Overview

At the meeting in September, 2006, the group briefly discussed how the negotiated physical link rate could be clarified against the SP state machine. This proposal attempts to base the negotiated physical and logical link rate fields to specific SP states. There was some discussion on which states should be persistant until something else more informative occurs. The following are my intentions and assumptions relative to the proposed changes.

   a) UNKNOWN happens at any power-on or hard reset, and non-Management reset requests excluding SPINUP_HOLD condtion.
   b) DISABLED only happens as a result of the Disable Phy request.
   c) PHY_RESET_PROBLEM only happens when the final SAS (not SATA) speed negotiation fails. This would persist until a power-on, hard reset, Disable Phy, Management Reset request, or upon detecting the device is no longer present.
   d) SPINUP_HOLD only happens when reaching the SP26: SATA_SpinupHold state, and remains at that value until cleared by a power-on, hard reset, DisablePhy, or Management reset request, speed negotiation completes, or Await ALIGN Timeout timer expires.
   e) PORT_SELECTOR is set when receiving the COMWAKE after sending the COMINIT. Since the ATTACHED SATA PORT SELECTOR bit is persistant across phy reset sequences, this value does not need to be persistant. It can be set back to UNKNOWN when hot plug timer expires. This means when attached to inactive port of the port selector, the field with toggle between UNKNOWN and PORT_SELECTOR every hot plug time. The PHY_RESET_PROBLEM, SPINUP_HOLD, and UNSUPPORTED_PHY_ATTACHED conditions have precedence over setting this value.
   f) RESET_IN_PROGRESS is set when a Management Reset request happens after the phy has already achieved a G1, G2, or G3 value, or a new Management Reset request happens while already in the RESET_IN_PROGRESS condition.
   g) G1, G2, or G3 is set whenever reaching the SP22:SATA_PHY_Ready SP state, or reaching the SP15:SAS_PHY_READY state.
   h) UNSUPPORTED_PHY_ATTACHED is a new proposed value, which indicates when a device is attached, but the phy was not able to negotiate to a common supported rate. This value would persist until a power-on, hard reset, Disable Phy, Management Reset request, or upon detecting the device is no longer present.

Proposed Changes

6.8.1 SP state machine overview

The SP state machine controls the phy reset sequence. This state machine consists of three sets of states:

   a) OOB sequence (OOB) states;
   b) SAS speed negotiation (SAS) states; and
   c) SATA host emulation (SATA) states.

This state machine consists of the following states:

   a) SP0:OOB_COMINIT (see 6.8.3.2)(initial state);
   b) SP1:OOB_AwaitCOMX (see 6.8.3.3);
   c) SP2:OOB_NoCOMSASTimeout (see 6.8.3.4);

    d) SP3:OOB_AwaitCOMINIT_Sent (see 6.8.3.5);
    e) SP4:OOB_COMSAS (see 6.8.3.6);
    f) SP5:OOB_AwaitCOMSAS_Sent (see 6.8.3.7);
    g) SP6:OOB_AwaitNoCOMSAS (see 6.8.3.8);
    h) SP7:OOB_AwaitCOMSAS (see 6.8.3.9);
    i) SP8:SAS_Start (see 6.8.4.2);
    j) SP9:SAS_WindowNotSupported (see 6.8.4.3);
    k) SP10:SAS_AwaitALIGN (see 6.8.4.4);
    l) SP11:SAS_AwaitALIGN1 (see 6.8.4.5);
    m) SP12:SAS_AwaitSNW (see 6.8.4.6);
    n) SP13:SAS_Pass (see 6.8.4.7);
    o) SP14 SAS_Fail (see 6.8.4.8);
    p) SP15:SAS_PHY_Ready (see 6.8.4.9);
    q) SP16:SATA_COMWAKE (see 6.8.5.2);
    r) SP17:SATA_AwaitCOMWAKE (see 6.8.5.3);
    s) SP18:SATA_AwaitNoCOMWAKE (see 6.8.5.4);
    t) SP19:SATA_AwaitALIGN (see 6.8.5.5);
    u) SP20:SATA_AdjustSpeed (see 6.8.5.6);
    v) SP21:SATA_Transmit_ALIGN (see 6.8.5.7);
    w) SP22:SATA_PHY_Ready (see 6.8.5.8);
    x) SP23:SATA_PM_Partial (see 6.8.5.9);
    y) SP24:SATA_PM_Slumber (see 6.8.5.10);
    z) SP25:SATA_PortSel (see 6.8.6.2);
   aa) SP26:SATA_SpinupHold (see 6.8.7.2);
   ab) SP27:SAS_Settings (see 6.8.4.10);
   ac) SP28:SAS_TrainSetup (see 6.8.4.11);
   ad) SP29:SAS_Train (see 6.8.4.12); and
   ae) SP30:SAS_TrainingDone (see 6.8.4.13).

The SP state machine shall start in the SP0:OOB_COMINIT state after:

    a) a power on;
    b) a hard reset;
    c) receiving a Management Reset request from the management layer (e.g., from the SMP PHY CONTROL function requesting a phy operation of LINK RESET or HARD RESET in an expander device); or
    d) receiving a Disable Phy request from the management layer (e.g., from the SMP PHY CONTROL function requesting a phy operation of DISABLE in an expander device).

The SP state machine shall maintain a MgmtReset state machine variable to determine whether a Management Reset request has been received. Any SP state that receives a Management Reset request shall set the MgmtReset state machine variable to one before making a transition to the SP0:OOB_COMINIT state (see 6.8.3.2). Any SP state that receives a power on, or a hard reset shall set the MgmtReset state machine variable to zero before making a transition to the SP0:OOB_COMINIT state.

The SP state machine shall maintain a Current SNW state machine variable to determine the current speed negotiation window (e.g., SNW-1, SNW-2, SNW-3, Final-SNW, Train-SNW, or ~~Phy Reset Problem~~ Unsupported Phy Attached).

If the phy supports:

    a) the SMP DISCOVER response (see 10.4.3.7);
    b) the SMP DISCOVER LIST response (see 10.4.3.13.3);
    c) the Protocol-Specific Port mode page (see 10.2.7.2); or
    d) the Protocol-Specific Port log page (see 10.2.8.1),

then the SP state machine shall maintain a ResetStatus state machine variable to determine the NEGOTIATED PHYSICAL LINK RATE field and/or NEGOTIATED LOGICAL LINK RATE field.

If the phy supports SNW-3, then the SP state machine shall maintain a Common Supported Settings state machine variable that contains supported settings common between the transmitted supported settings bits and the received supported settings bits.

If the phy supports SATA port selectors, the SP state machine shall maintain a COMWAKE_Received state machine variable to indicate whether a COMWAKE detected message was received in the SP0:OOB_COMINIT state or the SP1:OOB_AwaitCOMX state since the last time the SP0:OOB_COMINIT state was entered, and the SP state machine shall transition to the SP25:SATA_PortSel state whenever it receives a Transmit SATA Port Selection Signal request.

The SP state machine sends the following messages to the SP_DWS state machine (see 6.9):

a) Start DWS; and
b) Stop DWS.

The SP state machine receives the following messages from the SP_DWS state machine:

a) DWS Lost; and
b) DWS Reset.

The SP state machine shall maintain the timers listed in table 67.

Table 67 — SP state machine timers

Timer	Initial value
COMSAS Detect Timeout timer	COMSAS detect timeout (see table 73 in 6.6.1)
Await ALIGN Timeout timer	Await ALIGN timeout (see table 80 in 6.7.2.2)
Hot-Plug Timeout timer	Hot plug timeout (see table 79 in 6.7.1)
RCDT timer	RCDT (see table 81 in 6.7.4.2)
SNLT timer	SNLT (see table 81 in 6.7.4.2)
SNTT timer	SNTT (see table 81 in 6.7.4.2)
TLT timer	TLT (see table 81 in 6.7.4.2)
MTT timer	MTT (see table 81 in 6.7.4.2)

6.8.2 SP transmitter and receiver

The SP transmitter transmits OOB signals and dwords on the physical link based on messages from the SP state machine (see 6.8).

The SP transmitter receives the following messages from the SP state machine:

a) Transmit COMINIT;
b) Transmit COMSAS;
c) Transmit COMWAKE;
d) Transmit SATA Port Selection Signal;
e) Transmit D10.2;
f) Set Rate with a Physical Link Rate argument, and an SSC On or an SSC Off argument;
g) Transmit ALIGN with an argument indicating the specific type (e.g., Transmit ALIGN (0));
h) Transmit Settings Bits;
i) Transmit TRAIN Pattern;
j) Transmit TRAIN_DONE Pattern; and
k) Transmit MUX Sequence.

When not otherwise instructed, the SP transmitter transmits D.C. idle.

Upon receiving a Transmit MUX Sequence message, the SP transmitter transmits:

1) MUX (LOGICAL LINK 0);
2) MUX (LOGICAL LINK 1);
3) MUX (LOGICAL LINK 0);
4) MUX (LOGICAL LINK 1);
5) MUX (LOGICAL LINK 0); and
6) MUX (LOGICAL LINK 1).

The SP transmitter shall complete any physical link rate change requested with the Set Rate message within RCDT (see table 81 in 6.7.4.2).

.The SP transmitter sends the following messages to the SP state machine:

a) COMINIT Transmitted;
b) COMSAS Transmitted;
c) COMWAKE Transmitted;
d) SATA Port Selection Signal Transmitted;
e) TRAIN_DONE Pattern Transmitted; and
f) Settings Bits Transmitted.

The SP receiver receives OOB signals and dwords from the physical link and sends messages to the SP state machine indicating what it has received.

The SP receiver receives the following messages from the SP state machine:

a) Set Rate with a Physical Link Rate argument, and an SSC On argument or an SSC Off argument;
b) Start Training; and
c) Abort Training.

The SP receiver sends the following messages to the SP state machine:

a) COMINIT Detected;
b) COMSAS Detected;
c) COMWAKE Detected;
d) COMSAS Completed;
e) COMWAKE Completed;
f) ALIGN Received with an argument indicating the specific type (e.g., ALIGN Received (0));
g) Settings Bits Completed with arguments indicating the supported settings bits received;
h) Training Completed;
i) TRAIN_DONE Received; and
j) Dword Received.

The ALIGN Received, Dword Received, and TRAIN_DONE Received messages are only sent when the SP_DWS state machine has achieved dword synchronization.

