To: INCITS T10 Committee
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Subject: ADT State Diagrams

1 Revision History

Revision 0:
Initial proposal

2 Discussion

Section 4.3 and 4.4 can be made more readable by providing state diagrams and describing the transitions.

This proposal applies to ADT Revision 7.

2.1 Changes

Replace the entire contents of section 4.3 and 4.4 with the following.

4.3 ADT state machine

The ADT transport layer contains a single state machine to manage a connection between two ADT ports. The state machine consists of the following port states:

a) P0:Initial;
b) P1:Login;
c) P2:Active;
d) P3:Recovery pending;
e) P5:Recovering;
f) P6:Paused; and
g) P7:Logged-out.

Figure x describes the ADT state machine.

(See diagram at end)

Figure X ADT State Machine Diagram

See clause 6.5 for a description of the link layer information units described in the following sub clauses.

4.3.1 P0:Initial state description

A port shall transition to this state after a hard reset event or after receiving an acknowledgement for a Port Logout IU. Since only an automation port can send a Logout IU, only an automation port can transition to this state after completing a port logout.

A port in P0:Initial state shall send a NAK IU in response to any frame containing a protocol other than link service until the login process has completed.

The port shall transition to P1:Login after sending or receiving a Port Login IU.

4.3.2 P1:Login state description

This state consists of 4 sub-states referred to as link negotiation states used to manage the login process. The states are as follows:

a) N0:Initiate;
b) N1:Negotiating;
c) N2:Accept; and
d) N3:Complete.

Port Login IUs are used to establish or change link parameters used by both ports on the link. The login process is a negotiation between the ports that shall result in the determination of a set of operating parameters that are acceptable to both ports. Following a hard reset or a Port Logout condition, the Port Login IU shall be sent using default parameters (see 4.2). If the port is already logged in, the Port Login IU shall be sent using current operating parameters unless the port is initiating the exchange as part of link error recovery as described in clause 4.7.2. The login process consists of a series of Port Login IUs all within a single exchange. The same X-Origin and Exchange ID values are used in all frames throughout the process (see 6.3).

Figure x + 1 describes the sub-states used in the login process.

(See diagram at end)

Figure x + 1 Login Process State Diagram

A port shall transition to this state after sending or receiving a Port Login IU.

A port in this state shall send a NAK IU in response to any frame containing a protocol other than link service until the login process has completed.

A port shall transition to P2:Active state after successfully completing the port login process.

4.3.2.1 Precedence of port login exchanges

Existing 4.4.2 text.

4.3.2.2 N0:Initiate state description

A port shall transition to this state upon initiating a Port Login exchange.

Any frames received by the port after it sends a Port Login IU shall be discarded and a NAK IU shall be sent containing a status value of “Login in progress”. The port shall initiate a new Port Login exchange using default starting parameters and transition to N0:Intiate state.

A port shall transition to N1:Negotiating after it receives an ACK IU in response to the Port Login IU.

4.3.2.3 N1:Negotiating state description

A port shall transition to this state when it receives a Port Login IU.

After acknowledging a Port Login IU, transmission of frames for other exchanges shall either be suspended or aborted based on the setting of the AOE bit in the Port Login IU.

The port shall inspect the parameters in the received Port Login IU and :

1) If the ACCEPT bit is set to one and the parameters are unchanged from the values sent in the last Port Login IU, the port shall send a Port Login IU with the same value and transition to N3:Complete.
2) If the port receives a Port Login IU with the ACCEPT bit set to one with parameter values that are different from the last Port Login IU sent, the port shall send a NAK IU with a status value of “Negotiation error”. The port shall transition to N0:Intiate state and initiate a new Port Login exchange with default starting parameters.
3) If the accept bit is set to zero and the parameters in the Port Login IU are acceptable, the port shall send a Port Login IU with the parameters unchanged and the ACCEPT bit set to one and transition to N2:Accept state.
4) Otherwise, the port shall adjust all parameters that are unacceptable down to values that are acceptable to the port, and respond with a Port Login IU that contains these values. The ACCEPT bit shall be set to zero.

