Port Layer Working Draft from SAS r00c rev 0

8 Port Layer

8.1 Overview

The port layer (PL) state machines interface with one or more SAS link layer state machines and one or more SSP, SMP, and STP transport layer state machines to establish port connections and disconnections.

Figure 1 shows the relationship of the port layer to the transport and link layers.

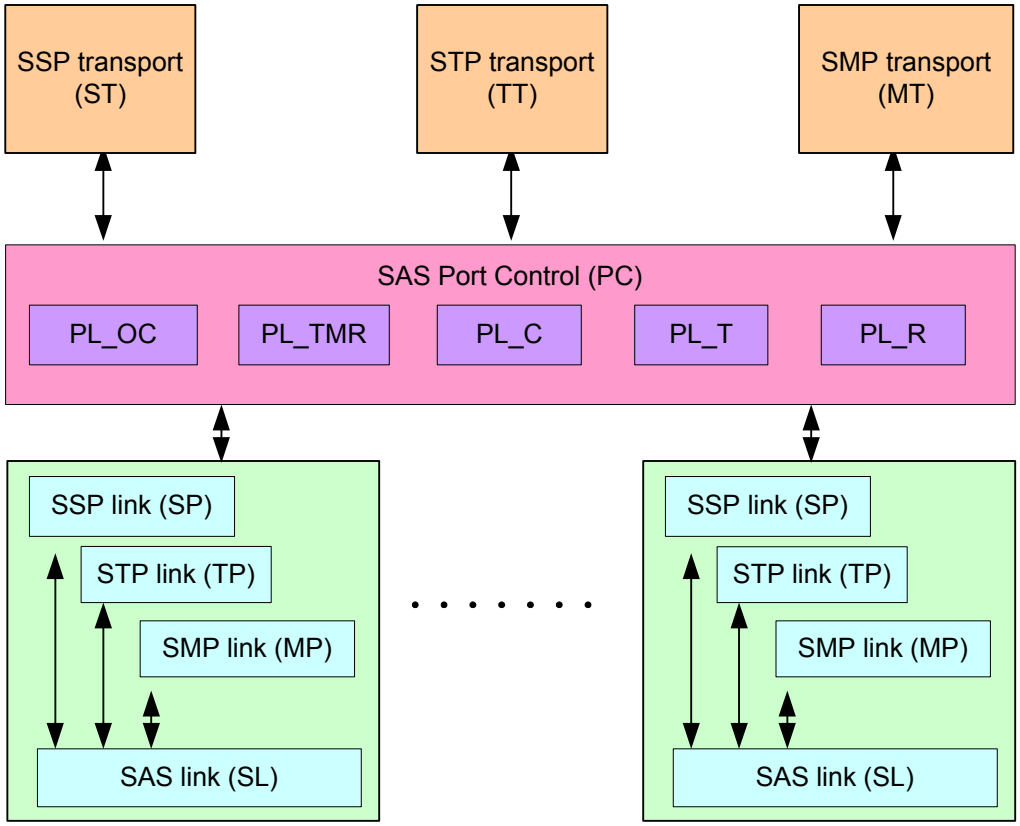


Figure 1. SAS port layer position

~~Three~~ Five state machines ~~that~~ run in parallel to form the port layer.

The PL state machines are ~~as follows~~:

a) ~~Receive and queue connection requests~~Overall Control (~~PL_RQ~~ PL_OC state machine);
b) Counters and ~~t~~Timers (PL_TMR state machine); ~~and~~
c) ~~Control~~ Connection (PL_C state machine);
d) Transmit a Frame (PL_T state machine); and
e) Receive a Frame (PL_R state machine).

The PL_~~RQ~~OC state machine's purpose is to:

a) ~~Queue~~ Monitor all of the ~~Interlocked or Non-Interlocked~~ frame transmission requests from the SSP, SMP and STP transport layers to the specified destination ~~port~~ SAS address. This state machine does not require knowledge of the type of frame to be transmitted. ~~For SSP initiator ports this consists of COMMAND, DATA, TASK, and AEN_RESPONSE frames. For SMP initiator ports, this consists of SMP Request frames. For SSP target ports this consists of DATA, RESPONSE, XFER_RDY, and AEN frames. For SMP target ports, this consists of SMP Response frames.~~
b) Determine the priority of frame transmission;
c) If not connected, initiate a connection sequence;

d) If /(When) connected , ~~indicate to the transport layer when a single frame transmission can occur;~~request a frame transmission by the PL_T state and notify the transport layer when the frame has been transmitted (or an error occurred).
e) Notify the transport layer if a connection cannot be opened;
f) Monitor the connected status of each phy.
~~f)~~g) For target devices only, initialize and monitor the counters and timers supported in the Disconnect-Reconnect mode page;
~~g)~~h) If a Disconnect-Reconnect counter or timer reaches the specification limit ~~then initiate~~ a Disconnect sequence will be initiated if an additional frame is to be transmitted to this destination SAS address.. ~~and notify the transport layer. The transport layer~~ The OC machine will later reconnect ~~request a new data transmission request~~ to continue with the ~~data~~ frame transmissions.
~~h)~~i) If a ~~Disconnect sequence~~ Cancel is requested ~~from~~ by the transport layer, then ~~initiate a disconnect sequence;~~ stop Arbitrating (if Arbitrating), or terminate the frame transmit being serviced. Do not terminate any receive functions and do not close the connection.
j) If a Accept_Reject Opens is requested by the transport layer then initiate this request to the link layer.
~~i)~~k) Notify the transport layer if a connection has been exited (this also allows transport layer recovery for premature disconnections);
~~j)~~l) If a DONE has been transmitted, do not ~~allow~~ request another IU transmission by the link layer until after the connection has been completely closed down (~~SL0:Idle entered~~ i.e., Connection Closed confirmation received from the link layer);
~~k)~~ If ~~DONEs~~ BREAKs have been transmitted ~~and~~ or received, ~~or a CLOSE or BREAK has been either transmitted or received,~~ do not ~~allow~~ request any transmissions and ignore any receptions until after the connection has been completely closed down (~~SL0:Idle entered~~i.e., when a BREAK has been transmitted and received)); ~~and~~
~~l)~~m) Initiate a “Close Connection” ~~function~~ request to the link layer to get DONE transmitted if the device ~~is opened by a receive function and~~ has nothing to transmit to this ~~Initiator (or Target~~destination SAS Address (subject to an optional “wait for a vendor-specific period of time”). Note this rule applies even if opened by a receive function.