For SATA speed negotiation, the ALIGN Received (0) message includes an argument containing the physical link rate at which the ALIGN (0) primitives were detected. For SAS speed negotiation, only ALIGNs at the physical link rate specified by the last Set Rate message received by the SP transmitter cause ALIGN Received messages.

6.8.3 OOB sequence states

6.8.3.1 OOB sequence states overview

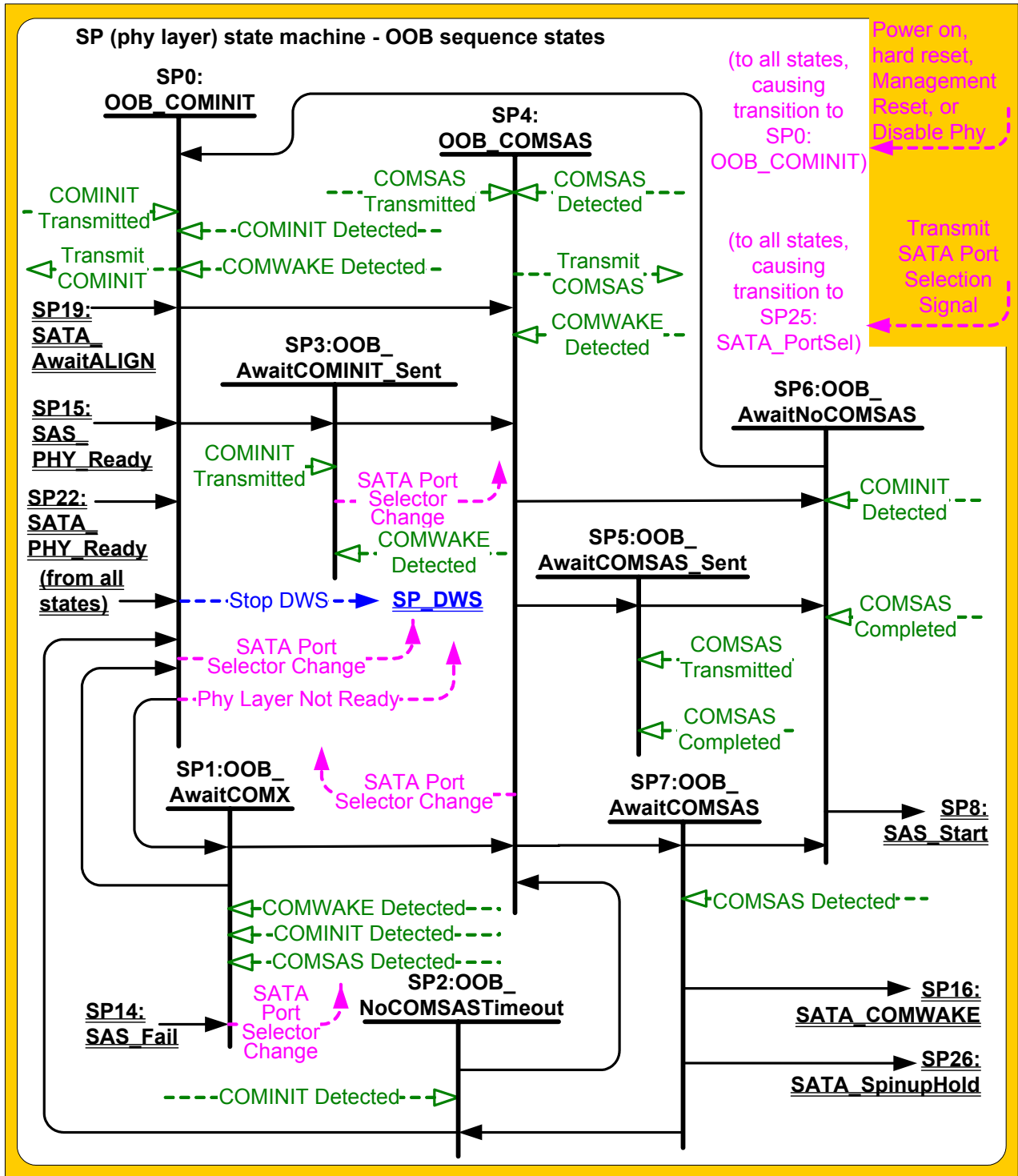Figure 117 shows the OOB sequence states. These states are indicated by state names with a prefix of OOB.

Figure 117 — SP (phy layer) state machine - OOB sequence states

6.8.3.2 SP0:OOB_COMINIT state

6.8.3.2.1 State description

This state is the initial state for this state machine.

Upon entry into this state, the phy shall:

a) set the COMWAKE_Received state machine variable to zero;
b) send a Stop DWS message to the SP_DWS state machine;
c) send a Phy Layer Not Ready confirmation to the link layer;
d) set the ATTACHED SATA DEVICE bit to zero in the SMP DISCOVER response (see 10.4.3.7) and the SMP DISCOVER LIST response (see 10.4.3.13.3);
e) if this state was entered due to power on, set the ATTACHED SATA PORT SELECTOR bit to zero in the SMP DISCOVER response (see 10.4.3.7) and the SMP DISCOVER LIST response (see 10.4.3.13.3); and
f) if this state was not entered because of a Disable Phy request, send a Transmit COMINIT message to the SP transmitter.

Upon entry into this state, if this state was entered because of a Disable Phy request, this state shall:

a) ignore COMINIT Detected messages until this state is re-entered due to a power on, hard reset, or Management Reset request; and
b) set the ResetStatus state machine variable to DISABLED.

Upon entry into this state, if this state was entered due to power on or hard reset, this state shall set the ResetStatus state machine variable to UNKNOWN.

Upon entry into this state, if this state was entered because of a Management Reset request, then this state shall:

a) if the ResetStatus state machine variable is not set to RESET_IN_PROGRESS, SPINUP_HOLD, G1, G2, or G3, set the ResetStatus state machine variable to UNKNOWN; or
b) if the ResetStatus state machine variable is set to RESET_IN_PROGRESS, SPINUP_HOLD, G1, G2, or G3, set the ResetStatus state machine variable to RESET_IN_PROGRESS.

Upon entry into this state, if this state was not entered due to a power on, hard reset, Disable Phy, or Management Reset request, then this state shall:

a) if the ResetStatus state machine variable is not set to PHY_RESET_PROBLEM, SPINUP_HOLD, or UNSUPPORTED_PHY_ATTACHED, set the ResetStatus state machine variable to UNKNOWN; or
b) if the ResetStatus state machine variable is set to PHY_RESET_PROBLEM, SPINUP_HOLD, or UNSUPPORTED_PHY_ATTACHED, not change the ResetStatus state machine variable.

If the phy supports SATA port selectors and this state receives a COMWAKE Detected message, this state shall:

a) if the ResetStatus state machine variable is not set to PHY_RESET_PROBLEM, SPINUP_HOLD, or UNSUPPORTED_PHY_ATTACHED, set the ResetStatus state machine variable to PORT_SELECTOR,
b) set the COMWAKE_Received state machine variable to one; and
c) if the ATTACHED SATA PORT SELECTOR bit is set to zero in the SMP DISCOVER response (see 10.4.3.7) and the SMP DISCOVER LIST response (see 10.4.3.13.3):
   A) set the ATTACHED SATA PORT SELECTOR bit to one in the SMP DISCOVER response and the SMP DISCOVER LIST response; and
   B) send a SATA Port Selector Change confirmation to the link layer.

This state machine waits for receipt of a COMINIT Transmitted message and/or a COMINIT Detected message.

6.8.3.2.2 Transition SP0:OOB_COMINIT to SP1:OOB_AwaitCOMX

This transition shall occur if this state receives a COMINIT Transmitted message and has not received a COMINIT Detected message.

6.8.3.2.3 Transition SP0:OOB_COMINIT to SP3:OOB_AwaitCOMINIT_Sent

This transition shall occur if this state receives a COMINIT Detected message and has not received a COMINIT Transmitted message.

6.8.3.2.4 Transition SP0:OOB_COMINIT to SP4:OOB_COMSAS

This transition shall occur if this state receives both a COMINIT Transmitted message and a COMINIT Detected message.

6.8.3.3 SP1:OOB_AwaitCOMX state

6.8.3.3.1 State description

Upon entry into this state, the phy shall initialize and start the Hot-Plug Timeout timer if this phy is:

a) an expander phy; or
b) an initiator phy or target phy implementing the Hot-Plug Timeout timer.

If the phy supports SATA port selectors and this state receives a COMWAKE Detected message, this state shall:

a) if the ResetStatus state machine variable is not set to PHY_RESET_PROBLEM, SPINUP_HOLD, or UNSUPPORTED_PHY_ATTACHED, set the ResetStatus state machine variable to PORT_SELECTOR,
b) set the COMWAKE_Received state machine variable to one; and
c) if the ATTACHED SATA PORT SELECTOR bit is set to zero in the SMP DISCOVER response (see 10.4.3.7) and the SMP DISCOVER LIST response (see 10.4.3.13.3):
   A) set the ATTACHED SATA PORT SELECTOR bit to one in the SMP DISCOVER response and the SMP DISCOVER LIST response; and
   B) send a SATA Port Selector Change confirmation to the link layer.

6.8.3.3.2 Transition SP1:OOB_AwaitCOMX to SP0:OOB_COMINIT

This transition shall occur if the Hot-Plug Timeout timer expires.

If the COMWAKE_Received state machine variable is set to zero and the ATTACHED SATA PORT SELECTOR bit is set to one in the SMP DISCOVER response (see 10.4.3.7) and the SMP DISCOVER LIST response (see 10.4.3.13.3), the state machine shall, before the transition:

a) set the ATTACHED SATA PORT SELECTOR bit to zero in the SMP DISCOVER response and the SMP DISCOVER LIST response; and
b) send a SATA Port Selector Change confirmation to the link layer.

Before the transition, if this state was entered from SP0:OOB_COMINIT, this state shall set the ResetStatus state machine variable to UNKNOWN.

> Editor's Note 2: This is to get the variable cleared when there isn't a device responding to anything anymore, and not have lingering RESET_IN_PROGRESS, PHY_RESET_PROBLEM, etc.

6.8.3.3.3 Transition SP1:OOB_AwaitCOMX to SP4:OOB_COMSAS

This transition shall occur after receiving either a COMINIT Detected message or a COMSAS Detected message. If COMSAS Detected was received, this transition shall include a COMSAS Detected argument.

