T10/07-025r2

To	From	Subject	Date
INCITS T10 Committee	Michael Banther, HP	ADT-2 Negotiable Time-Outs	15 January 2007

Revision History

05-377r0 – Initial document.

05-377r1 – Changes to the timeout formula. Provide asymmetric timeouts using new link service information units.

05-377r2 – Added a usage model. Changed the Timeout IU format consistent with comments received at the September, 2006 ADI-2 working group meeting.

07-025r0 – Various editorial and technical changes noted by the November, 2006 ADI-2 working group meeting.

07-025r1 – Added some of the editor's editorial comments.

07-025r2 – Additions and changes requested by the January, 2007 ADI-2 working group meeting.

Related documents

Automation/Drive Interface – Transport Protocol – 2 (ADT-2), T10/1742-D, revision 3, 20 July 2006.

Background

During the development of ADT, the ADI working group sought to find a formula for the acknowledgment time-out that would suit all of the known connection strategies used between existing automation devices and DT devices. Short time-out values favor time-division multiplexing connections between one automation device and several DT devices. Longer time-out values favor continuous connections between one automation device and one DT device or event-driven multiplexing connections between one automation device and several DT devices.

Experience has shown that the acknowledgement time-out formula chosen for ADT does not provide the flexibility desired by automation device developers. HP proposes replacing certain constants in the existing formula with negotiable parameters to allow run-time customization to the acknowledgement time-out value chosen.

Changes to the ADT-2 draft standard

3.1.P simple link service exchange: a simple exchange (see 3.1.40) with the PROTOCOL field set to link service (see 6.3).

3.1.Q time-out discovery exchange: an exchange that consists of a sequence of IUs as specified in 4.10.2.2.

4.6.1.2.2 Acknowledgement IU time-out

The sender of a frame, other than an acknowledgement IU, shall time-out the resulting acknowledgement. It shall be considered an error condition if a corresponding acknowledgement IU is not received within the time-out period (see 4.10). The time-out period shall start after the EOF of the frame has been sent. When operating with a maximum ACK offset greater than one, a port may start the time-out period for a frame that has completed transmission after the acknowledgement IU for a previously sent frame has been received. The minimum acknowledgement IU time-out period shall be calculated using the formula in figure 9.

$$\text{Timeout}_{ACK} = (\text{Period} * \text{Size}_{MAX} * 2) + (\text{Period} * (\text{Offset}_{MAX} * \text{Size}_{NAK} * 2)) + 0,1 \text{ seconds}$$

Where:

Timeout_{ACK} is the minimum time-out period in seconds.

Period is the time per byte calculated as (10 / Baud Rate) and is expressed in seconds per byte.

Size_{MAX} is the Maximum Payload Size negotiated with the Port Login process, plus SOF, EOF, ADT Header, and checksum bytes (see 6.1).

Offset_{MAX} is the maximum ACK offset negotiated with the Port Login process (see 4.4).

Size_{NAK} is the size in bytes of the NAK IU including SOF, EOF, and checksum bytes (see 6.5.3.3).

For example, at 9 600 Baud with a negotiated Maximum Payload Size of 1 024 and Maximum ACK Offset of 2, the minimum timeout period would be approximately 2,28 seconds.

Figure 9 — Minimum acknowledgement time-out period

4.10 Acknowledgement time-out period

4.10.1 Acknowledgement time-out period calculation

When changing operating parameters (see 3.1.31), a port shall calculate a new acknowledgement IU time-out period using the formula in figure 9. The port shall apply the new acknowledgement IU time-out period to every frame transmitted after changing operating parameters.

$$\text{Timeout}_{ACK} = (\text{Period} * \text{Size}_{MAX} * 2) + (\text{Period} * (\text{Offset}_{MAX} * \text{Size}_{NAK} * 2)) + 0,1$$

Where:

Timeout_{ACK} is the time-out period in seconds.

Period is the time per byte calculated as (10 / Baud Rate) and is expressed in seconds per byte.

Size_{MAX} is the maximum payload size negotiated with the Port Login process, plus SOF, EOF, ADT Header, and checksum bytes (see 6.1).

Offset_{MAX} is the maximum ACK offset negotiated with the Port Login process (see 4.4).

Size_{NAK} is the size in bytes of the NAK IU including SOF, EOF, and checksum bytes (see 6.5.3.3).

For example, at 9 600 Baud with a negotiated Maximum Payload Size of 1 024 and Maximum ACK Offset of 2, the timeout period would be approximately 2,28 seconds.

Figure 9 — Acknowledgement time-out period

4.10.2 Acknowledgement time-out period negotiation

4.10.2.1 Negotiation introduction

This standard allows for a port to have an acknowledgement time-out period that differs from the acknowledgement time-out period of the other port forming the link. The Time-out IU (see 6.5.X) provides the mechanism by which a port:

    a)   Reports its own acknowledgement time-out period parameters;

    b)   Discovers the acknowledgement time-out period parameters of the other port; and

    c)   Requests that the other port alter its acknowledgement time-out period value.

