state machine receives an XFER_RDY Arrived message, does not support transport layer retries of DATA frames, the RETRY DATA FRAMES bit is set to zero, and the requested offset is not expected (e.g., the data offset is not set to a value in the DATA OFFSET field in the previous XFER_RDY information unit plus the number of bytes transferred as a result of the previous XFER_RDY information unit), then this state shall send a Transmission Complete (XFER_RDY Requested Offset Error) message to the ST_IFR state machine.

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:

a) a Transmission Complete (Command Delivered) message;
b) if the vendor-specific number of retries of the COMMAND frame has been reached, then a Transmission Complete (Command Failed, NAK Received) message;
c) if the vendor-specific number of retries of the TASK frame has been reached, then a Transmission Complete (Task Failed, NAK Received) message;
d) a Transmission Complete (Command Failed, Connection failed) message and the command was for a non-data operation;
e) any Transmission Complete message for a TASK or write DATA frame; or
f) a Transmission Complete (Cancel Acknowledged) message.

8.2.5.2.3.3.4 Transition ST_ITS2:Initiator_Send_Frame to ST_ITS3:Prepare_Command

This transition shall occur if this state was entered from the ST_ITS1:Initiator _Start state with Command arguments.

This transition shall include all the Command arguments.

8.2.5.2.3.3.5 Transition ST_ITS2:Initiator_Send_Frame to ST_ITS4:Prepare_Task

This transition shall occur if this state was entered from the ST_ITS1:Initiator _Start state with Task arguments.

This transition shall include all the Task arguments.

8.2.5.2.3.3.6 Transition ST_ITS2:Initiator_Send_Frame to ST_ITS5:Prepare_Data_Out

This transition shall include a No-retry argument and occur after this state receives:

a) a Transmission Status (Frame Transmitted) confirmation followed by a Transmission Status (ACK_Received) confirmation for a COMMAND frame for a write operation and first burst is enabled;
b) an XFER_RDY Arrived message; or

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;

NOTE 55 - 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 for a write DATA frame from the port layer or messages from the ST_ITS5:Prepare_Data_Out state:
   A) Transmission Status (NAK Received);
   B) Transmission Status (ACK/NAK Timeout); or
   C) Transmission Status (Connection Lost without ACK/NAK) confirmation;
b) the XFER_RDY frame contained a RETRY DATA FRAMES bit set to one; and
c) the vendor-specific number of retries, if any, for the write DATA frame has not been exceeded.

This transition shall include all the:

a) Xfer_Rdy arguments: and
b) Command arguments.

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 a read operation.

This transition shall include all the Command arguments.

NOTE 56 - 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 the Command arguments:

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 SAS address;
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;
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;
l) in the information unit, ENABLE FIRST BURST bit set to the specified enable first burst bit;
m) in the information unit, TASK PRIORITY field set to the specified task priority;
n) in the information unit, TASK ATTRIBUTE field set to the specified task attribute;
o) in the information unit, ADDITIONAL CDB LENGTH field set to the specified additional CDB length;
p) in the information unit, CDB field set to the specified CDB; and
q) in the information unit, ADDITIONAL CDB BYTES field set to the specified additional CDB bytes, if any.

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.

This transition shall include the COMMAND frame as an argument.

This transition shall include all the Command arguments.

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 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 SAS address;
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;
f) CHANGING DATA POINTER bit set to zero;
g) NUMBER OF FILL BYTES field set zero.
h) TAG field set to the specified tag;
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;
l) in the information unit, TASK MANAGEMENT FUNCTION field set to the specified task management function; and
m) in the information unit, TAG OF TASK TO BE MANAGED field set to the specified tag of task to be managed.

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.

This transition shall include the TASK frame as an 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 using the following based on the Xfer_Rdy arguments or, if first burst is enabled, the command 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 SAS address;
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 specified tag;
i) TARGET PORT TRANSFER TAG field set to the specified target port transfer tag;
j) DATA OFFSET field set as specified in this subclause; and
k) in the information unit, DATA field set to the specified data.
l) fill bytes, if any.