If the ATTACHED SATA PORT SELECTOR bit is set to one in the SMP DISCOVER response (see 10.4.3.7) and the SMP DISCOVER LIST response (see 10.4.3.13.3), the state machine shall, before the transition:

a) set the ATTACHED SATA PORT SELECTOR bit to zero in the SMP DISCOVER response and the SMP DISCOVER LIST response; and
b) send a SATA Port Selector Change confirmation to the link layer.

6.8.3.4 SP2:OOB_NoCOMSASTimeout state

6.8.3.4.1 State description

Upon entry into this state, the phy shall initialize and start the Hot-Plug Timeout timer if this phy is:

    a)   this phy is an expander phy; or
    b)   this phy is an initiator phy or target phy implementing the Hot-Plug Timeout timer.

6.8.3.4.2 Transition SP2:OOB_NoCOMSASTimeout to SP0:OOB_COMINIT

This transition shall occur if the Hot-Plug Timeout timer expires.

6.8.3.4.3 Transition SP2:OOB_NoCOMSASTimeout to SP4:OOB_COMSAS

This transition shall occur after receiving a COMINIT Detected message.

6.8.3.5 SP3:OOB_AwaitCOMINIT_Sent state

6.8.3.5.1 State description

This state waits for a COMINIT Transmitted message.

If the phy supports SATA port selectors, the ATTACHED SATA PORT SELECTOR bit is set to zero in the SMP DISCOVER response (see 10.4.3.7) and the SMP DISCOVER LIST response (see 10.4.3.13.3), and this state receives a COMWAKE Detected message, this state shall:

    a)   if the ResetStatus state machine variable is not set to PHY_RESET_PROBLEM, SPINUP_HOLD, or UNSUPPORTED_PHY_ATTACHED, set the ResetStatus state machine variable to PORT_SELECTOR,
    b)   set the ATTACHED SATA PORT SELECTOR bit to one in the SMP DISCOVER response and the SMP DISCOVER LIST response; and
    c)   send a SATA Port Selector Change confirmation to the link layer.

6.8.3.5.2 Transition SP3:OOB_AwaitCOMINIT_Sent to SP4:OOB_COMSAS

This transition shall occur after receiving a COMINIT Transmitted message.

6.8.3.6 SP4:OOB_COMSAS state

6.8.3.6.1 State description

Upon entry into this state, the phy shall send a Transmit COMSAS message to the SP transmitter.

This state waits for receipt of a COMSAS Transmitted message and/or a COMSAS Detected message.

If the phy supports SATA port selectors, the ATTACHED SATA PORT SELECTOR bit is set to zero in the SMP DISCOVER response (see 10.4.3.7) and the SMP DISCOVER LIST response (see 10.4.3.13.3), and this state receives a COMWAKE Detected message, this state shall:

    a)   if the ResetStatus state machine variable is not set to PHY_RESET_PROBLEM, SPINUP_HOLD, or UNSUPPORTED_PHY_ATTACHED, set the ResetStatus state machine variable to PORT_SELECTOR,
    b)   set the ATTACHED SATA PORT SELECTOR bit to one in the SMP DISCOVER response and the SMP DISCOVER LIST response; and
    c)   send a SATA Port Selector Change confirmation to the link layer.

6.8.3.6.2 Transition SP4:OOB_COMSAS to SP5:OOB_AwaitCOMSAS_Sent

This transition shall occur if this state receives a COMSAS Detected message or this state was entered with a COMSAS Detected argument, and this state has not received a COMSAS Transmitted message.

If the ATTACHED SATA PORT SELECTOR bit is set to one in the SMP DISCOVER response (see 10.4.3.7) and the SMP DISCOVER LIST response (see 10.4.3.13.3), the state machine shall set the ATTACHED SATA PORT

SELECTOR bit to zero in the SMP DISCOVER response and the SMP DISCOVER LIST response and send a SATA Port Selector Change confirmation to the link layer before the transition.

6.8.3.6.3 Transition SP4:OOB_COMSAS to SP6:OOB_AwaitNoCOMSAS

This transition shall occur if this state receives both a COMSAS Transmitted message and a COMSAS Detected message.

If the ATTACHED SATA PORT SELECTOR bit is set to one in the SMP DISCOVER response (see 10.4.3.7) and the SMP DISCOVER LIST response (see 10.4.3.13.3), the state machine shall set the ATTACHED SATA PORT SELECTOR bit to zero in the SMP DISCOVER response and the SMP DISCOVER LIST response and send a SATA Port Selector Change confirmation to the link layer before the transition.

6.8.3.6.4 Transition SP4:OOB_COMSAS to SP7:OOB_AwaitCOMSAS

This transition shall occur if this state receives a COMSAS Transmitted message and has not received a COMSAS Detected message.

6.8.3.7 SP5:OOB_AwaitCOMSAS_Sent state

6.8.3.7.1 State description

This state waits for receipt of a COMSAS Transmitted message.

6.8.3.7.2 Transition SP5:OOB_AwaitCOMSAS_Sent to SP6:OOB_AwaitNoCOMSAS

This transition shall occur after receiving a COMSAS Transmitted message.

If this state received a COMSAS Completed message, it shall include a COMSAS Completed argument with the transition.

6.8.3.8 SP6:OOB_AwaitNoCOMSAS state

6.8.3.8.1 State description

This state machine waits for a COMSAS Completed message, which indicates that COMSAS has been completely received.

6.8.3.8.2 Transition SP6:OOB_AwaitNoCOMSAS to SP0:OOB_COMINIT

This transition shall occur after receiving a COMINIT Detected message.

Before the transition, this state shall set the ResetStatus state machine variable to UNKNOWN.

6.8.3.8.3 Transition SP6:OOB_AwaitNoCOMSAS to SP8:SAS_Start

This transition shall occur after receiving a COMSAS Completed message, or shall occur if a COMSAS Completed argument was received in the transition.

6.8.3.9 SP7:OOB_AwaitCOMSAS state

6.8.3.9.1 State description

Upon entry into this state, the phy shall initialize and start the COMSAS Detect Timeout timer.

6.8.3.9.2 Transition SP7:OOB_AwaitCOMSAS to SP2:OOB_NoCOMSASTimeout

This transition shall occur if the phy does not support SATA and the COMSAS Detect Timeout timer expires.

The state machine shall set the MgmtReset state machine variable to zero before the transition.

6.8.3.9.3 Transition SP7:OOB_AwaitCOMSAS to SP6:OOB_AwaitNoCOMSAS

This transition shall occur after receiving a COMSAS Detected message.

The state machine shall set the MgmtReset state machine variable to zero before the transition.

The state machine shall set the ATTACHED SATA PORT SELECTOR bit to zero in the SMP DISCOVER response (see 10.4.3.7) and the SMP DISCOVER LIST response (see 10.4.3.13.3). If the ATTACHED SATA PORT SELECTOR bit in the SMP DISCOVER response and the SMP DISCOVER LIST response was set to one prior to this transition, the state machine shall send a SATA Port Selector Change confirmation to the link layer before the transition.

6.8.3.9.4 Transition SP7:OOB_AwaitCOMSAS to SP16:SATA_COMWAKE

This transition shall occur if:

    a) the phy supports SATA;
    b) the COMSAS Detect Timeout timer expires; and
        A) the MgmtReset state machine variable is set to one; or
        B) the phy does not implement SATA spinup hold.

The state machine shall set the MgmtReset state machine variable to zero before the transition.

The state machine shall set the ATTACHED SATA DEVICE bit to one in the SMP DISCOVER response (see 10.4.3.7) and the SMP DISCOVER LIST response (see 10.4.3.13.3) before the transition.

6.8.3.9.5 Transition SP7:OOB_AwaitCOMSAS to SP26:SATA _SpinupHold

This transition shall occur if:

    a) the phy supports SATA;
    b) the COMSAS Detect Timeout timer expires;
    c) the phy implements SATA spinup hold; and
    d) the MgmtReset state machine variable is set to zero.

The state machine shall set the ATTACHED SATA DEVICE bit to one in the SMP DISCOVER response (see 10.4.3.7) and the SMP DISCOVER LIST response (see 10.4.3.13.3) before the transition.

6.8.4 SAS speed negotiation states

6.8.4.1 SAS speed negotiation states overview

Figure 118 shows the SAS speed negotiation states, in which the phy has detected that it is attached to a SAS phy or expander phy rather than a SATA phy, and performs the SAS speed negotiation sequence. These states are indicated by state names with a prefix of SAS.
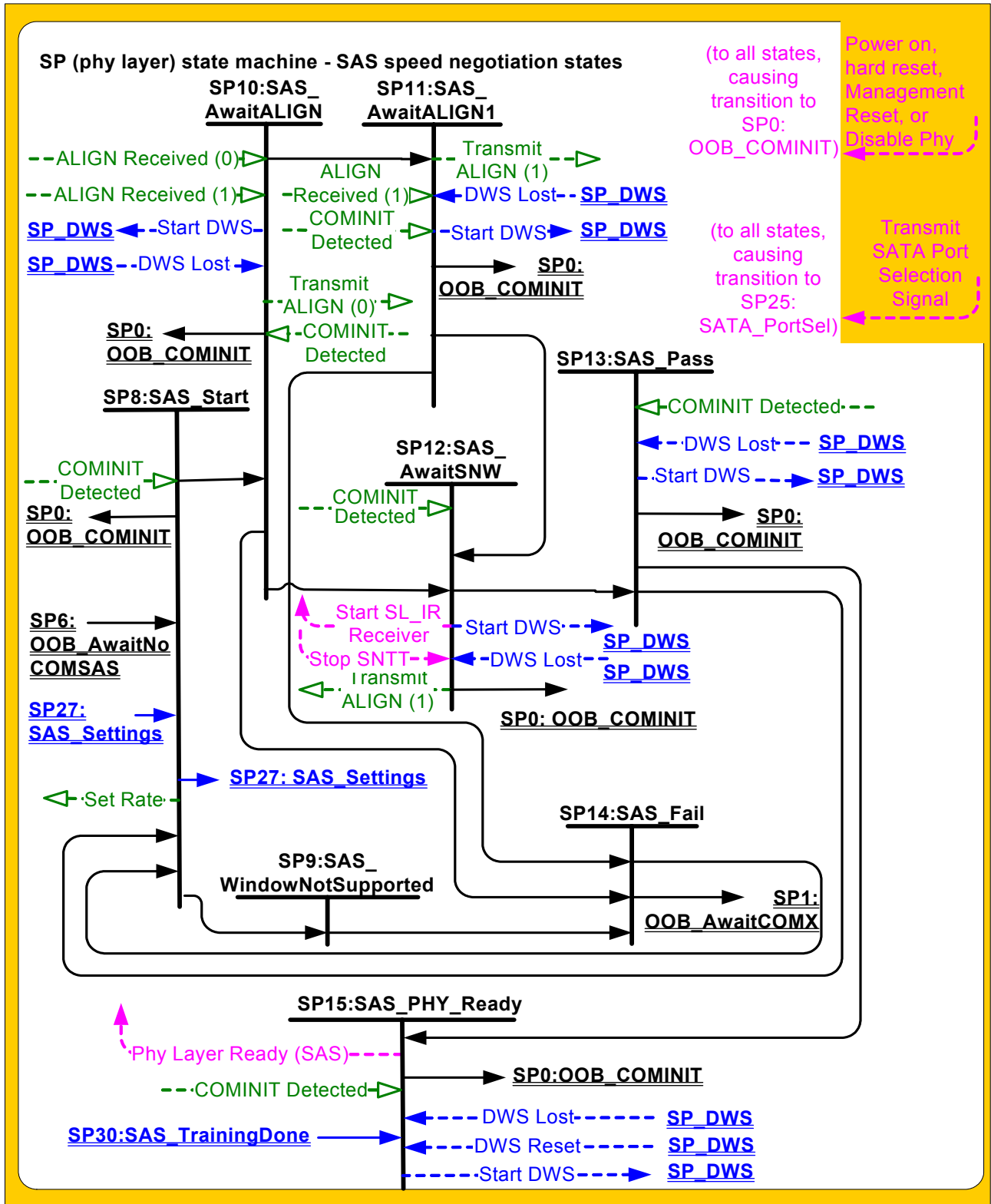
Figure 118 — SP (phy layer) state machine - SAS speed negotiation states