If a port has not received a Port Login IU within 15 seconds after receiving the ACK IU for a Port Login IU that it has sent, the port shall consider this condition an error. It shall abort the Port Login exchange, set the port operating parameters to default, initiate a new Port Login exchange and transition to N0:Initate state.

4.3.2.4 N2:Accept state description

A port shall transition to this state after it sends a Port Login IU with the parameters unchanged and the ACCEPT bit set to one.

If a port receives a Port Loign IU with the ACCEPT bit set to zero or with parameter values that are different from the last Port Login IU sent, the port shall send a NAK IU with a status value of “Negotiation error”.

If a port receives a Port Login IU with the ACCEPT bit set to one and unchanged parameters, the port shall acknowledge the frame. When the ACK IU has finished transmitting, the port shall set its operating parameters to the negotiated values and transition to the P2:Active state.

4.3.2.5 N3:Complete state description

A port shall transition to this state after sending a Port Login IU with the ACCEPT bit set to one after receiving a valid Port Login IU with unchanged parameters and ACCEPT bit set to one.

A port shall set its operating parameters to the negotiated values and transition to P2:Active state after receiving an ACK IU for the Port Login IU it sent.

If a port receives a NAK IU it shall initiate a new Port Login exchange with default starting parameters and transition to N0:Initiate state.

4.3.3 P2:Active state description

If the port is in P1:Login it shall transition to this state after successfully completing the port login process.

If the port is in P3:Pending Recovery, it shall transition to this state after receiving a valid Initiate Recovery IU with a FRAME NUMBER field value that matches the Expected Frame Number counter.

If the port is in P4:Initiating Recovery state, it shall transition to this state after receiving an ACK IU in response to an Initiate Recovery IU.

If the port is in P5:Recovering state, it shall transition to this state after receiving a valid frame with a FRAME NUMBER field value that matches the Expected Frame Number counter.

If the port is in P6:Paused state, it shall transition to this state after receiving any valid frame other than an acknowledgement.

A port shall transition to P1:Login state after it receives a valid Port Login IU.

A port shall transition to P3:Pending Recovery state after it detects a retryable error in a frame.

A port shall transition to P4:Initiate Recovery state after it detects a retryable error and transmits an Initiate Recovery IU.

A port shall transition to P5:Recovering state after it receives a valid Initiate Recovery IU with a FRAME NUMBER field value that does not match the Expected Frame Number counter.

A port shall transition to P6:Paused state after it receives a valid Pause IU and sent the corresponding ACK IU.

A port shall transition to P7:Logged Out state after it receives a valid Port Logout IU and sent the corresponding ACK IU.

4.3.4 P3:Pending Recovery state description

A port shall transition to this state when it has detected a retryable error during the reception of a frame.

Receipt of a frame other than an Initiate Recovery IU is an error and the port shall send a NAK IU with a status code equal to Awaiting Initiate Recovery IU.

A port shall transition to P5:Recovering state after it receives a valid Initiate Recovery IU with a FRAME NUMBER field value that does not match the Expected Frame Number counter.

A port shall transition to P2:Active state after it receives a valid Initiate Recovery IU with a FRAME NUMBER field value that matches the Expected Frame Number counter.

4.3.5 P4:Intiating Recovery state description

A port shall transition to this state after transmitting an Initiate Recovery IU.

A port in this state shall not send any frames other than acknowledgement IUs, Port Login IUs, or Port Logout IUs.

A port shall transition to P2:Active state once it receives the ACK IU that corresponds to the Initiate Recovery IU that caused the transition to this state.

4.3.6 P5:Recovering state description

A port shall transition to this state when it receives a valid Initiate Recovery IU with a FRAME NUMBER field value that does not match the Expected Frame Number counter

indicating that the other port will re-send frames that have already been received and acknowledged by this port. See clause 4.7.

A port in this state shall acknowledge and discard all frames that were previously processed. This is all frames with a FRAME NUMBER field value that does not match the Expected Frame Number counter.

When a frame with a FRAME NUMBER field value that matches the Expected Frame Number counter is received, the port shall transition to the P2:Active state and continue with normal operations.