The PL_TMR state machine’s purpose is to:

~~a)~~n) Accept initialization by ~~the PL_RQ~~ other port layer machines;
~~b) Time the connected milliseconds and notify the PL_RQ machine when this value exceeds the Maximum Connect Time limit specified in the Disconnect-Reconnect mode page for SSP devices;~~
~~c) Count the number of bytes transmitted by the target in a connection and notify the PL_RQ machine when this value exceeds the MAXIMUM BURST SIZE specified in the Disconnect-Reconnect mode page for SSP devices; and~~
o) Time or count the following parameters and indicate when this value exceeds the limit defined in the Disconnect-Reconnect Mode page for SSP devices
  a. MAXIMUM CONNECT TIME
  b. MAXIMUM BURST SIZE
  c. BUS INACTIVITY LIMIT
~~d)~~p) Time the Arbitration Wait Time (AWT)
q) Count the number of Open Failed(Pathway Blocked) confirmations received from the link layer

The PL_C state machine’s purpose is to:

a) Indicate if the device is not connected for receive or transmit;
b) Indicate if the device is connected for receive or transmit;
c) Request or retry a connection sequence via the link layer and handle exception conditions;
d) Initialize the Arbitration Wait Timer, the I_T Nexus Loss Timer and the Open Failed(Pathway Blocked) counter;
~~e~~) ~~Create the Open Connection request to the link layer which also includes:~~
~~A) Destination device name;~~
~~B) Protocol;~~
~~C) Arbitration wait time;~~
~~D) Link rate;~~

~~E) Initiator bit; and~~
~~F) Initiator connection tag.~~

~~f~~e) Indicate if a connection could or could not be established;
~~g~~f) Indicate if the device is connected but cannot transmit an IU; and
~~h~~g) Indicate if the device is in process of closing a connection and cannot receive or transmit until after the connection is closed and a new connection is established.

The PL_T state machines purpose is to:

a) Request a frame transmission by the link layer
b) Pass the transport layer's transmit frame from the transport to the link layer
c) Receive Frame Transmitted confirmation status from the link layer, and pass this status to the transport layer

The PL_R state machines purpose is to:

a) Pass the link layer's received frame from the link to the transport layer
b) Receive Frame Received confirmation status from the link layer, and pass this status to the transport layer

The PL_~~RQ~~OC state machine contains one state.

The PL_TMR state machine contains one state.

The PL_C state machine contains these states:

a) PL_C1:Idle;
b) PL_C2:Connected;
c) PL_C3:~~ReqWait~~ SelectPhy;
d) PL_C4:~~SelectPhy~~ ReqWait;
e) PL_C5:Check I_T Nexus Timer;
f) PL_C6:OpenFailed;
g) PL_C7:Done;
h) PL_C8:~~CloseWait~~ Broken;
~~i)PL_C9:Broken.~~

The PL_T state machine contains one state.

The PL_R state machine contains one state.

The PL state machine receives the following requests from the upper layer state machines (the transport layers):

a) Transmit Frame(Interlocked);
b) Transmit Frame(Non-Interlocked);
c) Cancel;
d) Accept_Reject Opens(Accept);
e) Accept_Reject Opens(Reject;

The PL state machine sends the following confirmations to the upper layer state machines (the transport layers):

a) Cancel Acknowledge
b) Transmission Status(Frame Transmitted)
c) Transmission Status(Connection Lost)
d) Transmission Status(Open Failed-Retry)
e) Transmission Status(Open Failed –Wrong Destination)
f) Transmission Status(Open Failed –Link Rate Not Supported)
g) Transmission Status(Open Failed –Protocol Not Supported)
h) Transmission Status(Open Failed –Pathway Blocked)
i) Transmission Status(Open Failed –Open Timeout Occurred)
j) Transmission Status(Open Failed –Port Layer Request)
k) Transmission Status(Open Failed –Break Received)
l) Transmission Status(Open Failed –No Destination)
m) Transmission Status(Open Failed –Bad Destination)
n) Transmission Status(Open Failed –STP Resources Busy)
o) Transmission Status(Open Failed –I_T Nexus Loss Timeout)

p) Transmission Status(Open Failed –Physical Not Ready)
q) Transmission Status(Credit Timeout)
r) Connection Closed(Break Received)
s) Connection Closed (Close Timeout)
t) ACK Received
u) NAK Received
~~w)~~v) ACK/NAK Timeout
w) Frame Received(ACK/NAK Balanced)
x) Frame Received(ACK/NAK Not Balanced)

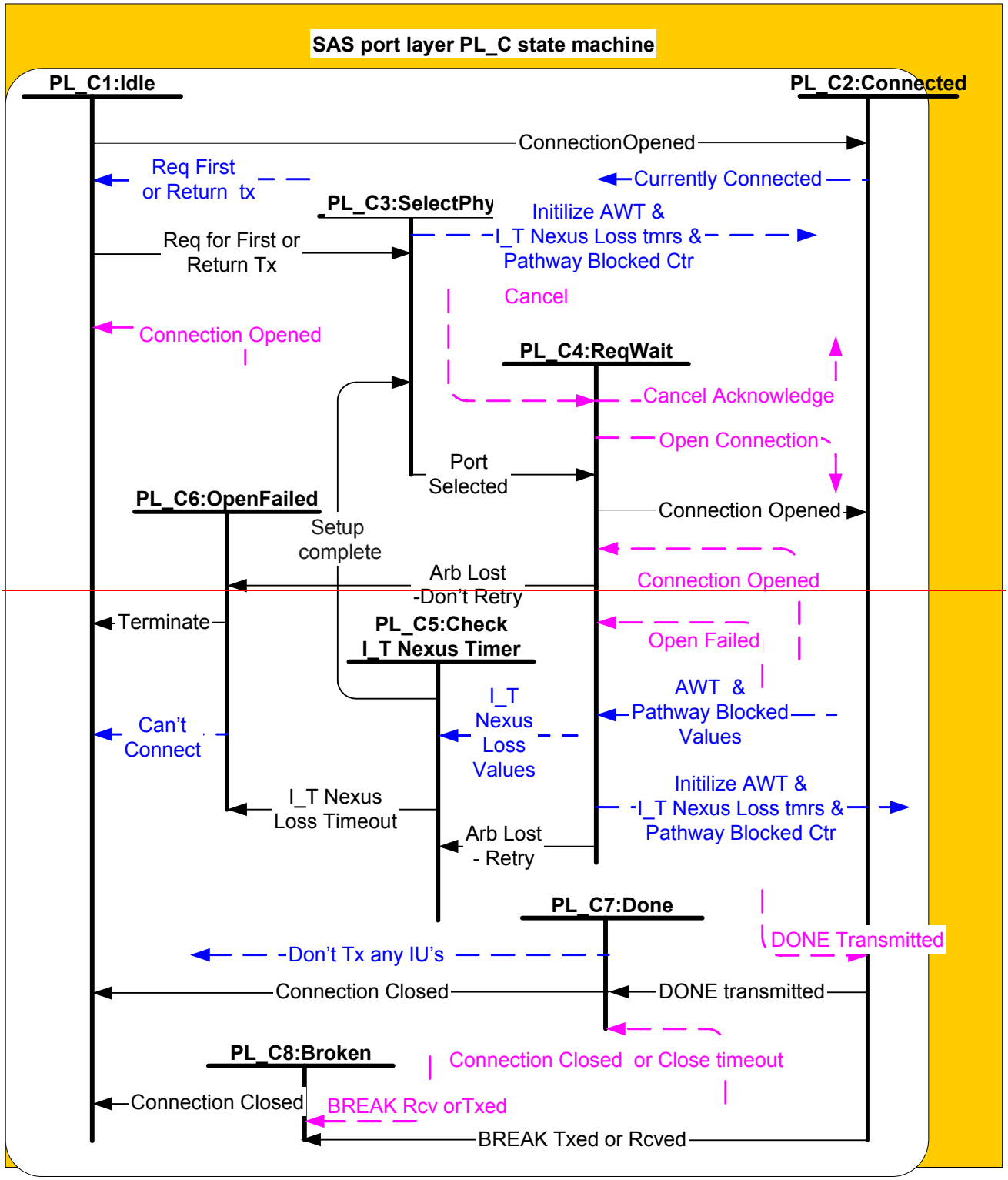
The PL state machine sends the following requests to the lower layer state machines (the link layers):

a) Open Connection;
b) Stop Arb; ~~and~~
c) Tx Frame(Balance Required)
d) Tx Frame(Balance Not required)
e) Close Connection
~~c)~~f) Reject Opens. [Editor's note: not currently generated anywhere. One valid reason in a target device is if no more credit can be provided until a frame needs to be sent out.]

