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To: T10 Committee (SCSI)

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Subject: SAS Identification state machine

1 Overview

This proposal defines the SAS identification state machine.

1.1 Identification/HARD_RESET sequence description

1.1.1 Overview

The identification/HARD_RESET sequence contains several state machines that run in parallel to control the flow of dwords on a link that are associated with the identification and HARD_RESET sequences (see figure 1). The identification/HARD_RESET sequence (IR) state machines are as follows:

a) SAS phy receiver (R state machine);
b) Originate IDENTIFY address frame and HARD_RESET (OIR state machine);
c) SAS phy transmitter (T state machine);
d) Frame receive (FR state machine); and
e) IDENTIFY and HARD_RESET control (IRC state machine).

All the state machines within the identification/HARD_RESET sequence shall begin on an indication of an enable identification/HARD_RESET sequence from the XXX:xxx state of the xx state machine.

If a state machine consists of multiple states the initial state is as indicated in state machine description in this subclause.

The R state machine's function is to receive primitives and frames from the link and indicate to other IR state machines the receipt of those dwords. The R state machine contains the IR_R1:Receive state (see 1.1.2).

The OIR state machine's function is to transmit an IDENTIFY address frame or a HARD_RESET. The OIR state machine contains the following states:

a) Initial state: IR_OIR1:IDENTIFY_idle (see 1.1.3);
b) IR_OIR2:Indicate_frame_tx (see 1.1.4); and
c) IR_OIR3:Indicate_reset_tx (see 1.1.5).

The T state machine's function is to transmit primitives and frames to the link and indicate to other state machines the transmission of those dwords. The T state machine contains the IR_T1:Transmit state (see 1.1.6).

The FR state machine's function is to receive an IDENTFIY address frame and indicating the successful or unsuccessful receipt of the IDENTFIY address frame. The FR state machine contains the IR_FR1:Frame_receive state (see 1.1.7).

The IRC state machine's function is to:

a) ensure an IDENTIFY address frame has been received and transmitted before confirming the identify sequence has completed; and

b) ensure a confirmation occurs if a HARD_RESET is received before an IDENTIFY address frame has been received.

The IRC state machine contains the IR_IRC1:IDENTIFY_reset_wait state (see 1.1.8).
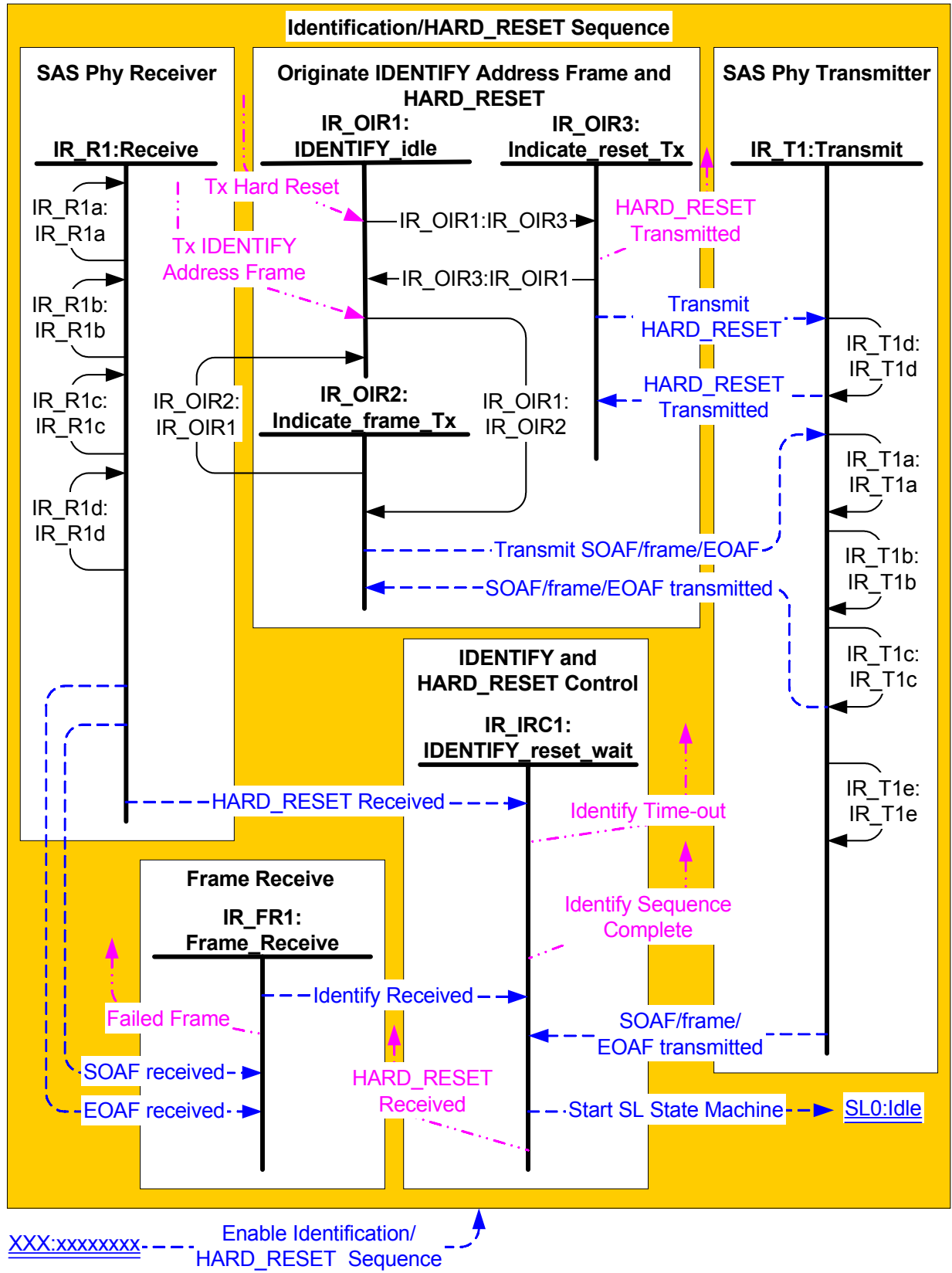
Figure 1 - Identification/HARD_RESET sequence state machine

