To: INCITS T10 Committee  
From: Susan Gray, Quantum  
Date: March 8, 2004  
Document Number: T10/04-056r3  
Subject: ADT Link service error recovery

1 Revision History

Revision 3:  
Incorporate input from March 8, 2004 meeting. Restructured section 4.7.2 and added error recovery for link service frames besides Port Login IUs.

Revision 2:  
Updated the error recovery tables. Incorporate input from February 23, 2004 teleconference.

Revision 1:  
Incorporate input from February 9, 2004 teleconference.

Revision 0:  
Initial proposal

2 Discussion

The current error recovery section does not address error recovery of link service frames. The following table summarizes the intended recovery procedures for each frame type and port state. “Corrupted” errors become retryable errors and are not listed in the table. Symbol framing errors don’t relate to frames and always have the same recovery procedure and therefore are not listed in the table.

<table>
<thead>
<tr>
<th>Legend:</th>
<th>retryable (sender detected error)</th>
<th>protocol – should never happen</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>resource limitation</td>
<td>recoverable (only possible for non-link service frames)</td>
</tr>
<tr>
<td>none: no error recovery method is currently defined</td>
<td></td>
<td></td>
</tr>
<tr>
<td>impossible: can’t happen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>illegal: not valid to send the frame type in the corresponding state</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Transmitter error recovery

<table>
<thead>
<tr>
<th>Frame State</th>
<th>Port Login</th>
<th>Port Logout</th>
<th>NOP</th>
<th>Pause</th>
<th>Initiate Recovery</th>
<th>Other frame types</th>
</tr>
</thead>
<tbody>
<tr>
<td>P0 Initial</td>
<td>Illegal</td>
<td>Resend</td>
<td>Resend</td>
<td>Illegal</td>
<td>None</td>
<td>Illegal</td>
</tr>
<tr>
<td>(port login is always sent from P1 login)</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>P1 Login</td>
<td>Initiate new login exchange – transition to P1</td>
<td>Resend</td>
<td>Resend</td>
<td>Illegal</td>
<td>Illegal</td>
<td>Illegal</td>
</tr>
<tr>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>P2 Logged-in / TS Active</td>
<td>Illegal</td>
<td>Resend</td>
<td>Resend</td>
<td>N/A</td>
<td>None</td>
<td>Transition to T1</td>
</tr>
<tr>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>Transition to T1</td>
</tr>
<tr>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Impossible</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Impossible</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>
ADT Revision 10 currently includes the following error recovery subclauses:

4.7 link layer error recovery

4.7.1 Error detection
4.7.1.1 Error detection overview
4.7.1.2 Error detection by the frame sender
4.7.1.3 Error detection by the frame receiver
4.7.2 Error recovery for non link service frames
4.7.2.1 (place holder for Port Login recovery)
4.7.2.2 Retryable error
4.7.2.3 Corrupted frame
4.7.2.4 Protocol error
4.7.2.5 Resource limitation
4.7.2.6 Recoverable error
4.7.2.7 Error recovery for symbol framing errors

3 Proposed changes

These changes apply to ADT revision 10.

Add N5:Login complete state to handle the successful completion of the login process and allows N0:Idle to be used for error cases.

Globally change N4:Complete to N4:Agreed

4.3.3.1
add

f) N5:Login Complete

replace existing Figure 5 Link Negotiation state diagram with the following diagram
4.3.3.3.1 State Description (N0:Idle)
The N0:Idle state waits for the port to receive a Port Login IU.

4.3.3.3.2 Transition N0:Idle to N1:Negotiating
This transition shall occur when a Port Login IU Received message is received and the parameters within the Port Login IU are unacceptable, the port shall transition to N1:Negotiating and send a Port Login IU with ACCEPT bit set to zero and parameters changed.

This transition shall occur when an Initiate Login message is received. The port shall transition to N1:Negotiating and send a Port Login IU with ACCEPT bit set to zero and starting parameters.

4.3.3.3.3 Transition N0:Idle to N2:Accept Sent
If the received Port Login IU has the ACCEPT bit is set to zero and the parameters are acceptable, the port shall transition to N2:Accept Sent and send a Port Login IU with the parameters unchanged and the ACCEPT bit set to one.

4.3.3.4.1 State description (N1)
If the port transitioned to this state due to an Initiate Login message, the port shall send a Port Login IU in a new
exchange. If the AOE bit is set, the Port Login IU shall be sent with default starting parameters as the contents.