The PL state machine receives the following confirmations from the lower layer state machines (the link layers):

a) Open Failed(Port Layer Request);
b) Open Failed(Open Timeout Occurred);
c) Open Failed(Break Received);
d) Open Failed(No Destination);
e) Open Failed(Bad Destination);
f) Open Failed(Wrong Destination);
g) Open Failed(Link Rate Not Supported);
h) Open Failed(Protocol Not Supported);
i) Open Failed(Retry);
j) Open Failed(STP Resources Busy);
k) Open Failed(Pathway Blocked);
~~l)Connection Rejected(Wrong Destination);~~
~~m)Connection Rejected(Protocol Not Supported);~~
~~n)Connection Rejected(Retry);~~
~~o)~~l) ~~Connection Rejected(Break Received);~~
m) Connection Opened(By SSP Source path);
n) Connection Opened(By STP Source path);
o) Connection Opened(By SMP Source path);
p) Connection Opened(By SSP Destination path);
q) Connection Opened(By STP Destination path);
r) Connection Opened By SMP Destination path);
s) Connection Closed(Break Received);
t) Connection Closed(Link Broken); [Editor's note: not currently used]
u) Connection Closed(Close Timeout);
v) Connection Closed(Normal);
w) Frame Received(ACK/NAK Balanced)
x) Frame Received(ACK/NAK Not Balanced)
y) Done Timeout Received(ACK/NAK Timeout)
z) Done Timeout Received(Credit Timeout)
aa) Frame Transmitted
~~bb) Balanced~~
~~cc) Not Balanced~~
dd) ACK/NAK Timeout
ee) Credit Timeout
ff) DONE Transmitted
gg) DONE Timeout
hh) ACK Received
ii) NAK Received

Figure 2 shows the PL_C state machine.



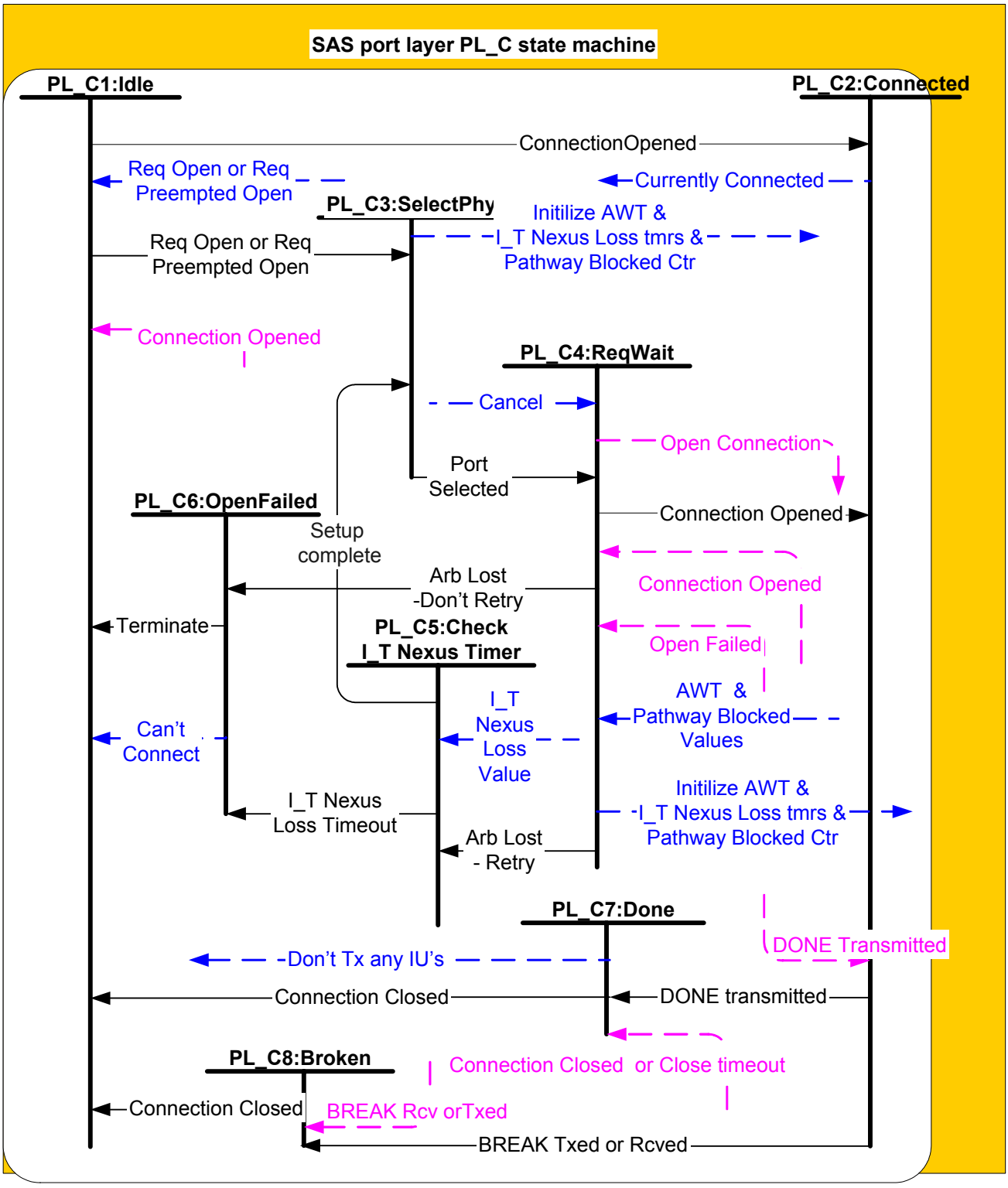
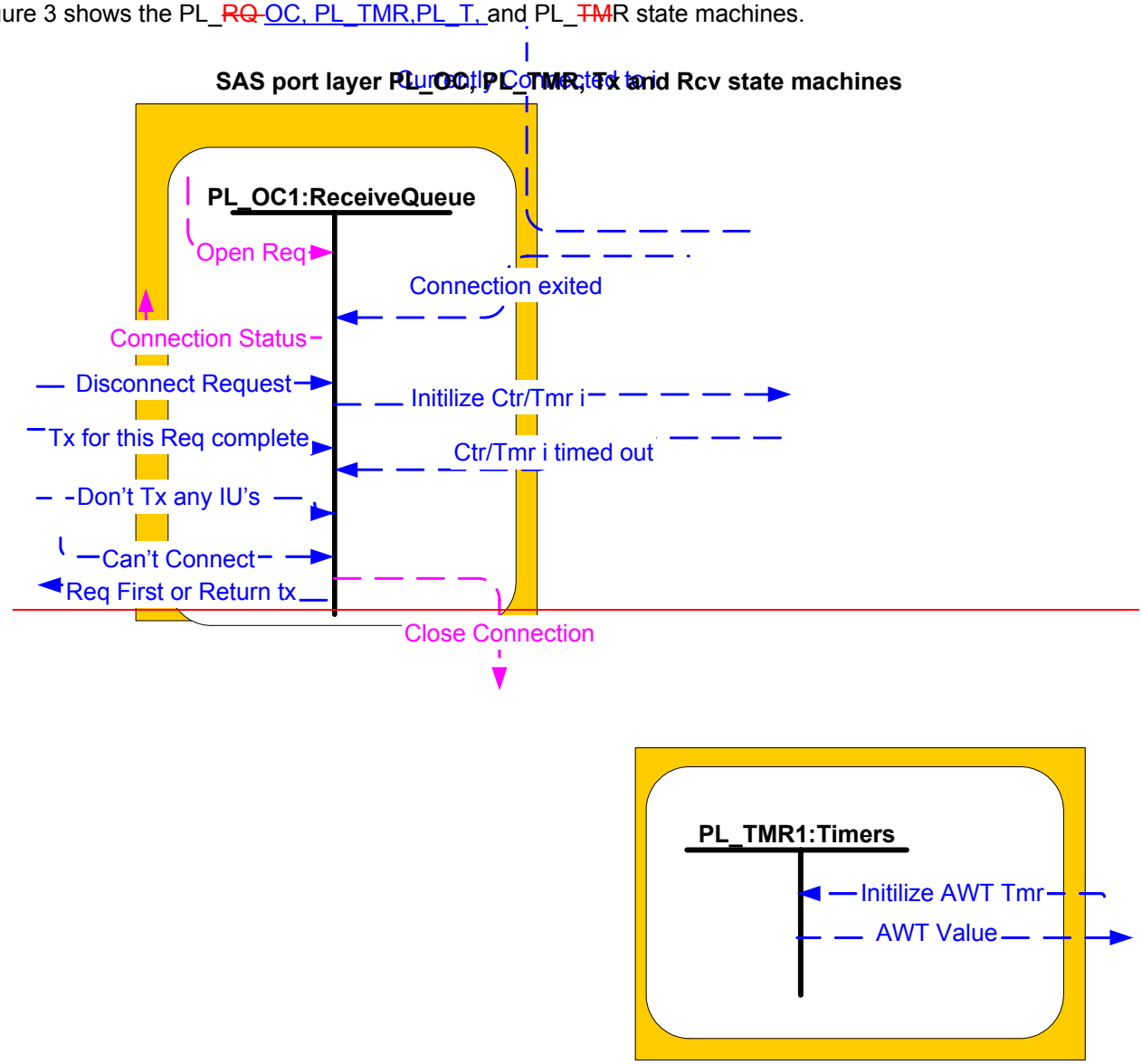