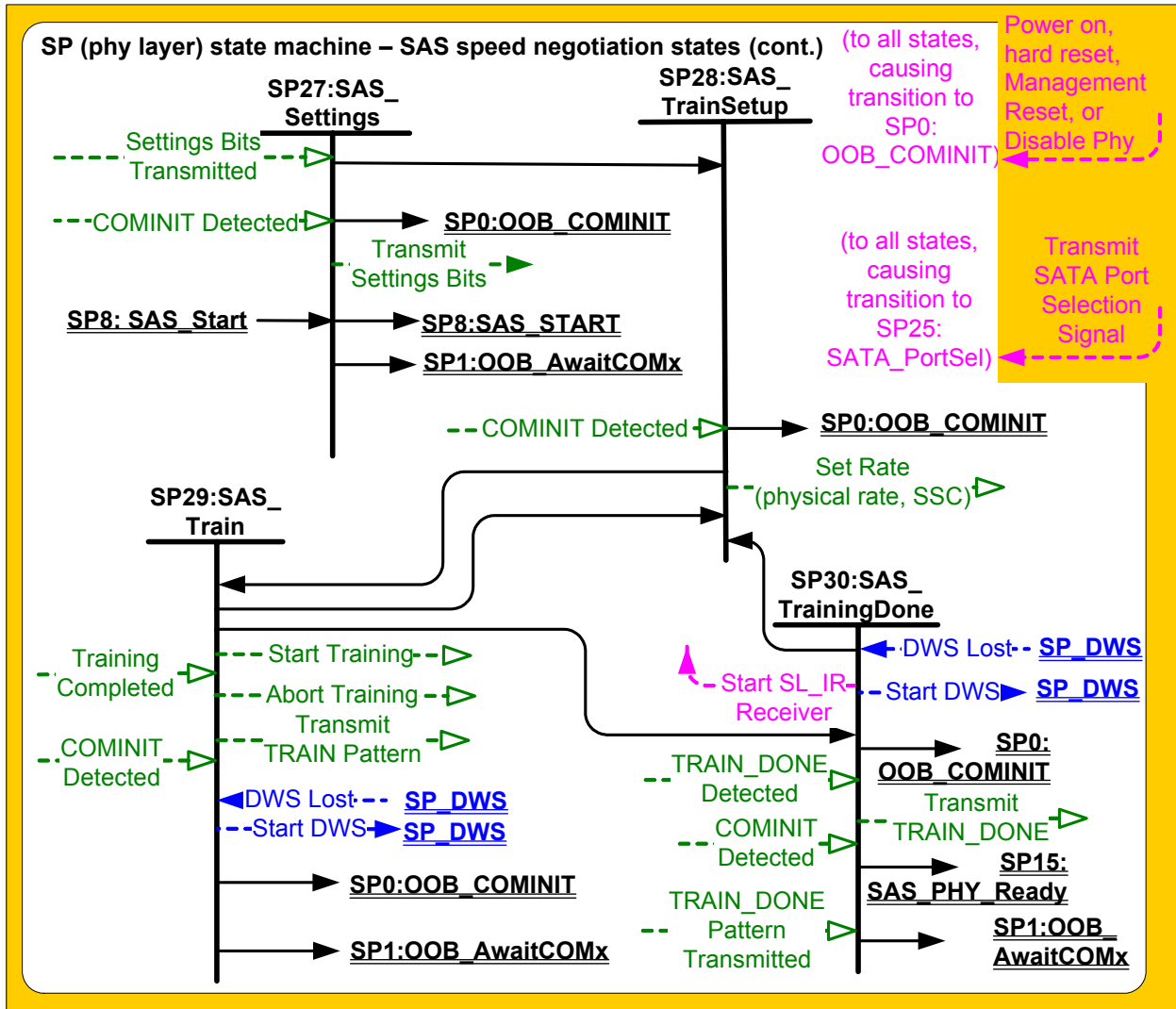Figure 119 shows the SAS speed negotiation states related to SNW-3 and Train-SNW.

Figure 119 — SP (phy layer) state machine - SAS speed negotiation states for SNW-3 and Train-SNW

6.8.4.2 SP8:SAS_Start state

6.8.4.2.1 State description

This is the initial state for the SAS speed negotiation sequence.

Upon entry into this state, the phy shall:

    a)   initialize and start the RCDT timer;
    b)   send a Set Rate message to the SP transmitter with the argument set to:
          A)   1.5 Gbps, if the transition into this state was from the SP6:OOB_AwaitNoCOMSAS state (i.e., if this is the first speed negotiation window); or
          B)   the value of the SAS Speed Negotiation Window Rate argument.

If this state is entered from SP6:OOB_AwaitNoCOMSAS, then the Current SNW state machine variable shall be set to SNW-1. If this state is not entered from SP6:OOB_AwaitNoCOMSAS, then the Current SNW state machine variable shall be set to:

    a)   SNW-2 if the Current SNW state machine variable is set to SNW-1;
    a)   SNW-3 if the Current SNW state machine variable is set to SNW-2, and either SNW-1 is invalid or SNW-2 is valid;

b) Final-SNW if the Current SNW state machine variable is set to SNW-2, SNW-1 is valid, and SNW-2 is invalid;

c) Final-SNW if the Current SNW state machine variable is set to SNW-3, SNW-3 is invalid, and SNW-2 is valid; or

d) ~~Phy Reset Problem~~ Unsupported Phy Attached if the Current SNW state machine variable is set to SNW-3, SNW-3 is invalid, and SNW-2 is invalid.

After the Current SNW state machine variable is updated, if the Current SNW state machine variable is not set to ~~Phy Reset Problem~~ Unsupported Phy Attached, then this state shall:

a) initialize and start the RCDT timer; and

b) if the speed negotiation window specified by the Current SNW state machine variable is supported, send a Set Rate message to the SP transmitter and SP receiver with:

   A) the Physical Link Rate argument set to 1,5 Gbps and an SSC Off argument, if the Current SNW state machine variable is set to SNW-1;

   B) the Physical Link Rate argument set to 3,0 Gbps and an SSC Off argument, if the Current SNW state machine variable is set to SNW-2;

   C) the Physical Link Rate arguments set to 1,5 Gbps and an SSC Off argument, if the Current SNW state machine variable is set to Final-SNW, SNW-1 was valid and SNW-2 was invalid;

   D) the Physical Link Rate arguments set to 3,0 Gbps and an SSC Off argument, if the Current SNW state machine variable is set to Final-SNW and SNW-2 was valid; or

   E) the Physical Link Rate argument set to 1,5 Gbps and either an SSC On argument or an SSC Off argument, if the Current SNW state machine variable is set to SNW-3.

During this state D.C. idle shall be transmitted.

6.8.4.2.2 Transition SP8:SAS_Start to SP0:OOB_COMINIT

This transition shall occur after receiving a COMINIT Detected message.

Before the transition, this state shall set the ResetStatus state machine variable to UNKNOWN.

6.8.4.2.3 Transition SP8:SAS_Start to SP9:SAS_WindowNotSupported

This transition shall occur after the RCDT timer expires if the SNW indicated by the Current SNW state machine variable is not supported.

6.8.4.2.4 Transition SP8:SAS_Start to SP10:SAS_AwaitALIGN

This transition shall occur after the RCDT timer expires if:

a) the Current SNW state machine variable is not set to SNW-3; and

b) the SNW indicated by the Current SNW state machine variable is supported.

6.8.4.2.5 Transition SP8:SAS_Start to SP27:SAS_Settings

This transition shall occur after the RCDT timer expires if:

a) the Current SNW state machine variable is set to SNW-3; and

b) SNW-3 is supported.

6.8.4.2.6 Transition SP8:SAS_Start to SP1:OOB_AwaitCOMX

This transition shall occur if the Current SNW state machine variable is set to ~~Phy Reset Problem~~ Unsupported Phy Attached.

Before the transistion, this state shall set the ResetStatus state machine variable to UNSUPPORTED_PHY_ATTACHED.

6.8.4.3 SP9:SAS_WindowNotSupported state

6.8.4.3.1 State description

Upon entry into this state, the phy shall initialize and start the SNTT timer.

During this state D.C. idle shall be transmitted.

6.8.4.3.2 Transition SP9:SAS_WindowNotSupported to SP14:SAS_Fail

This transition shall occur after the SNTT timer expires.