4.3.7 P6:Paused state description

A port shall transition to this state after sending an ACK IU in response to a Pause IU.

A port is in this state shall not transmit.

A port shall transition to P2:Active state after receiving any frame other than an acknowledgment IU.

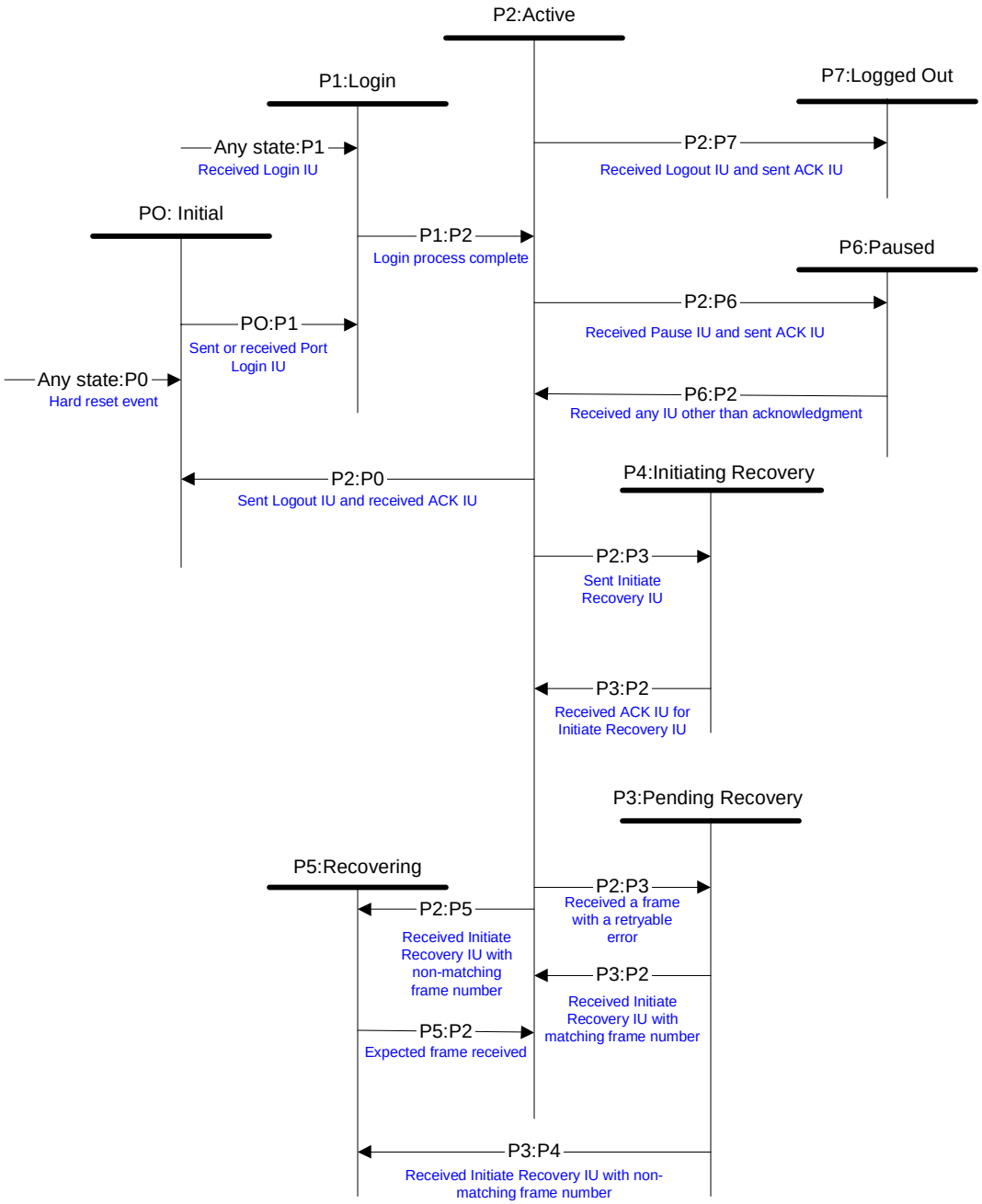
4.3.8 P7:Logged-out state description

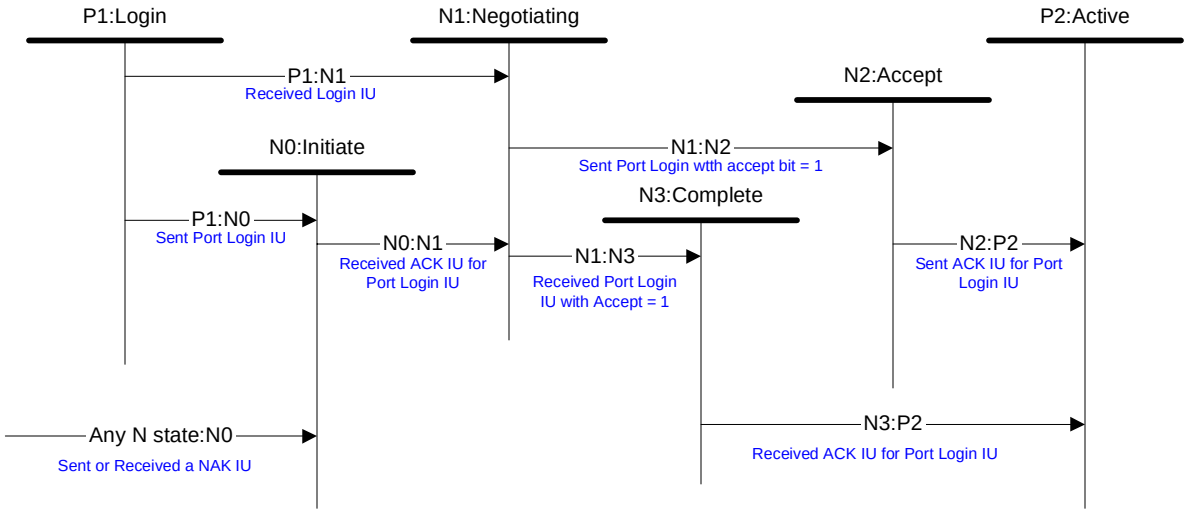
A port shall transition to this state after sending an ACK IU in response to a Logout IU.

A port in this state shall not initiate an exchange. While in this state, upon receiving any frame other than a Port Login IU, the port shall send a NAK IU with a status value of Rejected, port is not logged in.

Since only a drive port can receive a Logout IU, only a drive port can transition to this state after completing a port logout.

A port shall transition to P1:Login state after it receives a valid Login IU.


P2:Active
P1:Login
P7:Logged Out
Any state:P1
Received Login IU
P2:P7
Received Logout IU and sent ACK IU
PO: Initial
P1:P2
Login process complete
P6:Paused
P2:P6
Received Pause IU and sent ACK IU
PO:P1
Sent or received Port Login IU
Any state:P0
Hard reset event
P6:P2
Received any IU other than acknowledgment
P2:P0
Sent Logout IU and received ACK IU
P4:Initiating Recovery
P2:P3
Sent Initiate Recovery IU
P3:P2
Received ACK IU for Initiate Recovery IU
P3:Pending Recovery
P5:Recovering
P2:P3
Received a frame with a retryable error
P2:P5
Received Initiate Recovery IU with non-matching frame number
P3:P2
Received Initiate Recovery IU with matching frame number
P5:P2
Expected frame received
P3:P4
Received Initiate Recovery IU with non-matching frame number


P1:Login
N1:Negotiating
P2:Active
P1:N1
Received Login IU
N2:Accept
N1:N2
Sent Port Login wtth accept bit = 1
N0:Initiate
N3:Complete
P1:N0
Sent Port Login IU
N0:N1
Received ACK IU for Port Login IU
N1:N3
Received Port Login IU with Accept = 1
N2:P2
Sent ACK IU for Port Login IU
Any N state:N0
Sent or Received a NAK IU
N3:P2
Received ACK IU for Port Login IU