Figure 2. Port layer PL_C state machine

Figure 3 shows the PL_~~RQ~~OC, PL_TMR,PL_T, and PL_~~TM~~R state machines.



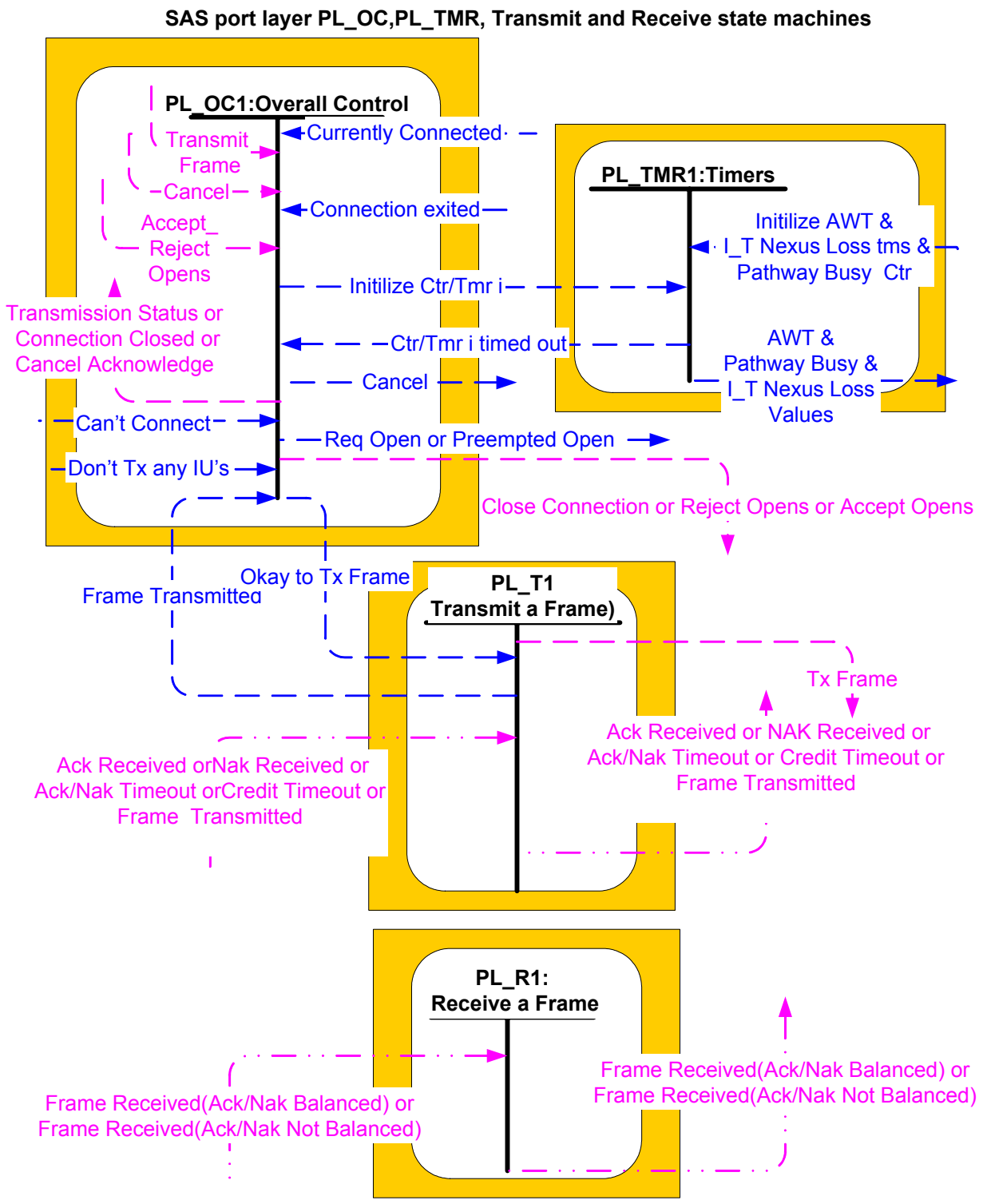


Figure 3. Port layer PL_~~RQ~~ OC, PL_TMR, PL_T, and PL_R state machines

8.2 PL_~~RQ1~~ OC1 ~~ReceiveQueue~~ Overall Control state machine

~~A transport layer state machine. Open Connection Request for a specific destination port to transmit at least one interlocked or non interlocked frame. Multiple requests (normally with different tag values) may exist at the same~~

~~time to the same or different destination ports. The PL_RQstate machine queues each of these requests and determines the priority order of servicing.~~

Within a transport layer, multiple Transmit Frame requests may exist. The PL_OC1 state machine monitors all of these requests and will determine the order in which these requests are executed. The PL_OC1 state machine will only be servicing one Transmit Frame request per phy.