If this state is entered with a No-retry argument then this state shall set the CHANGING DATA POINTER bit to zero and;

a) if this state was entered with Xfer_Rdy arguments, then 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; or
b) if this state was entered with Commands arguments, then set the DATA OFFSET field to zero.

If this state is entered with a Retry argument then this state shall set the CHANGING DATA POINTER bit in the frame to one and;

a) if this state was entered with Xfer_Rdy arguments, then set the DATA OFFSET field to the data offset value associated with the XFER_RDY frame; or
b) if this state was entered with command arguments, then set the DATA OFFSET field to zero.

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.

This transition shall include:

a) all the Xfer_Rdy arguments:
b) all the Command arguments;
c) the DATA frame as an argument; and
d) the received Transmission Status, if any, as an 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 or a read Data-In Arrived argument from the ST_ITS7:Process_Data_In state, then this state shall verify the read DATA frame received with the Data-In Arrived values as specified in table 105:

Table 114 — Reception Complete message sent on DATA frame verification failure

Verification [a]	Message sent to ST_IFR	Priority [b]
The transport layer retries of read DATA frames is not supported 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.	Reception Complete (Data Offset Error)	1
The transport layer retries of read DATA frames is supported, the CHANGING DATA POINTER bit is set to zero, and the value in the DATA OFFSET field is outside the range of the requested data.	Reception Complete (Data Offset Error)	1
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).	Reception Complete (Too Much Read Data)	2
The length of the information unit DATA field (i.e., the length of the information unit) is zero.	Reception Complete (Incorrect Data Length)	3

[a] If the verification tests true then the specified message is sent to ST_IFR.
[b] If more that one verification fails the message with the highest priority shall be sent to ST_IFR.

If:

a) transport layer retries of read DATA frames is supported;
b) the CHANGING DATA POINTER bit is set to zero;
c) 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; and
d) value in the DATA OFFSET field is within the range of the requested data,

then this state shall discard all Data-In Arrived messages until the CHANGING DATA POINTER bit is set to one. The Data-in Arrived message with the CHANGING DATA POINTER bit set to one, and any additional Data-in Arrived messages, shall be processed by this state.

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), this state shall continue processing messages and confirmations.

NOTE 57 - The application client may determine the command was received and is being processed by the device server and allow the command to complete.

NOTE 58 - 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_IFR 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:

a) a Reception Complete (Data-In Received) message;
b) a Reception Complete (Too Much Read Data) message;
c) a Reception Complete (Incorrect Data Length) message;
d) a Reception Complete (Cancel Acknowledged) message; or
e) a Reception Complete (Data Offset Error) 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 a read operation.

This transition shall include all the Command arguments.

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 the read DATA frame received with the Data-In Arrived values.

This transition shall include:

a) all the Command arguments; and
b) the read DATA frame as an argument.

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 in the read DATA frame argument.

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 the read DATA frame argument.

This transition shall include:

a) all the Command arguments;
b) the read DATA frame as an argument; and
c) the received Data-In Arrived, if any, as an argument.

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).

This state machine may maintain the timers listed in table 106.

Table 115 — 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.