1.1.2 IR_R1:Receive state

1.1.2.1 IR_R1:Receive state description

The receive state receives frames and primitives from the link.

As a result of receiving an SOAF from the link the receive state shall indicate using the SOAF received parameter that an SOAF was received to the frame_receive state.

As a result of receiving an EOAF from the link the receive state shall indicate using the EOAF received parameter that an EOAF was received to the frame_receive state.

As a result of receiving a HARD_RESET from the link the receive state shall indicate using the HARD_RESET received parameter that a HARD_RESET was received to the IDENTIFY_reset_wait state.

1.1.2.2 Transition IR_R1a:IR_R1a (Receive:Receive)

The IR_R1a:IR_R1a transition shall occur every time an SOAF is received on the link.

1.1.2.3 Transition IR_R1b:IR_R1b (Receive:Receive)

The IR_R1b:IR_R1b transition shall occur every time an dword associated with a frame is received on the link.

1.1.2.4 Transition IR_R1c:IR_R1c (Receive:Receive)

The IR_R1c:IR_R1c transition shall occur every time an EOAF is received on the link.

1.1.2.5 Transition IR_R1d:IR_R1d (Receive:Receive)

The IR_R1d:IR_R1d transition shall occur every time a HARD_RESET is received on the link.

1.1.3 IR_OIR1:IDENTFIY_idle state

1.1.3.1 IR_OIR1:IDENTIFY_idle state description

The IDENTIFY_idle state shall transition:

    a) to the indicate_frame_tx state on a request from the port layer to transmit an IDENTIFY address frame; or
    b) to the indicate_reset_tx state on a request from the port layer to transmit a HARD_RESET.

1.1.3.2 Transition IR_OIR1:IR_OIR2 (IDENTIFY_idle:Indicate_frame_tx)

The IR_OIR1:IR_OIR2 transition shall occur when the port layer requests using the tx IDENTIFY address frame parameter that an IDENTIFY address frame is to be transmitted.

1.1.3.3 Transition IR_OIR1:IR_OIR3 (IDENTIFY_idle:Indicate_reset_tx)

The IR_OIR1:IR_OIR3 transition shall occur when the port layer requests using the tx HARD_RESET parameter that a HARD_RESET is to be transmitted.

1.1.4 IR_OIR2:Indicate_frame_tx state

1.1.4.1 IR_OIR2:Indicate_frame_tx state description

The indicate_frame_tx state indicates to the transmit state using the transmit SOAF/frame/EOAF

parameter that an IDENTIFY address frame be transmitted on the link.

1.1.4.2 Transition IR_OIR2:IR_OIR1 (Indicate_frame_tx:IDENTIFY_idle)

The IR_OIR2:IR_OIR1 transition shall occur after the SOAF/frame/EOAF transmitted parameter is received from the transmit state.

1.1.5 IR_OIR3:Indicate_reset_tx state

1.1.5.1 IR_OIR3:Indicate_reset_tx state description

The indicate_reset_tx state indicates to the transmit state using the transmit HARD_RESET parameter that a HARD_RESET is be transmitted on the link.