6.8.4.4 SP10:SAS_AwaitALIGN state

6.8.4.4.1 State description

Upon entry into this state, the phy shall:

    a) initialize and start the SNTT timer and SNLT timer;
    b) send a Start DWS message to the SP_DWS state machine; and
    c) repeatedly send Transmit ALIGN (0) messages to the SP transmitter.

Each time this state receives a DWS Lost message, this state may send a Start DWS message to the SP_DWS state machine to re-acquire dword synchronization without running a new link reset sequence.

6.8.4.4.2 Transition SP10:SAS_AwaitALIGN to SP0:OOB_COMINIT

This transition shall occur after receiving a DWS Lost message if this state does not send a Start DWS message, or after receiving a COMINIT Detected message.

Before the transition, this state shall set the ResetStatus state machine variable to UNKNOWN.

6.8.4.4.3 Transition SP10:SAS_AwaitALIGN to SP11:SAS_AwaitALIGN1

This transition shall occur if this state receives an ALIGN Received (0) message before the SNLT timer expires.

6.8.4.4.4 Transition SP10:SAS_AwaitALIGN to SP12:SAS_AwaitSNW

This transition shall occur if this state receives an ALIGN Received (1) message before the SNLT timer expires.

6.8.4.4.5 Transition SP10:SAS_AwaitALIGN to SP14:SAS_Fail

This transition shall occur if the SNTT timer expires.

6.8.4.5 SP11:SAS_AwaitALIGN1 state

6.8.4.5.1 State description

This state shall repeatedly send Transmit ALIGN (1) messages to the SP transmitter.

Each time this state receives a DWS Lost message, this state may send a Start DWS message to the SP_DWS state machine to re-acquire dword synchronization without running a new link reset sequence.

6.8.4.5.2 Transition SP11:SAS_AwaitALIGN1 to SP0:OOB_COMINIT

This transition shall occur after receiving a DWS Lost message if this state does not send a Start DWS message, or after receiving a COMINIT Detected message.

Before the transition, this state shall set the ResetStatus state machine variable to UNKNOWN.

6.8.4.5.3 Transition SP11:SAS_AwaitALIGN1 to SP12:SAS_AwaitSNW

This transition shall occur if this state receives an ALIGN Received (1) message before the SNLT timer expires. This indicates that the other phy has been able to achieve dword synchronization in the current speed negotiation window.

6.8.4.5.4 Transition SP11:SAS_AwaitALIGN1 to SP14:SAS_Fail

This transition shall occur if the SNTT timer expires. This indicates that the other phy has not been able to achieve dword synchronization in the current speed negotiation window.

6.8.4.6 SP12:SAS_AwaitSNW state

6.8.4.6.1 State description

This state shall repeatedly send Transmit ALIGN (1) messages to the SP transmitter.

If the Current SNW state machine variable is set to Final-SNW, this state shall send a Start SL_IR Receiver confirmation to the link layer.

Each time this state receives a DWS Lost message, this state may send a Start DWS message to the SP_DWS state machine to re-acquire dword synchronization without running a new link reset sequence.

This state waits for the SNTT timer to expire or for a Stop SNTT request.

6.8.4.6.2 Transition SP12:SAS_AwaitSNW to SP0:OOB_COMINIT

This transition shall occur after receiving a DWS Lost message if this state does not send a Start DWS message, or after receiving a COMINIT Detected message.

Before the transition, this state shall set the ResetStatus state machine variable to UNKNOWN.

6.8.4.6.3 Transition SP12:SAS_AwaitSNW to SP13:SAS_Pass

This transition shall occur after the SNTT timer expires or after receiving a Stop SNTT request.

6.8.4.7 SP13:SAS_Pass state

6.8.4.7.1 State description

This state determines if:

  a) another SAS speed negotiation window is required; or
  b) the SAS speed negotiation sequence is complete.

Each time this state receives a DWS Lost message, this state may send a Start DWS message to the SP_DWS state machine to re-acquire dword synchronization without running a new link reset sequence.

6.8.4.7.2 Transition SP13:SAS_Pass to SP0:OOB_COMINIT

This transition shall occur after receiving a DWS Lost message if this state does not send a Start DWS message, or after receiving a COMINIT Detected message.

Before the transition, this state shall set the ResetStatus state machine variable to UNKNOWN.

6.8.4.7.3 Transition SP13:SAS_Pass to SP8:SAS_Start

This transition shall occur if the Current SNW state machine variable is not set to Final-SNW.

6.8.4.7.4 Transition SP13:SAS_Pass to SP15:SAS_PHY_Ready

This transition shall occur if the Current SNW state machine variable is set to Final-SNW.

6.8.4.8 SP14:SAS_Fail state

6.8.4.8.1 State description

This state determines if:

    a) another SAS speed negotiation window is required; or
    b) the SAS speed negotiation sequence is complete.

6.8.4.8.2 Transition SP14:SAS_Fail to SP1:OOB_AwaitCOMX

This transition shall occur if the Current SNW state machine variable is set to Final-SNW.

Before the transistion, this state shall set the ResetStatus state machine variable to PHY_RESET_PROBLEM.

6.8.4.8.3 Transition SP14:SAS_Fail to SP8:SAS_Start

This transition shall occur if the Current SNW state machine variable is not set to Final-SNW.

6.8.4.9 SP15:SAS_PHY_Ready state

6.8.4.9.1 State description

This state waits for a COMINIT Detected message, a DWS Lost message, or a DWS Reset message.

Upon entry into this state, the phy shall:

    a) if multiplexing is enabled (see table 86 in 6.7.4.2.3.3), send a Transmit MUX Sequence message to the SP transmitter; and
    b) send a Phy Layer Ready (SAS) confirmation to the link layer to indicate that the physical link has been brought up successfully in SAS mode.

Upon entry into this state, this state shall:

    a) if the SP transmitter is transmitting at 1.5Gbps, set the ResetStatus state machine variable to G1;
    b) if the SP transmitter is transmitting at 3.0Gbps, set the ResetStatus state machine variable to G2; or
    c) if the SP transmitter is transmitting at 6.0Gbps, set the ResetStatus state machine variable to G3.

While in this state dwords from the link layer are transmitted at the negotiated physical link rate at the rate established in the previous speed negotiation window.

If multiplexing is disabled, each time this state receives a DWS Lost message, this state may send a Start DWS message to the SP_DWS state machine to re-acquire dword synchronization without running a new link reset sequence.

> NOTE 22 - If multiplexing is enabled and this state receives a DWS Lost message, this state does not send a Start DWS message and the state machine transitions to SP0:OOB_COMINIT.

6.8.4.9.2 Transition SP15:SAS_PHY_Ready to SP0:OOB_COMINIT

This transition shall occur after:

    a) receiving a DWS Lost message, if this state does not send a Start DWS message;
    b) receiving a DWS Lost message followed by a COMINIT Detected message, if this state does not send a Start DWS message; or
    c) receiving a DWS Reset message.

This transition may but should not occur after receiving a COMINIT Detected message before receiving a DWS Lost message, or after receiving a COMINIT Detected message after sending a Start DWS message (i.e., the SP state machine should ignore COMINIT Detected messages unless the SP_DWS state machine has indicated loss of dword synchronization).

6.8.4.10 SP27:SAS_Settings state

6.8.4.10.1 State description

This state transmits and receives phy capabilities bits.

Upon entry to this state, the phy shall:

a) set the Common Supported Settings state machine variable to indicate that there are no supported settings bits in common; and
b) send Transmit Settings Bits message to the SP transmitter.

If a Settings Bits Detected message is received with the argument of parity good, then this state shall set the Common Supported Settings state machine variable to reflect the bits from bit 8 through bit 13 that are set to one in both the transmitted and received phy configuration bits.

This state waits for the SNTT timer to expire.

6.8.4.10.2 Transition SP27:SAS_Settings to SP0:OOB_COMINIT

This transition shall occur after receiving a COMINIT Detected message.

Before the transition, this state shall set the ResetStatus state machine variable to UNKNOWN.

6.8.4.10.3 Transition SP27:SAS_Settings to SP1:OOB_AwaitCOMX

This transition shall occur after the SNTT timer expires if:

a) a Settings Bits Detected message is received with an argument of parity bad; or
b) no common supported settings exist after the Common Supported Settings state machine variable is set as a result of receiving a Settings Bits Detected message.

Before the transition, this state shall:

a) if a Settings Bits Detected message is received with an argument of parity bad, set the ResetStatus state machine variable to PHY_RESET_PROBLEM; or
b) if no common supported settings exist after the Common Supported Settings state machine variable is set, set the ResetStatus state machine variable to UNSUPPORTED_PHY_ATTACHED.

6.8.4.10.4 Transition SP27:SAS_Settings to SP8:SAS_Start

This transition shall occur if:

a) the SNTT timer expires; and
b) a Settings Bits Detected message is not received during this state.

6.8.4.10.5 Transition SP27:SAS_Settings to SP28:SAS_TrainSetup

This transition shall occur:

a) after the SNTT timer expires; and
b) if Common Supported Settings state machine variable indicates at least one supported settings bit in common.

6.8.4.11 SP28:SAS_TrainSetup

6.8.4.11.1 State description

Upon entry into this state, the phy shall:

a) initialize and start the RCDT timer; and
b) send a Set Rate message to the SP transmitter and receiver with the arguments set to reflect the highest priority supported setting contained in the Common Supported Settings state machine variable.

After the Set Rate message is sent, the Common Supported Settings state machine variable shall be set to indicate the supported settings bit used for the Set Rate message is no longer in common.

During this state D.C. idle shall be transmitted.

6.8.4.11.2 Transition SP28:SAS_TrainSetup to SP0:OOB_COMINIT

This transition shall occur after receiving a COMINIT Detected message.

Before the transition, this state shall set the ResetStatus state machine variable to UNKNOWN.

6.8.4.11.3 Transition SP28:SAS_TrainSetup to SP29:SAS_Train

This transition shall occur after the RCDT timer expires.

6.8.4.12 SP29:SAS_Train state

6.8.4.12.1 State description

Upon entry into this state, the phy shall:

- a) initialize and start the MTT timer;
- b) initialize and start the TLT timer;
- c) send a Start Training message to the SP receiver; and
- d) send a Start DWS message to the SP_DWS state machine.

This state shall repeatedly send Transmit TRAIN Pattern messages to the SP transmitter.