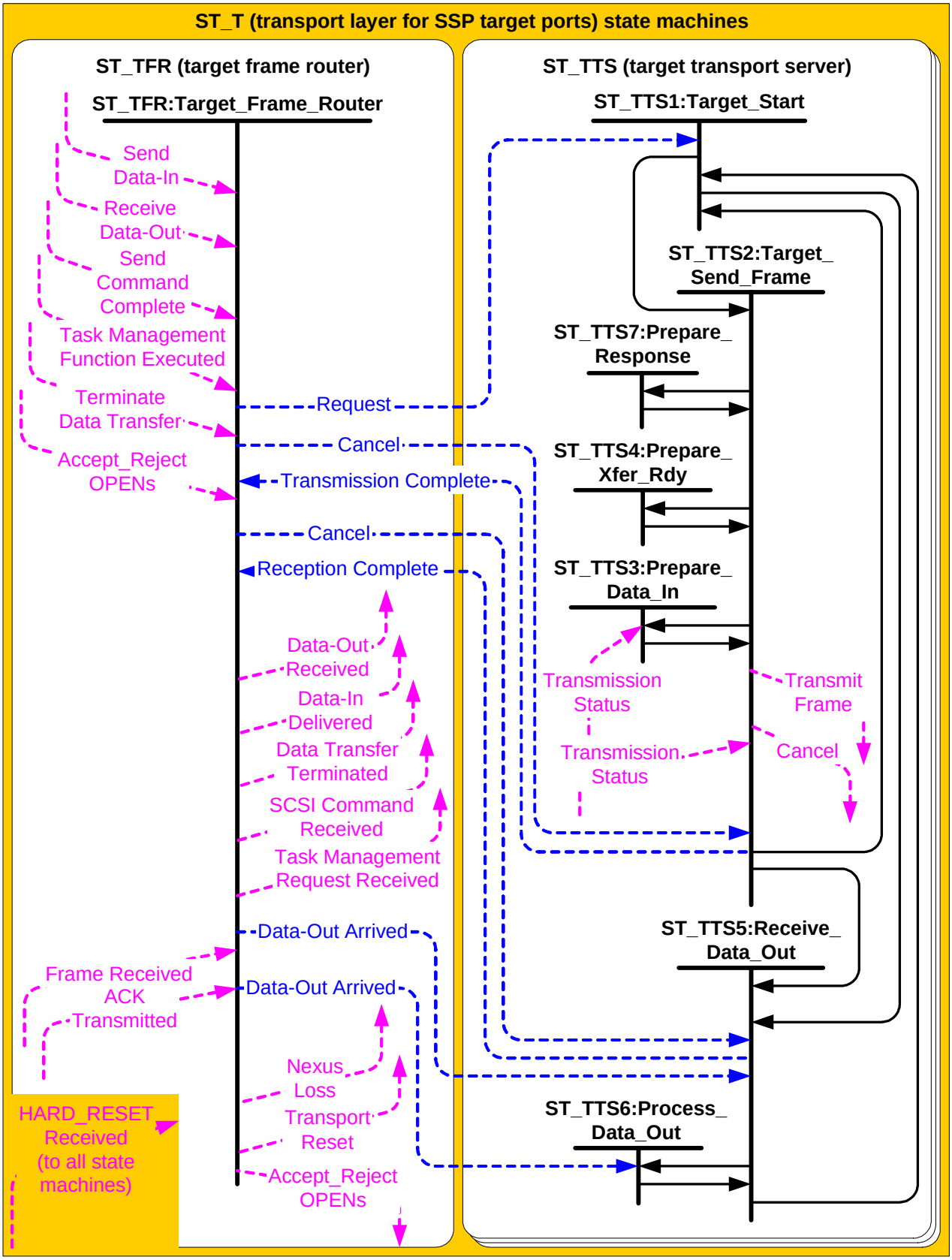

Figure 152 — ST_T (transport layer for SSP target ports) state machines

Editor's Note 16: Added Data-Out Arrived message into ST_TTS6 and Transmission Status confirmation into ST_TTS3 to allow for non-interlocked DATA frame transfers. Also removed the ST_TTS5 to ST_TTS2 transition which was not defined in SAS 1.1. rev 9 and is not needed.

8.2.5.3.2 ST_TFR (target frame router) state machine

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.

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 the reserved fields within the CDB in a COMMAND frame. Checking of reserved fields in a CDB is described in SPC-3.