A transport layer state machine generates the following arguments to the PL_OC1 state machine to request a frame transmission:

a) Either a Transmit Frame(Interlocked) or Transmit Frame(Non Interlocked) request;
b) The Frame – Includes the Frame Header and the Information Unit but without the Arbitration Wait Time or the Pathway Blocked Count
c) The Destination SAS Address
d) The link Rate
e) The Initiator bit
f) The Initiator Connection Tag

If a Transmit Frame request exists in any transport layer and if a connection exists to the destination SAS Address, this state will determine the Frame to the transmitted and request that the PL_T1 state transmit this frame by issuing a Okay to Tx Frame parameter to the PL_T1 state. After receiving back a Frame Transmitted parameter from the PL_T state machine and notifying the transport layer that this frame has(or has not) been transmitted, the PL_OC1 machine will monitor the connected transport layer for any additional frames to be transmitted to this destination SAS Address.

a) If the transport layer contains no more Transmit Frame requests to this destination SAS Address the PL_OC1 machine will issue a Close Connection request to the link Layer(which shall request that a DONE be transmitted).
b) If the transport layer contains additional Transmit Frame requests to this destination SAS Address, for Initiator devices only, frame transmissions to this destination SAS Address may continue.
c) If the transport layer contains additional Transmit Frame requests to this destination SAS Address, for target devices only, the PL_OC1 machine shall check to see if any of the CTR/Timers have exceeded the specified limits.
    a. If the CTR/Timer's have not exceeded the specified limits, frame transmissions to this destination SAS Address may continue.
    a) If the CTR/Timer's have exceeded the specified limits, The PL_OC1 machine shall request a "Close Connection" function from the link layer. After detection of a Connection Closed conformation from the link layer, the port layer may continue transmission of this data by redetecting the transport layer Transmit Frame request via the normal monitoring of the transport layer for transmission requests.

~~The priorities are as follows, from highest to lowest priority:~~
~~1)A destination port currently connected;~~
~~2)the continuation of transmission of non-interlocked frames;~~
~~3)returned to transmission requests; and~~
~~4)next highest priority queued request.~~

~~The PL_RQ state machine shall send a ConnectionStatus confirmation for each request. The status is be one of:~~

~~a)ConnectionResult(Connected): Connected to this destination – frame transmission may occur;~~
~~b)ConnectionResult(Wait): Wait for connection to this destination;~~
~~c)ConnectionResult(No Destination): Arbitration Lost (Arb Lost) – No destination;~~
~~d)ConnectionResult(Open Timeout): Arbitration Lost –open timeout exceeded; or~~
~~e)ConnectionResult(Connection Lost): Connection Exited (either normally, or prematurely).~~
~~f)~~a) ~~ConnectionResult(Disconnect In Progress)Disconnect in process – Disconnect-Reconnect timer/counter exceeded~~

It is assumed that the transport layer response for any desired sequence of frame transmissions (e.g. multiple Non Interlocked data frame transmissions) is instantaneous (I.e., if continuous frame transmissions are desired for the established I_T_L_Q connection then the next Transmit Request from the transport layer for that I_T_L_Q will be available when the Transmission Statues(Frame Transmitted) confirmation for the previous frame is sent to the transport layer by the port layer.

~~If a ConnectionResult(Connected) confirmation sent, the transport layer may transmit a frame. After the frame has been sent, the PL_RQ state machine shall clear its request queue of this request and check if it was an Interlocked or Non Interlocked frame.~~

~~a)If an Interlocked frame was sent, the RQ machine shall check its request queue for the next frame to be transmitted.~~

~~b)If a Non Interlocked frame was sent, The PL_RQ machine shall wait for the next subsequent Open Connection request (or Disconnect request) from this requester.~~

If not connected and in the PL_C1 state, and if the PL_OC1 Machine has detected a Transmit Frame request from the transport layer the PL_~~RQ~~ OC1 machine shall~~ send to the transport layer a ConnectionResult(Wait)confirmation and~~ initiate a connection sequence ~~bysending~~by sending either a Req Open or Req Preempted Open~~RequestConnection~~ parameter to the PL_C state machine.

a) ~~The "first" refers to the first time this transmission request has been serviced and~~ Using the Req Open parameter shall cause the AWT timer to be initialized when the PL_C3 state is entered.

b) Using the Req Preempted Open parameter shall cause the AWT timer to not be initialized when the PL_C3 state is entered. The Req Preempted parameter is used ~~The "return"refers~~ to establish~~ing~~ a connection ~~for a frame transmission~~ that had been previously requested ~~an open~~ but had been preempted by a connection opened to this ~~port~~ SAS Address from another source ~~port~~SAS Address ~~as a result~~because of a selected (i.e, a Connection Opened(By SSP or SMP or STP Destination path) confirmation is received~~SL2_Selected~~) path. ~~This shall cause the AWT timer to not be initialized when the PL_C3 state is entered.~~

When t~~T~~he PL_C state machine sends an Open Connection request to the link layer~~.~~ ~~O~~ne of the following situations results:

a) The connection is opened for this ~~destination port~~destination SAS Address as a result of the Open Connection request ~~for this transmit connection~~ (~~SL1:ArbSel path~~i.e., a Connection Opened(By SSP or SMP or STP Source path) confirmation is received) and the requested frame transmission can occur.

b) The connection is opened ~~for~~ with this port ~~destination port~~from the destination SAS Address requested in the Open Connection request~~as a result~~because of a selected (i.e, a Connection Opened(By SSP or SMP or STP Destination path) confirmation is received ~~SL2_Selected~~) path. ~~and~~ Therefore, the requested frame transmission can occur.

c) The connection is opened with this port ~~as the destination port~~from a different destination SAS Address requested in the Open Connection request~~as a result~~because of a selected (i.e, a Connection Opened(By SSP or SMP or STP Destination path) confirmation is received ~~SL2_Selected~~) path. ~~and~~ Therefore, the requested frame transmission ~~can not~~cannot occur. In this ~~case~~case, the PL_~~RQ~~ OC1 machine shall reexamine ~~its queue~~ the Transmit Frame requests for this transport layer to determine if any transmit requests exists for this different~~-~~ source port ~~device~~. The original requested frame transmission shall be ~~requeued~~ remembered ~~for transmission with~~ with a ~~"return"~~ Preempted status for priority and AWT control.

d) The connection is denied and is not established. The transport layer shall be notified with a Transmission Status (Open failed-xxx) confirmation and the PL_~~RQ~~ OC1 machine shall ~~check its queue~~ monitor the transport layers for the next transmit request to a different destination SAS Address.