This standard does not mandate the usage model described in 4.10.2.2 and 4.10.2.3.

4.10.2.2 Discovering another port's acknowledgement time-out period parameters

A port interrogates the acknowledgement IU time-out parameters of the other port forming the link through the use of a time-out discovery exchange (see 6.5.12.4). To discover the acknowledgement IU time-out parameters of the other port forming the link, a port initiates the exchange by sending a Time-out IU (see 6.5.X) with the ACTION CODE field set to DISCOVER. If the other port forming the link receives the Time-out IU without error, it responds with:

    1.   An ACK IU; and

    2.   A Time-out IU with the ACTION CODE field set to REPORT and the CURRENT ACKNOWLEDGEMENT IU TIME-OUT, MAXIMUM ACKNOWLEDGEMENT IU TIME-OUT, MINIMUM ACKNOWLEDGEMENT IU TIME-OUT, and TIME-OUT RESOLUTION fields set as specified by table Y+2.

Provided it received this Time-out IU without error, the port that initiated the time-out discovery exchange concludes it by sending an ACK IU.

    Editor's Note: Does the standard need a definition for 'time-out discovery exchange'?

4.10.2.3 Altering another port's acknowledgement time-out period

A port requests a change to the acknowledgement IU time-out period of the other port forming the link by sending a Time-out IU (see 6.5.X) in a simple link service exchange (see 6.5.12.2) with the ACTION CODE field set to REQUEST CHANGE and the CURRENT ACKNOWLEDGEMENT IU TIME-OUT field set to the desired time-out value.

    Editor's Note: The standard defines 'simple exchange' (see 3.1.40) but not 'simple link service exchange'.
    However the existing standard uses the term 'simple link service exchange' as does this proposal. Does the
    standard need a definition for 'simple link service exchange'?

4.10.2.4 Exception conditions

If a port sends a Time-out IU with the ACTION CODE field set to DISCOVER in a new exchange and receives a corresponding ACK IU but fails to receive a Time-out IU with the ACTION CODE field set to REPORT in the same exchange, the port may:

    a)   Send another Time-out IU with the ACTION CODE field set to DISCOVER in the same exchange; or

    b)   Send a Time-out IU with the ACTION CODE field set to REQUEST CHANGE and the CURRENT ACKNOWLEDGEMENT IU TIME-OUT field set to the desired time-out value in a simple link exchange (see 4.10.2.3).

If a port receives a Time-out IU with the ACTION CODE field set to REPORT in a nonexistent exchange, it shall transmit a NAK IU with a status code of INVALID EXCHANGE ID (see table 14) and discard the Time-out IU.

If a port receives a Time-out IU with an exchange ID that differs from an existing time-out discovery exchange, the other port forming the link has started a new time-out discovery exchange or a new simple link exchange. The port shall abort the existing time-out discovery exchange and process the new exchange as specified in 4.10.2.2 and 4.10.2.3.

    Note: Exception conditions may arise that this clause does not describe.

6.5.1 Link service frames overview

Table 12 – Link service information units

Frame Type	Automation device support	Data transfer device support	Description
0h	Mandatory	Mandatory	ACK (acknowledge)
1h	Mandatory	Mandatory	NAK (negative acknowledge)
2h	Mandatory	Mandatory	Port login
3h	Mandatory	Mandatory	Port logout
4h	Prohibited	Mandatory	Pause
5h	Mandatory	Mandatory	NOP (no operation)
6h	Mandatory	Mandatory	Initiate recovery
7h	Mandatory	Mandatory	Initiate recovery ACK (acknowledgement)
8h	Mandatory	Mandatory	Initiate recovery NAK (negative acknowledgement)
9h	Prohibited	Mandatory	Device Reset IU
Ah	Mandatory	Mandatory	Time-out
~~A~~Bh - Fh	-	-	Reserved

6.5.X Time-out information unit

The Time-out IU provides a mechanism for the ports forming a link to negotiate changes to one another's acknowledgement IU time-out period (see 4.10.2). Table Y defines the payload of the Time-out IU.

Table Y – Time-out IU payload contents

Bit / Byte	7	6	5	4	3	2	1	0
0	ACTION CODE			Reserved			Vendor Specific	
1	Reserved							
2	Reserved							
3	Reserved							
4	(MSB)			CURRENT ACKNOWLEDGEMENT IU TIME-OUT				
5								(LSB)
6	(MSB)			MAXIMUM ACKNOWLEDGEMENT IU TIME-OUT				
7								(LSB)
8	(MSB)			MINIMUM ACKNOWLEDGEMENT IU TIME-OUT				
9								(LSB)
10	(MSB)			TIME-OUT RESOLUTION				
11								(LSB)

The ACTION CODE field specifies the meaning of the CURRENT ACKNOWLEDGEMENT IU TIME-OUT, MAXIMUM ACKNOWLEDGEMENT IU TIME-OUT, MINIMUM ACKNOWLEDGEMENT IU TIME-OUT, and TIME-OUT RESOLUTION fields. Table Y+1 defines the CURRENT ACKNOWLEDGEMENT IU TIME-OUT, MAXIMUM ACKNOWLEDGEMENT IU TIME-OUT, MINIMUM ACKNOWLEDGEMENT IU TIME-OUT, and TIME-OUT RESOLUTION fields for the various ACTION CODE field values.

