

To: INCITS T10 Committee

From: Paul Entzel, Quantum

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Subject: Add content to model section of ADT.

1. Revision History

Revision 0:
Posted to the T10 web site 14 April 2003.

2. General

This proposal finally adds some content to the model clause of ADT. Much of this content is cut out of other areas in the standard and moved into the model since it is general in nature.

This proposal also addresses the following editors notes in ADTr03.

- ◆ Editors note 4 in clause 4.
- ◆ Editors note 5 in sub-clause 6.5.4.
- ◆ Editors note 6 in sub-clause 6.5.4.
- ◆ Editors note 7 is sub-clause 6.5.6.

3. Proposal

Add the following sub-clauses in the General clause (4):

4.1 Default operating parameters for the link

From section 6.6.2.2 move the sentence that reads “The default operating parameters for the port are”: and the list a parameters that follows it to this section. In section 6.6.2.2 replace the removed text with “See sub-clause 4.Y for the default operating parameters.”

4.2 ADT Port states

Table A defines the states that a port shall support. See section 6.5 for a description of the link layer information units described in this table.

Table A – ADT Port States

State	Description
P0:Initial	This is the state that a port shall take after power-up or hard reset events.
P1:Login	A port shall enter this state upon sending or receiving a Port Login IU. See the link negotiation state transition subclause for a description of the sub-states of this state.
P2:Active	A port shall enter this state after successfully completing port login negotiation.
P3:Recovering	A port shall enter this state when it sends an Initiate Recovery IU. See the Recovery State transition subclause for a description of the sub-states of this state.
P4:Paused	A port shall enter this state after acknowledging a Pause IU. A port in this state shall not transmit until a frame other than an acknowledgment frame is received or a hard reset event.
P5:Logged-Out	A port shall enter this state after acknowledging a Logout IU. A port in this state shall

	not transmit until a Port Login IU is received or a hard reset occurs. All other frames received while in this state shall be ignored.
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4.3 ADT Link Negotiation States

Move all of the text from section 6.5.4 through editors note 5 to this section. Edit it as shown:

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 power-up, ~~hard reset~~, or a Port Logout condition, the Port Login IU shall be sent using default parameters (i.e Baud rate). If the port is already logged in, the Port Login IU ~~may~~ shall be sent using current operating parameters ~~unless the port initiating the exchange is in P3:Recovering state~~. A port in ~~P0:Initial state~~ shall NAK any frame containing a protocol other than link service until the login process has completed. The login process consists of the following states, all within a single exchange containing a series of Port Login IUs containing the same X-Origin and Exchange ID values:

~~N0:Initiate - One of the ports on the link sends a Port Login IU containing its default parameters. The ACCEPT field shall be zero. 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 field of "Login in progress". Upon sending the Port Login IU that port shall enter Port State P1:Login and Link Negotiation State N1:Negotiating.~~

~~N1:Negotiating – If a port is not in Port State P1:Logging In state when it receives a Port Login IU, it shall set its Port State to P1:Login and its Link Negotiation State to N1:Negotiating. After acknowledging a Port Login IU, transmission of frames for other exchanges shall either 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 frame, the port shall send a Port Login IU with the same values and transition to N3:Complete state.~~
- ~~2) If the ACCEPT bit is set to zero and parameters in the Port Login IU are acceptable, the port shall send a Port Login IU with the ACCEPT bit set to one and transition to N2:Accept state 4.~~
- ~~3) Otherwise If one or more parameter is unacceptable, the port shall adjust these 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.~~

~~Upon receiving a Port Login IU, the login exchange originator shall send an ACK IU. If the parameters in the Port Login IU are acceptable, the port shall send a Port Login IU with the ACCEPT bit set to one and transition to state 4. If one or more parameter is unacceptable, the port shall adjust these parameters down to values that are acceptable to the port, and respond with a Port Login IU that contains these values. The ACCEPT bit set to zero.~~

~~If a port receives a Port Login IU with acceptable parameters, it shall set the ACCEPT bit to one and send it back. Upon receiving a Port Login IU with the ACCEPT bit set to one, a port shall send an ACK IU. If the port has not yet sent a Port Login IU with the ACCEPT bit set to one, it shall do so in response to this IU. The login parameters shall take effect after a port has received an ACK IU for a Port Login IU it sent with the ACCEPT bit set to one and has acknowledged a Port Login IU from the other port with an ACCEPT bit set to one.~~

~~N2:Accept – If the port receives a Port Login 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 status of Negotiation Error (new error type). The port shall transition to N0:Initiate state and initiate a new Port Login exchange with default starting parameters. If the 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 frame has finished transmitting, the port shall set its operating parameters to the negotiated values and transition to Port State P2:Active.