~~For target ports only, when a connection is first established (detected by the leading edge of the "Currently Connected to i" signal from the PL_C2 state), the PL_RQ machine shall initialize the counters and timers in the PL_TMR machine.~~

~~For target ports only, if connected, the PL_RQ machine shall check to see if any of the CTR/Timers have exceeded the specified limits after each frame transmission and prior to sending Connection Status back to the transport layer. (i.e., check CTR/Timers after each "Tx for this Req complete" signal is received and check CTR/Timers after each "Open Req (to i)" is received.~~

~~a)If the CTR/Timer's have not exceeded the specified limits, frame transmission may continue.~~

~~b)If the CTR/Timer's have exceeded the specified limits, The PL_RQ machine shall request a "Close Connection" function from the Link layer and notify the transport layer with a "Disconnect in process – Disconnect-Reconnect timer/counter exceeded" status. To continue transmission of this data, the transport layer shall generate a new "Open Req" transmission request which is placed in the request queue.~~

~~If a Disconnect request is received, The PL_RQ machine shall request a "Close Connection" function from the Link layer. Any queue entry transmission waiting for a response from the transport layer shall also be cleared.~~

When a connection is exited, the PL_~~RQ~~ OC1 machine shall notify the transport layer by a Connection Closed confirmation. (This also allows the transport layer to recover for a premature disconnection ~~if a frame transmission has been approved but before the transport layer has notified the PL_RQ machine that the transmission is completed~~ (i.e, if the transport layer receives a Connection closed Confirmation prior to receiving a Transmission Status confirmation))

If multiple phys exist for a device, the PL_OC may establish multiple connections to different destination SAS Addresses simultaneously and may transmit and receive via the different phys simultaneously.

If a DONE has been transmitted, the PL_~~RQ~~ OC1 machine shall not allow another IU transmission until after the connection has been completely closed down (~~SL0:Idle entered~~i.e, Connection Closed confirmation received)

If ~~DONEs have been transmitted and received, or if~~ a ~~CLOSE or~~ a BREAK has been transmitted or received, the PL_~~RQ~~ OC1 machine shall not allow any transmissions and shall ignore any receptions until after the connection has been completely closed down (~~SL0:Idle entered~~i.e, Connection Closed confirmation received)

The PL_~~RQ~~ OC1 machine shall detect if the connection was opened as a result of a device selection (~~detect "Currently Connected to i" signal from PL_C2 via the~~i.e., a Connection Opened(By SSP or SMP or STP Destination path), confirmation is received). If ~~determine that~~ there is no pending ~~t~~Transmit Frame requests in the ~~queue~~ transport layer to this source device, ~~and~~ the PL_OC1 Machine shall request a 'Close Connection" function from the link layer. This will result in ~~so that~~ a DONE ~~is~~ being transmitted to the ~~destination port~~ destination SAS Address so that the connection can be closed by a DONE being received from the destination ~~port~~ SAS Address.

8.3 PL_TMR1 Counters and Timers state machine

This state machine contains ~~the Arbitration Wait timer and~~ the SSP Disconnect-Reconnect mode page timers/ counters, the I_T Nexus Loss Timer, the Arbitration Wait timer, and the Open Failed(Pathway Blocked) confirmation counter.

~~These timers and counters are initialized by the PL_RQ machine when a connection is first established.~~

The Maximum Connect Time timer measures the amount of time an SSP connection is open and notifies the PL_~~RQ~~ OC state machine when this value exceeds the limit specified in the MAXIMUM CONNECT TIME field of the Disconnect-Reconnect mode page.

The Maximum Connect Time timer is initialized by the ~~R&Q~~PL_OC machine when a connection is first established and is only monitored during the current connection

The Maximum Burst Size counter counts the number of bytes transmitted by the target port in an SSP connection and notifies the PL_~~RQ~~ OC state machine when this value exceeds the limit specified in the MAXIMUM BURST SIZE field of the Disconnect-Reconnect mode page.

The Maximum Burst Size counter is initialized by the ~~R&Q~~PL_OC machine when a connection is first established and is only monitored during the current connection.

The Bus Inactivity Timer times when the target is maintaining a connection without transferring frames to the initiator device and notifies the ~~R&Q~~PL_OC machine when this value exceeds the limit specified in the BUS INACTIVITY LIMIT field of the Disconnect-Reconnect mode page

The Bus Inactivity Timer is initialized by the ~~R&Q~~PL_OC machine when a connection is first established. This timer is held in the initialized state and inhibited from operating during each frame transmission. The timer is allowed to time after each frame is transmitted and until the next frame is started to be transmitted. This timer is only monitored during the current connection and before a DONE is transmitted.

The I_T Nexus Loss Time timer times how long the target port shall retry connection requests that are rejected for certain reason codes. The PC_C5 state machine will detect when this value exceeds the I_T NEXUS LOSS

TIME specified in the Protocol-Specific Port Control mode page (19h) and transition to the PC_C6 state. The PC_C6 state machine will terminate connection requests and via the ~~R&Q~~PL_OC machine ~~remove this request from the queue and~~ notify the transport layer of this with a Transmission Status(Open Failed-I_T Nexus Loss Timeout) confirmation. ~~using the Conn Status (to i) parameter and a reason code of ARB LOST AFTER RETRY I_T NEXUS LOSS TIMEOUT.~~

The I_T Nexus Loss Time timer shall be initialized when the PC_C3 state is entered from the PC_~~R&Q1~~OC1 ~~-~~state a result of a Req Open or Req Preempted Open parameter transfer. This timer is only monitored while trying to open a connection for a transmission from the target. This timer is also initialized when a Open Failed(Retry) or Open Failed(Pathway Blocked) confirmation is received from the link layer.

The Arbitration Wait Timer measures the amount of time since arbitration was first started for a frame. This timer value is passed to the link layer by the PL_C state machine as part of its Open Connection request.

The Arbitration Wait Time~~r~~ timer shall be initialized when the PC_C3 state is entered from the PC_OC1 state a result of a Req Open parameter transfer~~a request for a "first" time frame transmission has occurred~~. The Arbitration Wait timer shall be reinitialized when ~~the following~~an Open Failed(Retry) confirmation~~s are~~ is received from the link layer:

a) ~~Open Failed(Retry~~).

This timer shall not be reinitialized when one of these Connection Rejected confirmations is received from the lower layer:

a) Open Failed(Wrong Destination);
b) Open Failed (Link Rate Not Supported);
c) Open Failed (Protocol Not Suppoted);
d) Open Failed(Pathway Blocked);
e) Open Failed(Open Timeout Occurred)TIMEOUT;
f) Open Failed(Port Layer Request);
g) Open Failed(Break Received);
h) Open Failed(No Destination);
i) Open Failed(Bad Destination); or
j) Open Failed(STP Resources Busy).

~~This~~ The AWT timer shall not be initialized when the PC_C3 state is entered from the PC_OC1 state a result of a Req Preempted Open parameter transfer. ~~a request for a "return" frame transmission is requested.~~

The Open Failed(Pathway Blocked) confirmation counter counts the number of Open Failed(Pathway Blocked) confirmations received from the link layer. This Counter value is passed to the link layer by the PL_C state machine as part of its Open Connection request.

The Open Failed(Pathway Blocked) confirmation counter shall be initialized when PC_C3 state is entered from the PC_OC1 state a result of a Req Open or Req Preempted Open parameter transfer. Any confirmation status other than Open Failed(Pathway Blocked) will reinitialize this counter. This counter is a 8 bit counter and will not be incremented past XFF.