If the frame type is correct relative to the confirmation, then this state machine may check that the hashed source SAS address matches the SAS address of the SAS port that transmitted the frame and that the hashed destination SAS address 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.

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.

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.

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

If this state machine sends a Request (Send Transport Response) message with an argument of Invalid Frame to ST_TTS1:Target_Start state in an ST_TTS state machine, then this state machine shall discard the frame and shall include the following Transport Response arguments in the message:

a) connection rate;
b) initiator connection tag;
c) destination SAS address set to the SAS address from which the invalid frame was received;
d) source SAS address set to the SAS address of the SAS port containing the state machine; and
e) tag.

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

If the frame type is COMMAND, the items checked in the frame are correct, and this state machine receives an ACK Transmitted confirmation, then this state machine shall send a SCSI Command Received transport protocol service indication 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 checked in the frame are correct, and this state machine receives an ACK Transmitted confirmation, then this state machine shall send a Task Management Request Received transport protocol service indication to the SCSI application layer. The indication shall include:

a) 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 in an XFER_RDY frame for the request, then this state machine shall check the target port transfer tag. If the target port transfer tag does not specify a valid state machine, then this state machine shall discard the frame.

If the frame type is DATA and the items checked in the frame are correct, and there is first burst data enabled or this state machine has received a Transmission Complete (Xfer_Rdy Delivered) from the ST_TTS 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 write DATA frame.

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.

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.

A Request (Send Data-In) 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 counts; and
g) application client buffer offset.

A Request (Receive Data-Out) 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;
h) first burst; and
i) target port transfer tag.

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 Command Complete 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 the argument specified in table 107 and the following Task Complete 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); and
d) tag.

Table 107 specifies which argument to send with Request (Send Transport Response) based on the Service Response argument that was received.

Table 116 — Task Management Function Executed Service Response argument mapping

Task Management Function Executed protocol service response Service Response argument received	Request (Send Transport Response) argument to send
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 108 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 117 — 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

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

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: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);
f) ST_TTS6:Process_Data_Out (see 8.2.4.3.3.7); and
g) ST_TTS7:Prepare_Response (see 8.2.4.3.3.8).

This state machine shall 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 place the data offset into the DATA OFFSET field of the retransmitted XFER_RDY frame; or
   B) if the SSP initiator port retries write DATA frames, to reestablish the write data context.

This state machine shall transition to the ST_TTS1:Target_Start state from any other state after receiving a HARD_RESET Received confirmation.

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.

8.2.5.3.3.2.2 Transition ST_TTS1:Target_Start to ST_TTS2:Target_Send_Frame

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

If a Request (Send Transport Response) message was received this transition shall include all the Transport Response arguments.

If a Request (Send Data-in) message was received this transition shall include all the Data-in arguments.

If a Request (Send Data-out) message was received this transition shall include all the Data-out arguments.

If a Request (Send Application Response) was received this transition shall include all the received arguments (i.e., the Command Complete arguments or the Task Complete arguments).

8.2.5.3.3.2.3 Transition ST_TTS1:Target_Start to ST_TTS5:Receive_Data_Out

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

This transition shall include all the Data-out 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:Prepare_Response state for transmission of a RESPONSE frame, then this state shall send a Transmit Frame (Interlocked) request to the port layer.

NOTE 59 - 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.

All Transmit Frame requests from this state shall include the SSP frame (e.g., DATA frame from the ST_TTS3:Prepare_Data_In state, XFER_RDY frame from the ST_TTS4:Prepare_Xfer_Rdy state, RESPONSE frame from the ST_TTS7: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 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 is not Transmission Status (Frame Transmitted) or Transmission Status (I_T Nexus Loss), then this state shall send the Transmission Complete message indicated in table 109 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 an XFER_RDY frame, a RESPONSE frame, or a read DATA frame where the number of bytes that have been transmitted equal the request byte count (i.e., all data has been transferred for the request), then this state shall wait to receive one of the following confirmations:

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

NOTE 60 - 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).