1.1.5.2 Transition IR_OIR3:IR_OIR1 (Indicate_reset_tx:IDENTIFY_idle)

The IR_OIR3:IR_OIR1 transition shall occur after the indicate_reset_tx state receives a HARD_RESET transmitted parameter from the transmit state and a confirmation is sent to the port layer using the HARD_RESET transmitted parameter that the HARD_RESET has been transmitted.

1.1.6 IR_T1:Transmit state

1.1.6.1 IR_T1:Transmit state description

The transmit state requests the link to transmit:

   a) an SOAF/frame/EOAF when the indicate_frame_tx state using the transmit SOAF/frame/EOAF parameter indicates an IDENTIFY address frame be transmitted; or
   b) a HARD_RESET when the indicate_reset_tx state using the transmit HARD_RESET parameter indicates a HARD_RESET be transmitted.

In the absence of any transmit requests the transmit state shall transmit idle dwords and ALIGNs on the link as necessary.

On an indication that a SOAF/frame/EOAF is to be transmitted the transmit state shall transmit an SOAF in the dword before the first dword of the frame and an EOAF in first dword after the last dword of the frame. If during the transmission of a frame an indication that a primitive is to be transmitted occurs the transmit state may transmit the indicated primitive by inserting the primitive between the frames' dwords.

The transmit state shall:

   a) indicate using the SOAF/frame/EOAF transmitted parameter to the indicate_frame_tx state each time an EOAF is transmitted; and
   b) indicate using the HARD_RESET transmitted parameter to the indicate_reset_tx state each time a HARD_RESET is transmitted.

1.1.6.2 Transition IR_T1a:IR_T1a (Transmit:Transmit)

The IR_T1a:IR_T1a transition shall occur every time an SOAF is transmitted on the link.

1.1.6.3 Transition IR_T1b:IR_T1b (Transmit:Transmit)

The IR_T1b:IR_T1b transition shall occur every time a dword associated with a frame is transmitted on the link.

1.1.6.4 Transition IR_T1c:IR_T1c (Transmit:Transmit)

The IR_T1c:IR_T1c transition shall occur every time an EOAF is transmitted on the link.

1.1.6.5 Transition IR_T1d:IR_T1d (Transmit:Transmit)

The IR_T1d:IR_T1d transition shall occur every time a HARD_RESET is transmitted on the link.

1.1.6.6 Transition IR_T1e:IR_T1e (Transmit:Transmit)

The IR_T1e:IR_T1e transition shall occur every time an idle is transmitted on the link.

1.1.7 IR_RF1:Frame_receive state

1.1.7.1 IR_RF1:Frame_receive state description

The frame_receive state checks the IDENTIFY address frame and determines if the IDENTIFY address frame was successfully received (e.g., no CRC error).

If the IDENTIFY address frame is received with a CRC error the frame_receive state shall send a confirmation to the port layer using the failed frame parameter that an IDENTIFY address frame receive error occurred.

1.1.8 IR_IRC1:IDENTIFY_reset_wait state

1.1.8.1 IDENTIFY_reset_wait state description

The IDENTIFY_reset_wait state ensures that an IDENTIFY address frame has been received and transmitted on the link before indicating to the SL0:Idle state it may accept connection requests from the port layer. The IDENTIFY address frame may be transmitted and received on the link in any order.

After the IDENTIFY_reset_wait state receives an SOAF/frame/EOAF transmitted parameter from the transmit state it shall initialize a receive identify time-out timer to one millisecond. If an identify received parameter is indicated from the frame_receive state before the identify time-out timer is exceeded the IDENTIFY_reset_wait state shall:

a) send a confirmation to the port layer using the identify sequence complete parameter that the identify sequence has completed; and
b) indicate to the SL0:idle state (see xxxx) using the start SL state machine parameter that the SL state machine may accept connection requests from the port layer.

If the identify time-out timer is exceeded before an identify received parameter from the frame_receive state is indicated the IDENTIFY_reset_wait state shall send a confirmation to the port layer using the identify time-out parameter that an identify time-out occurred.

If the IDENTIFY_reset_wait state receives a HARD_RESET received parameter from the receive state before an identify received parameter is received from the frame_receive state the following shall occur:

a) the IDENTIFY_reset_wait state shall send a confirmation to the port layer using the HARD_RESET received parameter that a HARD_RESET occurred; and
b) all the state machines within the identification and hard reset sequence shall be disabled until an indication of an enable identification/HARD_RESET sequence from the XXX:xxx state of the xx state machine occurs.

If the IDENTIFY_reset_wait state receives a HARD_RESET received parameter from the receive state after an identify received parameter is received from the frame_receive state the HARD_RESET shall be ignored.

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