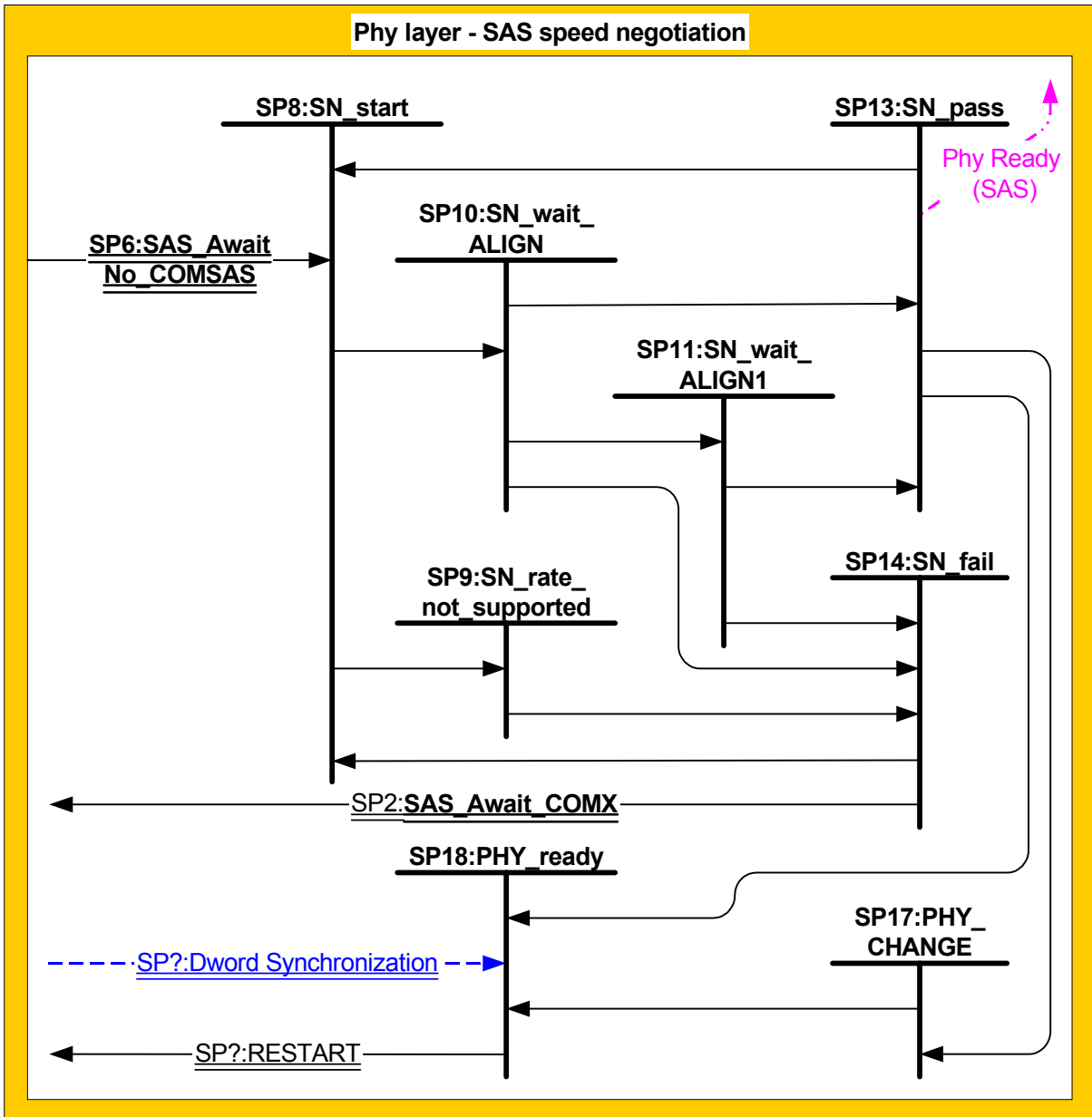Date: October 10, 2002

To: T10 Committee (SCSI)

From: George Penokie (IBM/Tivoli)

Subject: Alternate SAS Speed Negotiation State Diagram

**5.8.0.1**



**Phy layer - SAS speed negotiation**

**5.8.0.2 SP5:SN_Start state**

**5.8.0.2.1 State description**

This state transmit idles at the beginning of SAS speed negotiation windows.

Upon entering this state, the rate change delay timer is initialized to the rate change delay time value and enabled. The state machine remains in this state until a rate change delay has elapsed.

During this state idles shall be transmitted.

This state set the SAS speed negotiation rate to:

a) the lowest supported speed negotiation window if the transition into this state is from the SAS_wait_no_COMSAS state; or
b) to the value of the speed negotiation window received as an argument.

### 5.8.0.2.2 Transition SP8:SN_Start to SP10:SN_wait_ALIGN

This transition shall occur when the rate change delay timer times out and the current SAS speed negotiation window is supported.

### 5.8.0.2.3 Transition SP8:SN_start to SP9:SN_rate_not_supported

This transition shall occur when the rate change delay timer times out and the current SAS speed negotiation window is not supported.

### 5.8.0.3 SP9:SN_rate_not_supported state

### 5.8.0.3.1 State description

During this state idles shall be transmitted. Upon entering this state the speed negotiation window timer is initialized with the speed negotiation transmit window value and enabled.

### 5.8.0.3.2 Transition SP9:SN_rate_not_supported to SP14:SN_fail

This transition shall occur after the speed negotiation window timer counter times out.