Each time this state receives a DWS Lost message, this state shall send a Start DWS message to the SP_DWS state machine to re-acquire dword synchronization.

If the MTT timer expires, then this state shall send an Abort Training message to the SP receiver.

6.8.4.12.2 Transition SP29:SAS_Train to SP0:OOB_COMINIT

This transition shall occur after receiving a COMINIT Detected message.

Before the transition, this state shall set the ResetStatus state machine variable to UNKNOWN.

6.8.4.12.3 Transition SP29:SAS_Train to SP1:OOB_AwaitCOMX

This transition shall occur if

- a) the MTT timer expires; and
- b) the Common Supported Settings state machine variable does not contain additional common settings.

This is a phy reset problem.

Before the transistion, this state shall set the ResetStatus state machine variable to PHY_RESET_PROBLEM.

6.8.4.12.4 Transition SP29:SAS_Train to SP30:SAS_TrainingDone

This transition shall occur if:

- a) this state receives a Training Completed message before the TLT timer expires; and
- b) dword synchronization is acquired.

6.8.4.12.5 Transition SP29:SAS_Train to SP28:SAS_TrainSetup

This transition shall occur if:

- a) the MTT timer expires; and
- b) the Common Supported Settings state machine variable contains additional common supported settings.

6.8.4.13 SP30:SAS_TrainingDone state

6.8.4.13.1 State description

This state shall repeatedly send Transmit TRAIN_DONE Pattern messages to the SP transmitter.

Each time this state receives a DWS Lost message, this state may send a Start DWS message to the SP_DWS state machine to re-acquire dword synchronization without running a new link reset sequence.

This state waits for the MTT timer to expire or a TRAIN_DONE Received message from the receiver.

This state shall send a Start SL_IR Receiver confirmation to the link layer when a TRAIN_DONE Received message is received.

6.8.4.13.2 Transition SP30:SAS_TrainingDone to SP0:OOB_COMINIT

This transition shall occur after:

    a)   receiving a DWS Lost message if this state does not send a Start DWS message; or
    b)   receiving a COMINIT Detected message.

Before the transition, this state shall set the ResetStatus state machine variable to UNKNOWN.

6.8.4.13.3 Transition SP30:SAS_TrainingDone to AwaitCOMX

This transition shall occur if:

    a)   TRAIN_DONE Received message is not received before the MTT timer expires; and
    b)   the Common Supported Settings state machine variable does not contain additional common supported settings bits.

This is a phy reset problem.

Before the transistion, this state shall set the ResetStatus state machine variable to PHY_RESET_PROBLEM.

6.8.4.13.4 Transition SP30:SAS_TrainingDone to SP28:SAS_TrainSetup

This transition shall occur if:

    a)   the MTT timer expires; and
    b)   the Common Supported Settings state machine variable contains additional common supported settings bits.

6.8.4.13.5 Transition SP30:SAS_TrainingDone to SP15:SAS_PHY_Ready

This transition shall occur if this state receives:

    a)   at least four TRAIN_DONE Pattern Transmitted messages; and
    b)   a TRAIN_DONE Received message before the MTT timer expires.

6.8.5 SATA host emulation states

6.8.5.1 SATA host emulation states overview

Figure 120 shows the SATA host emulation states, in which the phy has detected that it is attached to a SATA phy and behaves as if it were a SATA host phy, initiating the SATA speed negotiation sequence. These states are indicated by state names with a prefix of SATA.

The power management states defined in this standard are for SAS initiator phys that support SATA; expander devices that support SATA do not support power management in this standard.
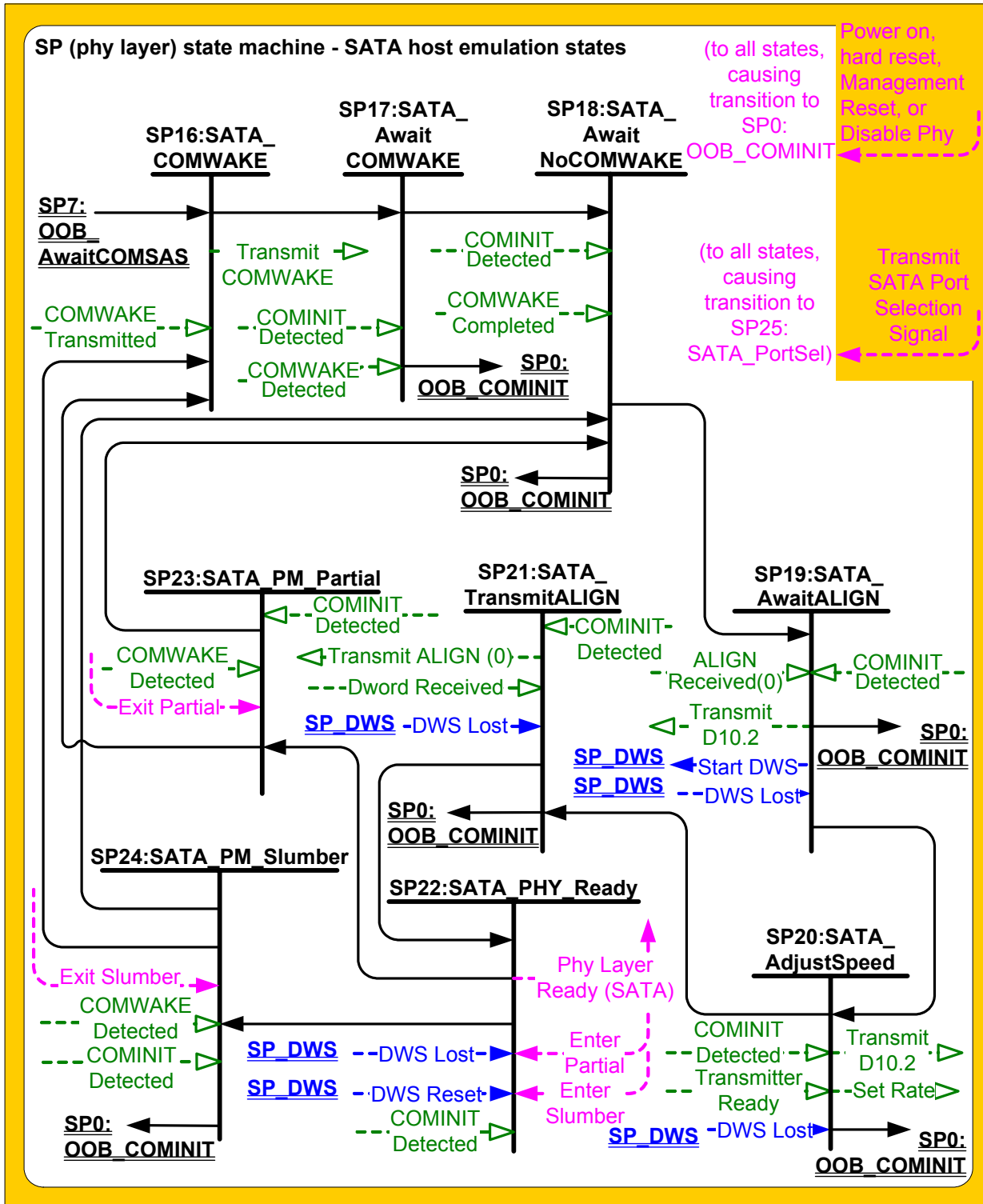
SP (phy layer) state machine - SATA host emulation states

Figure 120 — SP (phy layer) state machine - SATA host emulation states

6.8.5.2 SP16:SATA_COMWAKE state

6.8.5.2.1 State description

This state shall send a Transmit COMWAKE message to the SP transmitter and wait for a COMWAKE Transmitted message.

6.8.5.2.2 Transition SP16:SATA_COMWAKE to SP17:SATA_AwaitCOMWAKE

This transition shall occur after receiving a COMWAKE Transmitted message.

6.8.5.3 SP17:SATA_AwaitCOMWAKE state

6.8.5.3.1 State description

This state waits for COMWAKE to be received.

6.8.5.3.2 Transition SP17:SATA_AwaitCOMWAKE to SP0:OOB_COMINIT

This transition shall occur after receiving a COMINIT Detected message.

6.8.5.3.3 Transition SP17:SATA_AwaitCOMWAKE to SP18:SATA_AwaitNoCOMWAKE

This transition shall occur after receiving a COMWAKE Detected message.

6.8.5.4 SP18:SATA_AwaitNoCOMWAKE state

6.8.5.4.1 State description

This state waits for a COMWAKE Completed message.

6.8.5.4.2 Transition SP18:SATA_AwaitNoCOMWAKE to SP0:OOB_COMINIT

This transition shall occur after receiving a COMINIT Detected message.

Before the transition, this state shall set the ResetStatus state machine variable to UNKNOWN.

6.8.5.4.3 Transition SP18:SATA_AwaitNoCOMWAKE to SP19:SATA_AwaitALIGN

This transition shall occur after receiving a COMWAKE Completed message.

6.8.5.5 SP19:SATA_AwaitALIGN state

6.8.5.5.1 State description

Upon entry into this state, the phy shall send a Start DWS message to the SP_DWS state machine.

This state shall:

a) repeatedly send Transmit D10.2 messages to the SP transmitter;
b) initialize and start the Await ALIGN Timeout timer; and
c) wait for an ALIGN Received (0) message to be received or for the Await ALIGN Timeout timer to expire.

The phy shall start transmitting D10.2 characters no later than a COMWAKE response time (see 6.7.2.2) after entry into this state.

6.8.5.5.2 Transition SP19:SATA_AwaitALIGN to SP0:OOB_COMINIT

This transition shall occur if the Await ALIGN Timeout timer expires or after receiving a DWS Lost message, or after receiving a COMINIT Detected message.

Before the transistion, this state shall:

   a) if the Await ALIGN Timeout timer expires, set the ResetStatus state machine variable to UNSUPPORTED_PHY_ATTACHED;
   b) after receiving a DWS Lost message, set the ResetStatus state machine variable to UNKNOWN; or
   c) after receiving a COMINIT Detected message, set the ResetStatus state machine variable to UNKNOWN.

6.8.5.5.3 Transition SP19:SATA_AwaitALIGN to SP20:SATA_AdjustSpeed

This transition shall occur if this state receives an ALIGN Received (0) message before the Await ALIGN Timeout timer expires. The ALIGN Received (0) message indicates an ALIGN (0) was received at any of the physical link rates supported by this phy.