Table 109 defines the confirmations to be received from the port layer after a Transmission Status (Frame Transmitted) and the message that shall be sent by this state to the ST_TFR state machine upon receipt of the confirmation based on the conditions under which the confirmation was received.

Table 118 — 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)	The Transmit Frame request was for a read DATA frame and: a) the number of data bytes transmitted equal the request byte count; and b) 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)	The Transmit Frame request was for a RESPONSE frame and the vendor-specific number of retries has been reached.	Transmission Complete (Response Delivery Failed)
Transmission Status (NAK Received)	The Transmit Frame request was for an XFER_RDY frame and: a) the TRANSPORT LAYERS RETRIES bit is set to zero in the Protocol-Specific Logical Unit mode page (see x.x.x); or 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)		Transmission Complete (Xfer_Rdy Failed, Connection Failed)
Transmission Status (NAK Received)	The Transmit Frame request was for a read DATA frame and: a) the TRANSPORT LAYERS RETRIES bit is set to zero in the Protocol-Specific Logical Unit mode page (see x.x.x); or 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)		Transmission Complete (Data Failed, Connection Failed)

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

If this state receives a Cancel message from the ST_TFR state machine and this state has not received confirmations for all Transmit Frame requests sent to the port layer, then this state shall send a Cancel request to the port layer to cancel previous Transmit Frame requests. 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) 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.

8.2.5.3.3.3.3 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 include a No-retry argument and occur:

a) if this state was entered from the ST_TTS1:Target_Start state with Data-in arguments; or
b) after this state 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.

This transition shall include a Retry argument and occur after:

a) this state receives one of the following confirmations for a read DATA frame from the port layer or messages from the ST_TTS3:Prepare_Data_In state:
   A) Transmission Status (NAK Received);
   B) Transmission Status (ACK/NAK Timeout); or
   C) Transmission Status (Connection Lost without ACK/NAK) confirmation;
b) the TRANSPORT LAYERS RETRIES bit is set to one in the Protocol-Specific Logical Unit mode page (see x.x.x); and
c) the vendor-specific number of retries, if any, for the read DATA frame has not been exceeded.

This transition shall include all the Data-in arguments.

If this state was entered from the ST_TTS1:Target_Start state, then this transition shall include the First Frame argument.

If this state receives a Transmission Status from the port layer or from the ST_TTS3:Prepare_Data_In state, then this transition shall include the Next Frame argument.

8.2.5.3.3.3.5 Transition ST_TTS2:Target_Send_Frame to ST_TTS4:Prepare_Xfer_Rdy

This transition shall include a No-retry argument and occur if this state was entered from the ST_TTS1:Target_Start state with Data-out arguments and:

a) first burst is enabled, all first burst data has been received, and there is more data associated with the Data-out arguments to transfer;
b) first burst is not enabled and no XFER_RDY has been transmitted associated with the Data-out arguments; or
c) all data for a previous XFER_RDY has been received and there is more data associated with the Data-out arguments to transfer.

This transition shall include a Retry argument and occur after:

a) this state receives one of the following confirmation for a XFER_RDY frame:
   A) Transmission Status (NAK Received);
   B) Transmission Status (ACK/NAK Timeout); or
   C) Transmission Status (Connection Lost without ACK/NAK) confirmation;
b) the TRANSPORT LAYERS RETRIES bit is set to one in the Protocol-Specific Logical Unit mode page (see x.x.x); and
c) the vendor-specific number of retries, if any, for the XFER_RDY frame has not been exceeded.

This transition shall include all the Data-out arguments.

If this state was entered from the ST_TTS1:Target_Start state, then this transition shall include the First Xfer_Rdy argument.

If this receives a Transmission Status, then this transition shall include the Next Xfer_Rdy argument.

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.

This transition shall include all the Data-out arguments.