### 5.8.0.4 SP10:SN_wait_ALIGN state

### 5.8.0.4.1 State description

The state machine transmits ALIGN characters at the rate relating to the current SAS speed negotiation window (e.g., generation 1, generation 2, generation 3). Upon entering this state:

a) the speed negotiation lock time timer is initialize with the negotiation lock time value and enabled, and
b) the speed negotiation transmit time timer is initialize with the negotiation transmit time value and enabled.

### 5.8.0.4.2 Transition SP10:SN_wait_ALIGN to SP11:SN_await_ALIGN1

This transition shall occur when ALIGNs at the current SAS speed negotiation windows rate are received and recognized before an speed negotiation lock time timer times out.

This transition shall send as arguments the current value of the current value of the speed negotiation transmit time timer to the SN_wait_ALIGN1.

### 5.8.0.4.3 Transition SP10:SN_wait_ALIGN to SP12:SN_pass

This transition shall occur when speed negotiation transmit time timer times out if ALIGN(1)s at the current SAS speed negotiation windows rate are being received and recognized.

### 5.8.0.4.4 Transition SP10:SN_wait_ALIGN to SP14:SN_fail

This transition shall occur if the speed negotiation transmit time timer times out before dword synchronization occurs.

### 5.8.0.5 SP11:SN_wait_ALIGN1 state

### 5.8.0.5.1 State description

During this state ALIGN(1)s are transmitted. Upon entering this state the speed negotiation transmit time timer is set to the value of the negotiation transmit time argument passed in the transition into this state and enabled.

### 5.8.0.5.2 Transition SP11:SN_wait_ALIGN1 to SP14:SN_fail

This transition shall occur if no ALIGN(1)s were detected before speed negotiation transmit time timer times out.

### 5.8.0.5.3 Transition SP11:SN_wait_ALIGN1 to SP14:SN_ pass

This transition shall when the occur speed negotiation transmit time timer times out if ALIGN(1)s are detected.

### 5.8.0.6 SP13:SN_Pass state

### 5.8.0.6.1 State description

This state determines if:

    a)  another SAS speed negotiation window is required;
    b)  the SAS speed negotiation is complete and the SAS device is an expander; or
    c)  the SAS speed negotiation is complete and the SAS device is not an expander.

### 5.8.0.6.2 Transition SP13:SN_pass to SP16:SN_start

This transition shall occur;

    a)  after setting the SAS speed negotiation window to one greater than the current SAS speed negoti-
        ation window; and
    b)  if the state machine has not fallen back during this current SAS speed negotiation (see x.x.x).

Which speed negotiation window to use is sent as an argument with this transition.

### 5.8.0.6.3 Transition SP13:SN_pass to SP18:PHY_CHANGE

This transition shall occur:

    a)  if speed negotiation has progressed to where it failed and then had fallen back to the last
        negotiated speed and then subsequently passed and the SAS device is an expander device; and
    b)  after sending a Phy Ready (SAS) confirmation link layer (?) to indicate that the link has been
        brought up successfully in SAS mode.

### 5.8.0.6.4 Transition SP13:SN_pass to SP18:PHY_ready

This transition shall occur:

    a)  if speed negotiation has progressed to where it failed and then had fallen back to the last
        negotiated speed and then subsequently passed and the SAS device is not an expander device;
        and
    b)  after sending a Phy Ready (SAS) confirmation link layer (?) to indicate that the link has been
        brought up successfully in SAS mode.

### 5.8.0.7 SP14:SN_fail state

### 5.8.0.7.1 State description

This state determines if the SAS speed negotiation window failure occurred because:

a) the maximum SAS speed negotiation window has been attempted and there haven't been any successful negotiated rates;
b) the SAS speed negotiation failed after dropping back to the last successful SAS speed negotiation window;
c) the SAS speed negotiation has failed and there was a previous successful SAS speed negotiation; or
d) no SAS speed negotiation has previously passed and the maximum SAS speed negotiation window has not yet been attempted.

### 5.8.0.7.2 Transition SP14:SN_fail to SP2:SAS_wait_COMX

This transition shall occur if:

a) the maximum SAS speed negotiation window has been attempted and there haven't been any successful negotiated rates; or
b) the SAS speed negotiation failed after dropping back to the last successful SAS speed negotiation window;

### 5.8.0.7.3 Transition SP14:SN_fail to SP8:SN_start

This transition shall occur:

a) after setting the SAS speed negotiation window to one less the current SAS speed negotiation window; and
b) if the SAS speed negotiation has failed and there was a previous successful SAS speed negotiation; or
a) after setting the SAS speed negotiation window to one greater than the current SAS speed negotiation window; and
b) if no SAS speed negotiation has previously passed and the maximum SAS speed negotiation window has not yet been attempted.

Which speed negotiation window to use is sent as an argument with this transition.

### 5.8.0.8 SP17:PHY_CHANGE state

### 5.8.0.8.1 State description

This state is only present in expander devices. This state broadcasts a CHANGE on all other ports in the expander device.

### 5.8.0.8.2 Transition SP17:PHY_CHANGE to SP18:PHY_ready

This transition shall occur after broadcasting the CHANGE primitive.

### 5.8.0.9 SP18:PHY_ready state

### 5.8.0.9.1 State description

This state enables the SAS phy dword synchronization state machine (DWS) to provide rule checking for dword synchronization and determination of link failure.

This state shall not be exited until a Dword Synchronization (acquired) parameter is received.

After a Dword Synchronization Acquired parameter is received this state machine monitors for:

a) the receipt of a COMINIT; and
b) Dword Synchronization (loss) parameter.

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

### 5.8.0.9.2 Transition SP18:PHY_ready to SP1:SAS_reset

This transition shall occur if:

a) a COMINIT is received; or
b) a Dword Synchronization (loss) parameter is received.