Editors Note: What happens to the counter when switch phys as part of trying to open a connection

8.4 PL_C state machine

8.4.1 PL_C1:Idle state

8.4.1.1 State description

The PL_C1:Idle state is the idle state for the port layer ~~connection~~ Connection state machine.

This state is entered when no connections exist on the port. This state is entered when ~~all~~ the connection is closed.

This state is exited when a Connection Opened confirmation is received from the lower layer This state ~~is~~ is also exited when the PL_~~RQ~~ OC state machine ~~requests~~ initiates a connection sequence via a Req Open or Req Preempted Open parameter transfer to the PL_C1 state. ~~first or return transmit~~

8.4.1.2 Transition PL_C1:Idle to PL_C2:Connected

The PL_C1:PL_C2 transition shall occur when a Connection Opened(By SSP or STP or SMP Destination path) confirmation is received from the lower layer.

8.4.1.3 ~~Transition PL_C1:Idle to PL_C3:ReqWait~~Transition PL_C1:Idle to PL_C3:SelectPhy

The PL_C1:PL_C3 transition shall occur after the PL_OC state machine initiates a connection sequence via a Req Open or Req Preempted Open parameter transfer to the PL_C1 state. ~~when the PL_RQ state machine requests a first or continued transmit function be performed.~~

8.4.2 ~~-~~PL_C2:Connected state

8.4.2.1 State description

This state indicates that a connection exists and that primitives and frames may be transmitted and received~~\~~.

This state shall notify the PL_~~RQ~~ OC state machine when a connection is first established, that a connection exists, and shall indicate when the connection is closed.

8.4.2.2 Transition PL_C2:Connected to PL_C7:Done

If the connection is SSP, the PL_C2:PL_C7 transition shall occur when a DONE has been transmitted by this port.

8.4.2.3 ~~Transition PL_C2:Connected to PL_C8:CloseWait~~Transition PL_C2:Connected to PL_C8:Broken

The PL_C2:PL_C8 transition shall occur when a ~~CLOSE~~ BREAK has been transmitted or received by this port.

~~1.4.2.4Transition PL_C2:Connected to PL_C9:Broken~~

~~The PL_C2:PL_C9 transition shall occur when a BREAK has been transmitted or received by this port.~~

8.4.3 PL_~~C4~~C3:SelectPhy state

8.4.3.1 State description

[~~Editor's note: all PL_C1 to PL_C3 transitions should pass through here, not just retried opens from PL_C3 to PL_C3.~~]

When this state is entered from the PL_C1:Idle state, this state shall:

a) ~~i~~initialize a I_T Nexus Loss time timer which limits the number of retry connection requests that are rejected for certain confirmations to the specified destination SAS Address;
b) Select the phy through which the connection request is to be made;
c) Initialize the AWT if a Req Open parameter was sent from the PL_OC state machine;
d) Not initialize the AWT if a Req Preempted Open parameter was sent from the PL_OC state machine; and
e) Initialize the Open Failed(Pathway Blocked) confirmation counter

When this state is entered from the PL_C5 state, ~~This~~ this state may select a different phy ~~shall set up the next link~~ (if the port is a wide port) to attempt another Open Connection request. ~~[Editor's note: reword]~~

If only one phy exists, the same ~~link~~Link~~-~~phy shall be re-specified.

~~If more than one phy exists, then this state may select a different link~~Link~~ to be used for the Open Connection request.~~

8.4.3.2 Transition PL_~~C4~~C3:SelectPhy to PL_~~C5~~C4:~~CheckTimer~~ReqWait

The PL_~~C4~~C3:PL_~~C5~~ C4 transition shall occur when the phy for the Open Connection request has been set up or switched.

8.4.4 ~~PL_C3~~PL_C4:ReqWait state

8.4.4.1 State description

This state sends an Open Connection request to the selected link layer and phy plus interprets the resultant responses.

~~When this state is entered for the first time from the PL_C1:Idle state, this state shall:~~

~~a)initialize a ULP open timeout timer to 1 ms which limits the total time than an open function is attempted for this open request to the specified destination port;~~
~~b)Select the link through which the connection request is to be made;~~
~~c)Initialize the AWT for a "req for first tx" frame transmission request; and~~
~~d)Not initialize the AWT for a "req for return" tx frame transmission request.~~

The Open Connection request includes these ~~parameters~~arguments:

a) Destination ~~device name~~ SAS Address;
b) Protocol;
c) Arbitration W~~w~~ait time
d) Open Failed(Pathway Blocked) count;
e) phy
~~d)~~f) Link rate;
~~e)~~g)Initiator bit; and
~~f)~~h) Initiator connection tag.

~~This state shall thensend an Open Connection request to the selected link layer~~.

This state shall then monitor the link layer ~~response~~ confirmations to determine if;

a) The connection was opened due to the Open Connection Request;
b) ~~the result of the Open Connection request or to determine if an~~a receive connection occurred, overriding the Open Connection request;
c) Arbitration was lost and a retry may be warranted ; or
d) Arbitration was lost and no retry is warranted.

This state will reinitialize (or not) the AWT, and I_Tnexus Loss timers plus the Pathway Blocked timer as defined in section 8.3 PL_TMR1 Counters and Timers state machine.

8.4.4.2 Transition PL_~~C3~~C4:ReqWait to PL_C2:Connected

If a Connection Opened confirmation is received from the link layer, the PL_~~C3~~C4:PL_C2 transition shall occur

~~1.4.4.3~~Transition PL_~~C3~~C4:ReqWait to PL_~~C4~~C5: ~~Retry~~Check I_T Nexus Timer

8.4.4.3 The PL_~~C3~~C4:PL_~~C4~~ C5 transition shall occur ~~as a result~~because of receiving from the link layer the following confirmations (Arb Lost-Retry conditions):

a) Open Failed(Retry);
b) Open Failed(No Destination);
c) Open Failed(Pathway Blocked); or
d) Open Failed(Open Timeout Occurred).

8.4.4.4 Transition PL_~~C3~~C4:ReqWait to PL_C6:OpenFailed

The PL_C4:PL_C6 transition shall occur because of receiving a Cancel request from the transport layer (Arb Lost-Don't Retry condition):or:

The PL_~~C3~~C4:PL_C6 transition shall occur ~~as a result~~because of receiving from the link layer the following confirmations (Arb Lost-Don't Retry conditions):

a) Open Failed(Bad Destination);
b) Open Failed(Wrong Destination);
c) Open Failed(Link Rate Not Supported);
d) Open Failed(Protocol Not Supported);

e) Open Failed(STP Resources Busy);
f) Open Failed(Port Layer Request); or
g) Open Failed(Break Received).