6.8.5.6 SP20:SATA_AdjustSpeed state

6.8.5.6.1 State description

This state waits for the SP transmitter to adjust to the same physical link rate of the ALIGNs that were detected by the receiver circuitry.

This state shall:

   1) send a Set Rate message to the SP transmitter; and
   2) repeatedly send Transmit D10.2 messages to the SP transmitter.

6.8.5.6.2 Transition SP20:SATA_AdjustSpeed to SP0:OOB_COMINIT

This transition shall occur after receiving a DWS Lost message, or after receiving a COMINIT Detected message.

Before the transition, this state shall set the ResetStatus state machine variable to UNKNOWN.

6.8.5.6.3 Transition SP20:SATA_AdjustSpeed to SP21:SATA_TransmitALIGN

This transition shall occur after receiving a Transmitter Ready message.

6.8.5.7 SP21:SATA_TransmitALIGN state

6.8.5.7.1 State description

This state shall repeatedly send Transmit ALIGN (0) messages to the SP transmitter.

6.8.5.7.2 Transition SP21:SATA_TransmitALIGN to SP0:OOB_COMINIT

This transition shall occur after receiving a DWS Lost message, or after receiving a COMINIT Detected message.

Before the transition, this state shall set the ResetStatus state machine variable to UNKNOWN.

6.8.5.7.3 Transition SP21:SATA_TransmitALIGN to SP22:SATA_PHY_Ready

This transition shall occur after receiving three consecutive Dword Received messages containing primitives other than ALIGN (0).

6.8.5.8 SP22:SATA_PHY_Ready state

6.8.5.8.1 State description

While in this state dwords from the link layer are transmitted at the negotiated physical link rate at the rate established in the previous state.

Upon entry into this state, this state shall:

    a) if the SP transmitter is transmitting at 1.5Gbps, set the ResetStatus state machine variable to G1;
    b) if the SP transmitter is transmitting at 3.0Gbps, set the ResetStatus state machine variable to G2; or
    c) if the SP transmitter is transmitting at 6.0Gbps, set the ResetStatus state machine variable to G3.

This state shall send a Phy Layer Ready (SATA) confirmation to the link layer to indicate that the physical link has been brought up successfully in SATA mode.

This state waits for a COMINIT Detected message, a DWS Lost message, or a DWS Reset message.

Each time this state receives a DWS Lost message, this state may send a Start DWS message to the SP_DWS state machine to re-acquire dword synchronization without running a new link reset sequence.

6.8.5.8.2 Transition SP22:SATA_PHY_Ready to SP0:OOB_COMINIT

This transition shall occur after:

    a) receiving a DWS Lost message, if this state does not send a Start DWS message;
    a) receiving a DWS Lost message followed by a COMINIT Detected message, if this state does not send a Start DWS message; or
    b) receiving a DWS Reset message.

This transition may but should not occur after receiving a COMINIT Detected message before receiving a DWS Lost message, or after receiving a COMINIT Detected message after sending a Start DWS message (i.e., the SP state machine should ignore COMINIT Detected messages unless the SP_DWS state machine has indicated loss of dword synchronization).

6.8.5.8.3 Transition SP22:SATA_PHY_Ready to SP23:SATA_PM_Partial

This transition shall occur after receiving an Enter Partial request.

6.8.5.8.4 Transition SP22:SATA_PHY_Ready to SP24:SATA_PM_Slumber

This transition shall occur after receiving an Enter Slumber request.

6.8.5.9 SP23:SATA_PM_Partial state

6.8.5.9.1 State description

This state waits for a COMWAKE Detected message or an Exit Partial request.

6.8.5.9.2 Transition SP23:SATA_PM_Partial to SP0:OOB_COMINIT

This transition shall occur after receiving a COMINIT Detected message.

Before the transition, this state shall set the ResetStatus state machine variable to UNKNOWN.

6.8.5.9.3 Transition SP23:SATA_PM_Partial to SP16:SATA_COMWAKE

This transition shall occur after receiving a Exit Partial request.

6.8.5.9.4 Transition SP23:SATA_PM_Partial to SP18:SATA_AwaitNoCOMWAKE

This transition shall occur after receiving a COMWAKE Detected message.

6.8.5.10 SP24:SATA_PM_Slumber state

6.8.5.10.1 State description

This state waits for a COMWAKE Detected message or an Exit Slumber request.

6.8.5.10.2 Transition SP24:SATA_PM_Slumber to SP0:OOB_COMINIT

This transition shall occur after receiving a COMINIT Detected message.

Before the transition, this state shall set the ResetStatus state machine variable to UNKNOWN.

6.8.5.10.3 Transition SP24:SATA_PM_Slumber to SP16:SATA_COMWAKE

This transition shall occur after receiving a Exit Slumber request.

6.8.5.10.4 Transition SP24:SATA_PM_Slumber to SP18:SATA_AwaitNoCOMWAKE

This transition shall occur after receiving a COMWAKE Detected message.

6.8.6 SATA port selector state

6.8.6.1 State description

Figure 121 shows the SP25:SATA_PortSel state. This state controls transmission of the SATA port selection signal when a specified phy processes a Transmit SATA Port Selection Signal request.
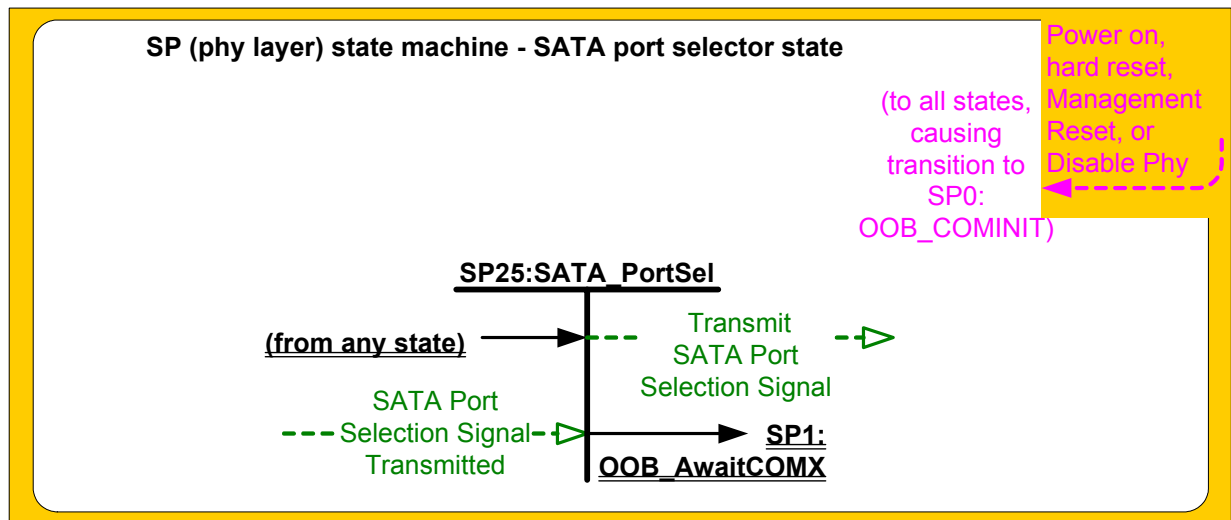

Figure 121 — SP (phy layer) state machine – SATA port selector state

Upon entry into this state, the phy shall:

a) set the ResetStatus state machine variable to UNKNOWN;
b) send a Transmit SATA Port Selection Signal message to the SP transmitter;
c) set the ATTACHED SATA PORT SELECTOR bit to zero in the SMP DISCOVER response (see 10.4.3.7) and the SMP DISCOVER LIST response (see 10.4.3.13.3); and
d) set the ATTACHED SATA DEVICE bit to zero in the SMP DISCOVER response and the SMP DISCOVER LIST response.

6.8.6.2 Transition SP25:SATA_PortSel to SP1:OOB_AwaitCOMX

This transition shall occur after receiving a SATA Port Selection Signal Transmitted message.

6.8.7 SATA spinup hold state

6.8.7.1 State description

Upon entry into this state, this state shall set the ResetStatus state machine variable to SPINUP_HOLD.

Figure 122 shows the SP26:SATA_SpinupHold state.
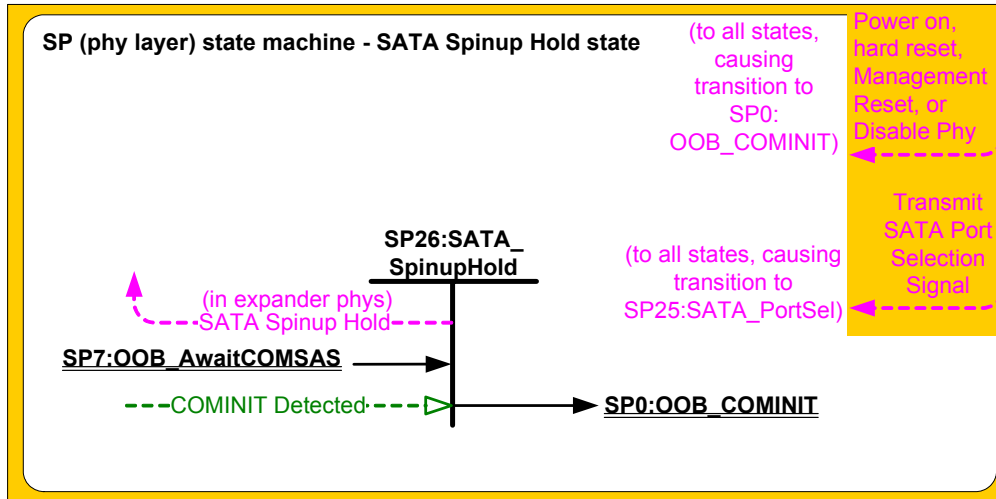
Figure 122 — SP (phy layer) state machine - SATA spinup hold state

If this state machine is in an expander phy, this state shall send a SATA Spinup Hold confirmation to the link layer.

6.8.7.2 Transition SP26:SATA_SpinupHold to SP0:OOB_COMINIT

This transition shall occur if this state receives a COMINIT Detected message.

10.4.3.7 DISCOVER function

The DISCOVER function returns information about the specified phy. This SMP function provides information from the IDENTIFY address frame received by the phy and additional phy-specific information. This SMP function shall be implemented by all management device servers.