Table Y+1 – Time-out IU Action Codes

Code	Code Name	Received IU field	Description
00b	REPORT	CURRENT ACKNOWLEDGEMENT IU TIME-OUT	Acknowledgement IU time-out period, in milliseconds, currently in effect in the sending port.
		MAXIMUM ACKNOWLEDGEMENT IU TIME-OUT	Maximum acknowledgement IU time-out period, in milliseconds, supported by the sending port.
		MINIMUM ACKNOWLEDGEMENT IU TIME-OUT	Minimum acknowledgement IU time-out period, in milliseconds, supported by the sending port.
		TIME-OUT RESOLUTION	Minimum difference between acknowledgement IU time-out periods, in milliseconds, supported by the sending port.
01b	DISCOVER	CURRENT ACKNOWLEDGEMENT IU TIME-OUT	Ignored
		MAXIMUM ACKNOWLEDGEMENT IU TIME-OUT	Ignored
		MINIMUM ACKNOWLEDGEMENT IU TIME-OUT	Ignored
		TIME-OUT RESOLUTION	Ignored
10b	REQUEST CHANGE	CURRENT ACKNOWLEDGEMENT IU TIME-OUT	Requested value of the receiving port's acknowledgement IU time-out, in milliseconds.
		MAXIMUM ACKNOWLEDGEMENT IU TIME-OUT	Ignored
		MINIMUM ACKNOWLEDGEMENT IU TIME-OUT	Ignored
		TIME-OUT RESOLUTION	Ignored
11b		–	Reserved

A port that processes a time-out IU with the ACTION CODE field set to REQUEST CHANGE and a supported value in the CURRENT ACKNOWLEDGEMENT IU TIME-OUT field shall set its acknowledgement IU time-out to the value contained in the CURRENT ACKNOWLEDGEMENT IU TIME-OUT field. A port that processes a time-out IU with the ACTION CODE field set to REQUEST CHANGE and an unsupported value in the CURRENT ACKNOWLEDGEMENT IU TIME-OUT field shall either:

a) Set its acknowledgement IU time-out period to the closest supported value greater than the value contained in the CURRENT ACKNOWLEDGEMENT IU TIME-OUT field and send an ACK IU; or

b) Not alter the acknowledgement IU time-out period and send a NAK IU with a status code of INVALID OR ILLEGAL IU RECEIVED (see table 14).

A port that processes a time-out IU with the ACTION CODE field set to a value other than REQUEST CHANGE shall not alter its acknowledgement IU time-out period.

A port that receives a Time-out IU with the ACTION CODE field set to 11b shall send a NAK IU with a status code of INVALID OR ILLEGAL IU RECEIVED (see table 14).

6.5.12.1 Link service exchange types

Link service exchanges may be negotiation exchanges, port logout exchanges, pause exchanges, NOP exchanges, or device reset exchanges, or time-out discovery exchanges.

6.5.12.2 Simple link service exchange lifetime

Port logout IUs, Pause IUs, NOP IUs, and Device Reset IUs, and Time-out IUs with the ACTION CODE field set to REQUEST CHANGE are sent in simple exchanges. A simple exchange begins in the sending port with the transmission of the IU and ends with the reception of the corresponding ACK IU or NAK IU with the PR bit set to zero. A simple exchange begins in the receiving port with the reception of a valid IU and ends with the transmission of the ACK IU or NAK IU with the PR bit set to zero.

6.5.12.4 Time-out discovery exchange lifetime

In a port initiating a time-out discovery exchange, the exchange begins when the port transmits a Time-out IU with the ACTION CODE field set to DISCOVER in a nonexistent exchange. In a port not initiating a time-out discovery exchange, the exchange begins

when the port receives a Time-out IU with the ACTION CODE field set to DISCOVER in a nonexistent exchange. A time-out discovery exchange ends in a port when either:

a) the port has sent a Time-out IU with the ACTION CODE field set to REPORT in an existing exchange and received an ACK IU in response to it;

b) the port has received a Time-out IU with the ACTION CODE field set to REPORT in an existing exchange and sent an ACK IU in response to it;

c) the port has sent a Time-out IU and received a NAK IU in response to it;

d) the port has received a Time-out IU and sent a NAK IU in response to it; or

e) the port has received a Time-out IU with a different exchange ID, indicating that a new time-out exchange has started.