N3:Complete – If the port receives a NAK frame it shall transition to N0:Initiate state and initiate a new Port Login exchange with default starting parameters. If the port receives an ACK frame for the Port Login IU it sent, it shall set its operating parameters to the negotiated values and transition to Port State P2:Active.

To avoid a deadlock condition when both ports in a link attempt to initiate a Port Login exchange at the same time, the following rules shall be applied to Port Login exchanges. An automation device port that receives a Port Login IU with an exchange originated by the other port shall:

- a) If the automation device port has initiated a Port Login Exchange that has not yet completed, it shall ACK and discard the Port Login IU from the other port.
- b) If no other Port Login exchange is open, it shall either discard the Port Login IU and initiate a Port Login exchange, or it shall negotiate the Port Login using the exchange originated by the other port.

A Data Transfer Device that receives a Port Login IU in a new exchange shall abort all other Port Login exchanges, transition to N1:Login state, and process the Port Login IU as specified by that state.

4.4 ACK Offset

On the ADT link, the receiving port explicitly acknowledges all frames that are transmitted. By default, the link operates configured so a port must wait for an acknowledgement frame for every frame it sends before sending another frame, except for acknowledgement frames. This mode of operation requires a minimal amount of resources in the port to buffer incoming frames. However, it imposes a throughput reduction caused by delays waiting for acknowledgement.

The MAXIMUM ACK OFFSET field in the Port Login IU allows the ports to negotiate a number of frames that may be sent without waiting for acknowledgement, based on the resources available in the port. Regardless of the setting of this field, all frames shall be acknowledged in the order they are received.

Each port shall keep a counter to track the unacknowledged frames that it has sent, called the unacknowledged frame count. This counter shall be set to 0 at power-up and hard reset events. It shall also be set to zero before sending a Port Login IU or Initiate Recovery IU. The counter shall be incremented by one for each frame that is sent except acknowledgement frames. It shall be decremented by one for each acknowledgement frame that is received. A port shall not transmit frames when this counter is equal to the maximum ACK offset value. If the port has not successfully completed Port Login negotiation, it shall not transmit a frame if the unacknowledged frame count is 1.

4.5 Expected Frame Number

The ADT frame header contains a field called FRAME NUMBER that serves three major purposes:

- a) It allows an acknowledgement frame to be associated with a specific frame.
- b) It allows a receiving port to detect missing frames.
- c) It allows a port to retry transmission of frames that fail.

To accomplish all of this, each port must keep 2 counters, one to keep track of the frame number in the next frame to send, and the other to track the next expected frame number.

The next frame to send shall be calculated as follows:

- 1) When initiating a Port Login exchange, it shall be set to 0.
- 2) When receiving a Port Login IU of a new exchange, it shall be set to 0.
- 3) When sending an Initiate Recovery IU, it shall be set to the frame number of the first frame detected in error.
- 4) When sending an acknowledgment frame it shall not be adjusted.
- 5) For all other frame types, it shall be set to the frame number of the last frame sent plus one. If this value is greater than 7, it shall be set to 0.

The expected frame number shall be used to detect missing frames in the receive stream. It shall be calculate as follows:

- 1) When a Port Login IU is received, it shall be set to the value in the FRAME NUMBER field plus one. If this value is greater than 7, it shall be set to 0.
- 2) When receiving an acknowledge IU, it shall not be adjusted.
- 3) If an Initiate Recovery IU is received, or the port is operating in P3:Recovering state, it shall be set and used according to the rules in the Recovery states.
- 4) Otherwise, if the port is operating in P2:Active state, the port shall compare the frame number field in each received frame with the expected frame number counter. If they do not match, the port shall send a NAK IU in response to the frame with a status code of "Non-sequential frame numbers" and the expected frame number counter shall not be adjusted. If they match, the expected frame number counter shall be incremented by one. If this value is greater than 7, it shall be set to 0.

4.6 Link layer error recovery

Move sub-clause 6.6 to this section. Modify list item c) in sub-clause 6.6.2.3 as shown:

- c) If the frame number does not match, this is an indication that an ACK IU was lost in transmission. **The port shall transition into P3:Recovering state. While in this state, frames that are received by the port shall be acknowledged and discarded until the frame that matches the value in the FRAME NUMBER field in the Initiate Recovery IU. ~~Normal operation shall continue~~ once the frame received matches the value in the FRAME NUMBER field in the Initiate Recovery IU, the port shall transition to P2:Active state and continue with normal operation.**