> NOTE 23 - The DISCOVER LIST function (see 10.4.3.13) returns information about one or more phys.

Table 68 defines the request format.

Table 68 — DISCOVER request

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (40h)							
1	FUNCTION (10h)							
2	Reserved							
3	REQUEST LENGTH (02h)							
4	Reserved							
7								
8	Reserved							IGNORE ZONE GROUP
9	PHY IDENTIFIER							
10	Reserved							
11								
12	(MSB)							
15	CRC							(LSB)

The SMP FRAME TYPE field shall be set to 40h.

The FUNCTION field shall be set to 10h.

The REQUEST LENGTH field shall be set to 02h. For compatibility with previous versions of this standard, a REQUEST LENGTH field set to 00h specifies that there are 2 dwords before the CRC field.

An IGNORE ZONE GROUP bit set to one specifies that the management device server shall return information about the specified phy (i.e., the phy specified by the PHY IDENTIFIER field) regardless of the zone permission table.

An IGNORE ZONE GROUP bit set to zero specifies that the management device server shall:

    a) if the SMP initiator port has access to the specified phy based on the zone permission table, return the requested information; and

    b) if the SMP initiator port does not have access to the specified phy, return a function result of PHY VACANT in the response frame.

If the management device server is not in a zoning expander device with zoning enabled, it shall ignore the IGNORE ZONE GROUP bit.

The PHY IDENTIFIER field specifies the phy (see 4.2.7) for which the information is being requested.

The CRC field is defined in 10.4.3.1.

Table 69 defines the response format.

Table 69 — DISCOVER response (part 1 of 2)

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (10h)							
2	FUNCTION RESULT							
3	RESPONSE LENGTH (17h)							
4	(MSB)			EXPANDER CHANGE COUNT				
5								(LSB)
6	Reserved							
8								
9	PHY IDENTIFIER							
10	Reserved							
11								
12	Reserved	ATTACHED DEVICE TYPE			ATTACHED REASON			
13	Reserved				NEGOTIATED LOGICAL LINK RATE			
14	Reserved				ATTACHED SSP INITIATOR	ATTACHED STP INITIATOR	ATTACHED SMP INITIATOR	ATTACHED SATA HOST
15	ATTACHED SATA PORT SELECTOR	Reserved			ATTACHED SSP TARGET	ATTACHED STP TARGET	ATTACHED SMP TARGET	ATTACHED SATA DEVICE
16	SAS ADDRESS							
23								
24	ATTACHED SAS ADDRESS							
31								
32	ATTACHED PHY IDENTIFIER							
33	Reserved					ATTACHED INSIDE ZPSDS PERSISTENT	ATTACHED REQUESTED INSIDE ZPSDS	ATTACHED BREAK_REPLY CAPABLE
34	Reserved							
39								
40	PROGRAMMED MINIMUM PHYSICAL LINK RATE				HARDWARE MINIMUM PHYSICAL LINK RATE			
41	PROGRAMMED MAXIMUM PHYSICAL LINK RATE				HARDWARE MAXIMUM PHYSICAL LINK RATE			
42	PHY CHANGE COUNT							
43	VIRTUAL PHY	Reserved			PARTIAL PATHWAY TIMEOUT VALUE			
44	Reserved				ROUTING ATTRIBUTE			
45	Reserved	CONNECTOR TYPE						

Table 69 — DISCOVER response (part 2 of 2)

Byte\Bit	7	6	5	4	3	2	1	0
46	CONNECTOR ELEMENT INDEX							
47	CONNECTOR PHYSICAL LINK							
48	Reserved							
49								
50	Vendor specific							
51								
52	ATTACHED DEVICE NAME							
59								
60	Reserved	REQUESTED INSIDE ZPSDS CHANGED BY EXPANDER	INSIDE ZPSDS PERSISTENT	REQUESTED INSIDE ZPSDS	ZONE ADDRESS RESOLVED	ZONE GROUP PERSISTENT	INSIDE ZPSDS	ZONING ENABLED
61	Reserved							
62								
63	ZONE GROUP							
64	SELF-CONFIGURATION STATUS							
65	SELF-CONFIGURATION LEVELS COMPLETED							
66	Reserved							
67								
68	SELF-CONFIGURATION SAS ADDRESS							
75								
76	Reserved							
91								
92	Reserved							
93								
94	Reserved				NEGOTIATED PHYSICAL LINK RATE			
95	Reserved							HARDWARE MUXING SUPPORTED
96	(MSB)							
99				CRC				(LSB)

The SMP FRAME TYPE field shall be set to 41h.

The FUNCTION field shall be set to 10h.

The FUNCTION RESULT field is defined in 10.4.3.2.

The RESPONSE LENGTH field shall be set to 17h. For compatibility with previous versions of this standard, a RESPONSE LENGTH field set to 00h indicates that there are 12 dwords before the CRC field.

The EXPANDER CHANGE COUNT field is defined in the SMP REPORT GENERAL response (see 10.4.3.3).

The PHY IDENTIFIER field indicates the phy for which physical configuration link information is being returned.

The ATTACHED DEVICE TYPE field indicates the device type detected received during the link reset sequence and is defined in table 70.

Table 70 — ATTACHED DEVICE TYPE **field**

Code	Description
000b	No device attached
001b	End device
010b	Expander device
011b	Expander device compliant with a previous version of this standard
All others	Reserved

The ATTACHED DEVICE TYPE field shall only be set to a value other than 000b after:

    a) the identification sequence is complete if a SAS device or expander device is attached; or
    b) the initial Register - Device to Host FIS has been received if a SATA phy is attached.

The ATTACHED REASON field indicates the value of the REASON field received in the IDENTIFY address frame (see 7.8.2) during the identification sequence. If a SATA phy is attached, the ATTACHED REASON field shall be set to 0h after the initial Register - Device to Host FIS has been received.

The NEGOTIATED LOGICAL LINK RATE field and NEGOTIATED PHYSICAL LINK RATE field are is defined in table 71 and indicates the logical and physical link rate negotiated during the link reset sequence or other conditions of the phy. The negotiated physical link rate may be less than the programmed minimum physical link rate or greater than the programmed maximum physical link rate if the programmed physical link rates have been changed since the last link reset sequence.

Table 71 — NEGOTIATED PHYSICAL LINK RATE **field** (part 1 of 2)

Name Value of ResetStatus state machine variable	Code	Description
UNKNOWN	0h	Phy is enabled; unknown logical or physical link rate. [a]
DISABLED	1h	Phy is disabled.
PHY_ RESET_ PROBLEM	2h	Phy is enabled; a phy reset problem occurred (see 6.7.4.2.4).

Table 71 — NEGOTIATED PHYSICAL LINK RATE **field** (part 2 of 2)

~~Name~~ **Value of ResetStatus state machine variable**	Code	Description
SPINUP_ HOLD	3h	Phy is enabled; detected a SATA device and entered the SATA spinup hold state. The SMP PHY CONTROL function (see 10.4.3.24) phy operations of LINK RESET and HARD RESET may be used to release the phy. ~~This field shall be updated to this value at SATA spinup hold time (see 6.8.7 and 6.11)(i.e., after the COMSAS Detect Timeout timer expires during the SATA OOB sequence) if SATA spinup hold is supported.~~
PORT_ SELECTOR	4h	Phy is enabled; detected a SATA port selector. The physical link rate has not been negotiated since the last time the phy's SP state machine entered the SP0:OOB_COMINIT state. The SATA spinup hold state has not been entered since the last time the phy's SP state machine entered the SP0:OOB_COMINIT state. The value in this field may change to 3h, 8h, 9h, or Ah if attached to the active phy of the SATA port selector. Presence of a SATA port selector is indicated by the ATTACHED SATA PORT SELECTOR bit (see table 240).
RESET_ IN_ PROGRESS	5h	Phy is enabled; the expander phy is performing an SMP PHY CONTROL function (see 10.4.3.24) phy operation of LINK RESET or HARD RESET. ~~The value in this field shall change when this field is updated to any other value.~~ This value ~~shall only be~~ is returned if the specified phy contained a value of 8h, 9h, or Ah in this field when an SMP PHY CONTROL function phy operation of LINK RESET or HARD RESET phy operation is processed.
G1	8h	Phy is enabled; 1,5 Gbps ~~logical or~~ physical link rate. ~~b~~ ~~The NEGOTIATED LOGICAL LINK RATE field shall be updated to this value after the speed negotiation sequence completes if it negotiates a single 1,5 Gbps logical link or negotiates two multiplexed 1,5 Gbps logical links.~~
G2	9h	Phy is enabled; 3 Gbps ~~logical or~~ physical link rate. ~~b~~ ~~The NEGOTIATED LOGICAL LINK RATE field shall be updated to this value after the speed negotiation sequence completes if it negotiates a single 3 Gbps logical link or negotiates two multiplexed 3 Gbps logical links.~~
G3	Ah	Phy is enabled; 6 Gbps ~~logical or~~ physical link rate. ~~b~~ ~~The NEGOTIATED LOGICAL LINK RATE field shall be updated to this value after the speed negotiation sequence completes if it negotiates a single 6 Gbps logical link.~~
Reserved	Bh - Fh	Phy is enabled; reserved for future logical or physical link rates.
Reserved.	All others	
	[a] This code may be used by an application client in its local data structures to indicate an unknown negotiated logical or physical link rate (e.g., before the discover process has queried the phy). ~~b The NEGOTIATED PHYSICAL LINK RATE field shall be updated to this value after the speed negotiation sequence completes if it negotiates this physical link rate.~~	

The NEGOTIATED LOGICAL LINK RATE field is defined in in table 72 (new table) and indicates the logical link rate negotiated during the link reset sequence. This field may be different from the negotiated physical link rate when multiplexing is enabled

Table 72 — NEGOTIATED LOGICAL LINK RATE **field**

NEGOTIATED PHYSICAL LINK RATE	Multiplexing	NEGOTIATED LOGICAL LINK RATE
G2	Disabled	9h
G2	Enabled	8h
G3	Disabled	Ah
G3	Enabled	9h
all others		same as NEGOTIATED PHYSICAL LINK RATE

NOTE 24 - In previous versions of this standard that did not define multiplexing, the NEGOTIATED LOGICAL LINK RATE field was called the NEGOTIATED PHYSICAL LINK RATE field and the NEGOTIATED PHYSICAL LINK RATE field in byte 94 did not exist.