If the port transitioned to this state due to a negotiation error, the port shall send a Port Login IU in a new exchange with default starting parameters as the contents.

When a Port Login IU message is received, the parameters shall be inspected.

If the Port Login IU parameters are not acceptable, 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 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 initiate a new Port Login exchange with default starting parameters as the contents.

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, and initiate a new Port Login exchange.

4.3.3.4.2 Transition N1:Negotiating to N0:Idle (new section)
If a port receives a Port Login IU with a protocol error or resource limitation error, the port shall send a NAK IU and transition to N0:Idle.

4.3.3.5.2 Transition N2:Accept Sent to N0:Idle (new section)
If a port receives a Port Login IU with a protocol error or resource limitation error, the port shall send a NAK IU and transition to N0:Idle.

4.3.3.6.2 Transition N3:Accept ACK Sent to N5:Login Complete
When the ACK IU has finished transmitting, the port shall transition to N5:Login Complete and set its operating parameters to the negotiated values.

4.3.3.7.2 Transition N4:Agreed to N5:Login Complete
After receiving an ACK IU for the Port Login IU it sent, the port shall transition to N5:Login Complete and set its operating parameters to the negotiated values.

4.3.3.8 N5:Login Complete state
4.3.3.8.1 State description
A port enters this state when both ports have sent and received a Port Login IU with the ACCEPT bit set to one. Upon entry into this state, a Login Process Complete message shall be sent to the port state machine.

Renumber 4.7.2 subclauses to the following:

4.7.2 Error recovery
4.7.2.1 Corrupted frame
When a port detects corruption of a received frame it shall discard the frame and shall not send an acknowledgement IU.

NOTE: The sender of the frame detects a retryable error upon a timeout without receipt of an acknowledgement IU and performs error recovery as defined in section 4.6.2.2.

4.7.2.2 Error recovery for symbol framing errors
After detecting four or more symbol framing errors without the receipt of a frame, a port shall abort all exchanges, set the operating parameters of the interface to default settings, transition to P1:Login and initiate a Port Login exchange with the AOE bit set to one.

4.7.2.3 Recoverable error
Same as 4.7.2.7.

4.7.2.4 Retryable error
4.7.2.4.1 Port Login IU
A port that is in P1:Login that receives a NAK IU or detects an acknowledgment IU time-out shall restart the negotiation by transitioning to N1:Negotiating, setting operating parameters to default (see 4.2), and initiating a new login exchange using starting parameters.

4.7.2.4.2 Port Logout, NOP and Pause IUs
If the port detects an acknowledgement IU time-out, the port may resend the IU. If sent, the IU shall be within a new exchange.

If the port receives a NAK IU due to a resource limitation, the port may resend the IU. If sent, the IU shall be within a new exchange.

If the port receives a NAK IU due to any other error condition, the behavior is not specified.

4.7.2.4.3 Initiate Recovery IU
For error recovery on Initiate Recovery IUs, see 4.7.2.4.4.

4.7.2.4.4 Non link service IUs
Same as current 4.7.2.2

4.7.2.5 Protocol error
4.7.2.5.1 Port Login IU
If a protocol error is detected on a Port Login IU, the port shall send a NAK IU, set the operating parameters to default (see 4.2) and transition to P1:Login, sub state N0:Idle.

4.7.2.5.2 Port Logout, NOP, Initiate Recovery and Pause IUs
If a protocol error is detected on a Port Logout IU, NOP IU, Initiate Recovery IU or Pause IU, the port shall send a NAK IU with PR bit set to zero and appropriate status code and discard the frame.

4.7.2.5.3 Non link service IUs
Same as 4.7.2.4

4.7.2.6 Resource limitation
4.7.2.5.1 Port Login IU
If a resource limitation error is detected on a Port Login IU, the port shall send a NAK IU, set the operating parameters to default (see 4.2) and transition to P1:Login, sub state N0:Idle.

4.7.2.5.2 Port Logout, NOP, Initiate Recovery and Pause IUs
If a resource limitation error is detected on a Port Logout IU, NOP IU, Initiate Recovery IU or Pause IU, the port shall send a NAK IU with PR bit set to zero and appropriate status code and discard the frame.

4.7.2.5.3 Non link service IUs
Same as 4.7.2.5