8.2.5.3.3.3.7 Transition ST_TTS2:Target_Send_Frame to ST_TTS7:Prepare_Response

This transition shall include a No-retry argument and occur if this state:

a) was entered from the ST_TTS1:Target_Start state with Command Complete arguments; or
b) was entered from the ST_TTS1:Target_Start state with Task Complete arguments.

This transition shall include a Retry argument and the previous RESPONSE frame, and occur if this state:

a) receives one of the following confirmations for a RESPONSE frame:
   A) Transmission Status (NAK Received);
   B) Transmission Status (ACK/NAK Timeout); or
   C) Transmission Status (Connection Lost without ACK/NAK) confirmation; and
b) the vendor-specific number of retries for the RESPONSE frame has not been exceeded. The number of retries for a RESPONSE frame shall be greater than or equal to one.

This transition shall include all the:

a) Command Compete arguments; or
b) Task Compete arguments.

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 the Data-in arguments to construct the frame (see 8.2.4.3.2).

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

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 SAS address;
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 data;
h) TAG field set to the specified tag;
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 specified data; and
l) fill bytes, if any.

If this state is entered with a No-retry argument then this state shall generate the following values when constructing the frame:

a) set the CHANGING DATA POINTER bit set to zero; and
b) if this state is entered with the:

A) First Frame argument, then set the DATA OFFSET field to the specified application client buffer offset; or
B) Next Frame argument, then set the DATA OFFSET field to the value in the DATA OFFSET field in the previous read DATA frame plus the number of bytes in the previous read DATA information unit.

If this state is entered with a Retry argument then this state shall generate the following values when constructing the frame:

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.

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.

This transition shall include:

a) all the Data-in arguments; and
b) the read DATA frame as an argument; and
c) the received Transmission Status, if any, as an 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 the Data-out arguments (see 8.2.4.3.2):

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 SAS address;
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) RETRANSMIT bit set as 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;
i) TARGET PORT TRANSFER TAG field set to a vendor-specific value, unless otherwise specified in this subclause;
j) DATA OFFSET field set to zero; and
k) in the information unit, REQUESTED OFFSET field set as specified in this subclause; and
l) in the information unit, WRITE DATA LENGTH field set to the specified write data length.

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 with a No-retry argument then this state shall generate the following values when constructing the XFER_RDY frame:

a) set the RETRANSMIT bit set to zero;
b) if the TRANSPORT LAYER RETRIES bit is set to one in the Protocol-Specific Logical Unit mode page (see x.x.x), then the target port transfer tag value shall be set to a different value for the TARGET PORT TRANSFER TAG field in each XFER_RDY frame than that used in the previous XFER_RDY frame; and
c) if this state is entered with the:
   A) First Xfer_Rdy argument, then set the REQUESTED OFFSET field to the specified application client buffer offset; or
   B) Next Xfer_Rdy argument, then set the REQUESTED OFFSET field to the value in the REQUESTED OFFSET field in the previous XFER_RDY information unit plus the WRITE DATA LENGTH field of the previous XFER_RDY information unit.

If this state is entered with a Retry argument then this state shall generate the following values when constructing the frame:

a) set the RETRANSMIT bit in the frame to one;

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; and
c) set the REQUESTED OFFSET field to a data offset value associated with a previous XFER_RDY information unit.

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.