~~**1.4.4 PL_C4:SelectPhy state**~~

~~**1.4.4.1State description**~~

~~[Editor's note: all PL_C1 to PL_C3 transitions should pass through here, not just retried opens from PL_C3 to PL_C3.]~~

~~This state shall set up the next link (if the port is a wide port) to attempt another Open Connection request. [Editor's note: reword]~~

~~If only one phy exists the same link shall be re-specified.~~

~~If more than one phy exists, then this state may select a different link to be used for the Open Connection request.~~

~~**1.4.4.2Transition PL_C4:SelectPhy to PL_C5:CheckTimer**~~

~~The PL_C4:PL_C5 transition shall occur when the phy for the Open Connection request has been set up or switched.~~

8.4.5 ~~-~~PL_C5:Check I_T Nexus Timer state

8.4.5.1 State definition

~~This state shall first check to see if the open timeout timer has exceeded the specified limit and take the appropriate action if it has.~~

~~If the open timeout timer has not reached its limit, this state shall ensure that the link layer is in the SL0:Idle state prior to transitioning to the PL_C3 state.~~

~~This state shall reinitialize the AWT timer if the link layer status was OPEN FAILED-RETRY.~~

~~This state shall not reinitialize the AWT timer if the link layer status was OPEN FAILED-PATHWAY BLOCKED OR ARBITRATION LOST-OPEN TIMEOUT OCCURRED.~~

This state shall either set up for a connection retry or exit to the PC_C6 state to terminate connection retries.

This state will first check if the link layer sent a Open Failed(Retry) or Open Failed(Pathway Blocked) conformation. If yes , a connection retry will be set up. If no, the State will check to see if the I_T Nexus Loss timer has exceeded the specified limit . If no, a connection retry will be set up. If yes, the state will exit to the PC_C6 state.

~~This state shall reinitialize the AWT timer if the link layer .~~

~~This state shall not reinitialize the AWT timer if the link layer.~~

This state shall delay 15 microseconds before it is exited.

8.4.5.2 ~~Transition PL_C5:CheckTimer to PL_C3:ReqWait~~Transition PL_C5:CheckTimer to PL_C3:Select Phy

The PC_C5: PC_C3 transition shall occur if ~~the ULP Open timeout timer has not reached the specified limit and if the link layer is in the SL0:Idle state.~~

a) The link layer sent a Open Failed(Retry) or Open Failed(Pathway Blocked) conformation or.
b) (if a is not true) If the I_T NEXUS L Loss timer has not exceeded the specified limit .

8.4.5.3 Transition PL_C5:CheckTimer to PL_C6:OpenFailed

The PC_C5: PC_C6 transition shall occur if:

c) The link layer did not sent a Open Failed(Retry) or Open Failed(Pathway Blocked) conformation or

a) (if a is not true) If the I_T NEXUS L Loss timer has exceeded the specified limit

~~The PL_C5:PL_C6 transition shall occur if the open timeout timer has reached the specified limit~~.

8.4.6 PL_C6:OpenFailed state

8.4.6.1 State definition

This state shall send a Stop Arb request to the link layer (if currently arbitrating), set up ~~the~~ the confirmation to the transport layer as either:

Transmission Status(Open Failed –Wrong Destination)
Transmission Status(Open Failed –Link Rate Not Supported)
Transmission Status(Open Failed –Protocol Not Supported)
Transmission Status(Open Failed –Pathway Blocked)
Transmission Status(Open Failed –Open Timeout Occurred)
Transmission Status(Open Failed –Port Layer Request)
Transmission Status(Open Failed –Break Received)
Transmission Status(Open Failed –No Destination)
Transmission Status(Open Failed –Bad Destination)
Transmission Status(Open Failed –STP Resources Busy)
Transmission Status(Open Failed –I_T Nexus Loss Timeout)
Transmission Status(Open Failed –Physical Not Ready)

~~Connection Status to either Arb Lost – No Retry or Arb Lost -ULP Open timeout exceeded to return to the transport layer,~~ and then wait for the link layer to enter the SL0:Idle state. ~~[Editor's note: this state should receive the Open Failed(Port Layer Request) confirmation]~~

8.4.6.2 Transition PL_C6:OpenFailed to PL_C1:Idle

The PL_C6:PL_C1 transition shall occur when the link layer enters the SL0:Idle state.

8.4.7 PL_C7:Done state

8.4.7.1 State definition

This state is entered only during SSP connections. It indicates that a DONE has been received and that this port cannot transmit any additional frames until the connection has been closed and reestablished. While in this state, the port may transmit primitives and receive frames and primitives.

8.4.7.2 Transition PL_C7:Done to PL_~~C8~~C1:~~CloseWait~~ Idle

The PL_C7:PL_~~C8~~ C1 transition shall occur when port layer receives a Connection Closed or Close Timweout confirmation from the link layer.

~~**1.4.8 PL_C8:CloseWait state**~~

~~**1.4.8.1State definition**~~

~~This state is entered only during SSP connections. This state indicates that a DONE has been transmitted and received by the device or that a CLOSE has been transmitted or received and that this port shall not transmit or receive anything until the connection has been reestablished.~~

~~1.4.8.2Transition PL_C8:CloseWait to PL_C1:Idle~~

~~The PL_C8:PL_C1 transition shall occur when the port layer receives a Connection Closed confirmation from the link layer.~~

~~1.4.9~~8.4.8 PL_~~C9~~C8:Broken state

~~1.4.9.1~~8.4.8.1 State definition

This state indicates that a BREAK has been either transmitted and received and that this port shall not transmit anything or receive anything until the connection has been reestablished.

~~1.4.9.2~~8.4.8.2 Transition PL_~~C9~~C8:Broken to PL_C1:Idle

The PL_C8:PL_C1 transition shall occur when ~~the the~~the port layer receives a Connection Closed confirmation from the link layer.

8.5 PL_T1 Transmit a Frame

8.5.1 State Definition

When a connection is established and a frame is to be transmitted, the PL_OC state machine will send the Okay to Tx Frame parameter to the PL_T1 state. Arguments will include whether to transmit with Balance Required or Not, and the Frame to be transmitted.

The PL_T1 machine will generate a TX Frame(Balanced Required) request to the port layer when:

a) A Transmit Frame(Interlocked) request is received from the transport layer or;

b) Any Transmit Frame(Non Interlocked) request following a Transmit Frame(Interlocked) request from the transport layer; or

c) Any Transmit Frame(Non Interlocked) request with a different Tag value in the Frame Header from the previous Transmit Frame(Non Interlocked) request

The PL_T1 machine will generate a TX Frame(Balanced Not Required) request to the port layer when:

a) A Transmit Frame(Non Interlocked) request is received from the transport layer that does not follow a Transmit Frame(Interlocked) request or has the same Tag value in the Frame Header that the preceding Transmit Frame(Non Interlocked) request had.

After a Tx Frame request has been sent to the link layer and when the frame has been transmitted by the link Layer , a Frame Transmitted confirmation will be sent to this state from the link layer (If the transmission could not occur a Connection Closed confirmation will be sent instead). This state will then send the transport layer a Transmission Status(Frame Transmitted) confirmation (or a Connection Closed confirmation if an error occurred). This state will also send the PL_OC state a Frame Transmitted parameter which will notify the PL_OC state that another frame can be transmitted. This state will also monitor and pass the following transmit confirmations regarding the previous Frame transmissions from the link layer to the transport layer:

1) Ack Received;
2) Nak Received;
3) ACK/NAK Timeout; or
4) Credit Timeout;

8.6 PL_R1 Receive a Frame

Activity in this state may only occur if a connection is opened. This state will pass the received frame along with the Frame Received(Ack/Nak Balanced) or Frame Received(Ack/Nak Not Balanced) confirmation from the link layer to the transport layer.