This transition shall include:

a) all the Data-out arguments; and
b) the 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

If this state receives a Data-Out Arrived message from the ST_TFR state machine or a read Data-Out Arrived argument from the ST_TTS6:Process_Data_Out state, then this state shall verify the write DATA frame received with the Data-Out Arrived values as specified in table 110:

Table 119 — Reception Complete message sent on DATA frame verification failure

Verification [a]	Message sent to ST_TFR	Priority [b]
The transport layer retries of write DATA frames is supported, 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.	Reception Complete (Data Offset Error)	1
The transport layer retries of write DATA frames is supported, the CHANGING DATA POINTER bit is set to zero, and the value in the DATA OFFSET field is outside the range of the requested data.	Reception Complete (Data Offset Error)	1
The transport layer retries of write DATA frames is not supported 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.	Reception Complete (Data Offset Error)	1
The 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 10.2.6.1.5).	Reception Complete (Too Much Write Data)	2
A 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.	Reception Complete (Too Much Write Data)	2
The length of the information unit DATA field is zero.	Reception Complete (Information Unit Too Short)	3

[a] If the verification tests true then the specified message is sent to ST_TFR.
[b] If more that one verification fails the message with the highest priority shall be sent to ST_TFR.

If transport layer retries of write DATA frames is supported, 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 discard all Data-out

Arrived messages until the CHANGING DATA POINTER bit is set to one. The Data-out Arrived message with the CHANGING DATA POINTER bit set to one, and any additional Data-out Arrived messages, shall be processed by this state.

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

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

a) this state is entered from the ST_TTS1:Target_Start state 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
c) this state is entered from the ST_TTS6:Process_Data_Out state (i.e., Data-Out data was received and processed).

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

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

If this state is entered from the ST_TTS6:Process_Data_Out state and number of bytes received argument equals the Data-out arguments (i.e., request byte count), then this state shall send a Reception Complete (Data-Out Received) 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.

8.2.5.3.3.6.2 Transition ST_TTS5:Receive_Data_Out to ST_TTS6:Process_Data_Out

This transition shall occur after this state receives and verifies the write DATA frame received with the Data-Out Arrived values.

This transition shall include the write DATA frame as an argument.

8.2.5.3.3.6.3 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.

8.2.5.3.3.7 ST_TTS6:Process_Data_Out state

8.2.5.3.3.7.1 State description

This state shall process the data received in the write DATA frame argument 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 the write DATA frame argument.

This transition shall include:

a) the write DATA frame as an arguments;
b) the number of bytes received argument; and
c) the received Data-Out Arrived, if any, as an argument.

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 with a No-retry argument, then this state shall construct a RESPONSE frame using the received Command Complete arguments or the received Task Complete 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 destination SAS address;
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 specified tag;
h) TARGET PORT TRANSFER TAG field set to zero;
i) DATA OFFSET field set to zero.

If this state was entered with a No-retry argument and Task Complete arguments, then this state shall set the fields relating to the information unit using the received Task Complete arguments 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, DATAPRES field set to RESPONSE DATA;
c) in the information unit, STATUS field set to zero;
d) in the information unit, SENSE DATA LENGTH field set to zero;
e) in the information unit, RESPONSE DATA LENGTH field set to 00000004h;
f) in the information unit, RESPONSE DATA field set as specified in table 111;
g) in the information unit, SENSE DATA field not included; and
h) fill bytes, if any.

Table 111 specifies how the RESPONSE DATA field shall be set based on the arguments received with the Request (Send Transport Response) message.

Table 120 — 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 a No-retry argument and Command Complete arguments, then this state shall set the fields relating to the information unit using the received Command Complete arguments 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;
b) in the information unit, DATAPRES field set to SENSE_DATA if sense data is specified or NO_DATA if sense data is not specified;
c) in the information unit, STATUS field set to the specified status;
d) in the information unit, SENSE DATA LENGTH field set to the length of the specified sense data, if any;
e) in the information unit, RESPONSE DATA LENGTH field set to zero;
f) in the information unit, RESPONSE DATA field not included;
g) in the information unit, SENSE DATA field set to the specified sense data, if any; and
h) fill bytes, if any.

If this state was entered with a Retry argument, 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.

8.2.5.3.3.8.2 Transition ST_TTS7:Prepare_Response to ST_TTS2:Target_Send_Frame

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

This transition shall include the RESPONSE frame and all the:

a) Command Complete arguments; or
b) Task Complete arguments.