IEEE P802.15

**Wireless Personal Area Networks**

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| Project | IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs) |
| Title | 802.15.9 Fragmentation Replacement Text |
| Date Submitted | 10 December 2014 |
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| Re: | [802.15.9 Draft 1.0] |
| Abstract | [This document describes improvements to 802.15.9 draft 1.0.] |
| Purpose | [To improve Key Management Protocol 802.15.9] |
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Replaces Clauses 5 & 7 in Draft-D1.0 802.15.9 (X=5, Y=7)

Note that the following uses the standard MCPS-DATA Service which should not require any modification. The MCPS-Purge Service should have a note added that a fragmented Data Transfer does not remove an MSDU from its transfer queue until the frame carrying the last fragment is transmitted.

## X.x Data Transfer Control Services

Data Transfer Control services provide support for linking a Protocol Identifier to the MSDU transferred either as a single payload or as a sequence of fragments. Two Information Elements are defined to allow signaling of the Protocol ID associated with the MSDU and to negotiate a Fragment Sequence. An initial handshake shall be used to ensure the destination device is available to receive a fragmented MSDU. A similar handshake may be used before sending an MSDU in a single frame.

### X.x.1 MSDU Protocol ID

For any MSDU transfer a Data Transfer Control IE (DTC IE) may be included in the frame to declare a protocol identifier associated with the MSDU. The protocol ID is the {insert reference to Protocol ID standard database} value for the source and destination protocol handler for the content of the MSDU.

For an MSDU transferred in a single frame the DTC IE shall be carried in the frame containing the MSDU. An optional RTS/CTS handshake may be requested in a frame preceding the frame carrying the MSDU.

For an MSDU transferred as a fragment sequence, the protocol ID declared in the DTC IE is associated with the Fragment Transaction ID carried in the Fragment Data IEs in the subsequent fragment sequence.

## X.x.2 Fragmentation

The Fragmentation Service is invoked by the MAC to deliver an MSDU exceeding the macFragmentThreshold octet count value. Since this value, by definition, indicates a long frame, the Fragmentation Service applies an RTS/CTS handshake to ensure the destination device is available and able to receive the MSDU transfer.

An initial Request-to-Send (RTS) transmission carries a DTC IE describing the intended MSDU size and the number of fragments into which it is divided, together with the Protocol ID of the intended recipient protocol entity within the destination device and a Fragment Transaction ID.

If the recipient of the frame carrying the RTS is available and able to receive the MSDU a Clear-to-Send (CTS) transmission carrying a DTC IE is transmitted to the RTS source.

Each device shall maintain a monotonically increasing counter which is incremented after each value is assigned to a Fragment Transaction ID. All fragments in the same fragment sequence shall carry the same Fragment Transaction ID. The combination of {Device Source Address, Fragment Transaction ID and Fragment Number} uniquely identifies any fragment in any fragment sequence.

If a device is unable to accept the fragment sequence offered in a received fragment RTS, it may respond with a CTS with:

* a value of zero in the Total MSDU Size to indicate inability to receive the fragment sequence
* different Total MSDU Size field value indicating total octet count it is able to accept.

If the values of these fields in a received CTS differ from the corresponding RTS field values, the source of the RTS should abandon the fragment transaction and may attempt a new transaction which would satisfy the indicated limits.

The transmission of fragments shall not commence until a CTS has been received with Fragment Transaction ID, Fragment Number and Total MSDU Size fields matching a corresponding RTS.

Each fragment in the fragment transaction shall be sent in a FragmentData IE with immediate acknowledgement requested in the frame control field of the frame carrying the FragmentData IE. Frames for which the requested acknowledgement is not received shall be retransmitted using standard frame re-transmission services.

Acknowledgement of the preceding fragment in a fragment sequence shall be received before the next fragment in the fragment sequence is transmitted.

If the requested acknowledgement for the frame carrying a fragment if not received after macFragmentRetryCount attempts the fragment transaction is abandoned and the corresponding MCPS-DATA.confirm shall indicate failure in the same manner as for a failed un-fragmented transfer request.

If the next fragment in a fragment sequence is not received macFragmentTimeOut after the last received fragment, the recipient of the fragment sequence may abandon the reassembly operation and discard any received fragment data.

## Y.y Information Elements (IEs)

### Y.y.1. Data Transfer Control IE (DTC IE)

The DTC IE shall be formatted as a Header IE as defined in { see 802.15.4e-2012 5.2.4.2} with Element ID set to DTC {*request an assigned Header IE ID from 802.15 ANA*} and Length field set to the appropriate value for the format shown in Figure 1.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Bit:0 | 1 | 2 | 3-7 | Octets:2 | 2 | Octets:1 | 2 |
| Transfer Type{0 = MSDU1 = Fragment Transaction} | RTS/CTS Control | RTS/CTS0 = RTS1 = CTS | Reserved | Protocol ID | Fragment Transaction ID | Number of Fragments | Total MSDU Size (Octets) |

Figure 1: Data Transfer Control IE

The Transfer Type field shall be set to 0 to indicate the MSDU transfer takes place in a single frame or shall be set 1 to indicate the MSDU transfer takes place in a fragment sequence.

If the Transfer Type field value indicates an MSDU in a single frame:

* The RTS/CTS Control field shall be set to 0 to indicate that no RTS/CTS handshake is required and the MSDU is carried in the frame payload of the current frame. The RTS/CTS field is not used and should be set to 0.
* The RTS/CTS Control field shall be set to 1 to indicate that an RTS/CTS handshake is required before the MSDU can be sent:
	+ The RTS/CTS field shall be set to 0 to indicate the current frame is an RTS handshake
	+ The RTS/CTS field shall be set to 1 to indicate the current frame is a CTS handshake.
* The Protocol ID field shall be set to the value of the {insert reference to Protocol ID Authority} identifier for the source/destination MAC Client protocol handler for the MSDU.
* The Fragment Transaction ID, Number of Fragments and Total MSDU Size fields are not present in the DTC IE.

If the Transfer Type field value indicates an MSDU transaction in a sequence of fragments:

* The RTS/CTS Control field shall be set to 1.
* The RTS/CTS field shall be set to 0 to indicate the current frame is an RTS handshake or shall be set to 1 to indicate the current frame is a CTS handshake.
* The Protocol ID field shall be set to the value of the {insert reference to Protocol ID Authority} identifier for the source/destination MAC Client protocol handler for the MSDU.
* If the RTS/CTS field value indicates an RTS:
	+ The Fragment Transaction ID field shall be set to the next value of a monotonically increasing counter maintained by the device
	+ The Number of Fragments field shall be set to the total number of fragments in the fragment sequence.
	+ The Total MSDU Size field shall be set to the number of octets in the un-fragmented MSDU.
* If the RTS/CTS field value indicates a CTS:
	+ The Fragment Transaction ID field shall be set to the value of the corresponding RTS Fragment Transaction ID field
	+ The Number of Fragments field shall be set to the value of the corresponding RTS Number of Fragments field
	+ The Total MSDU Size field shall be set to:
		- 0 to indicate the device is not available to receive data
		- the corresponding RTS Total MSDU Size field value to indicate the device is available to receive the fragment sequence
		- a value less than the corresponding RTS Total MSDU Size field value to indicate the device is available to receive a data transfer but has insufficient resources for the MSDU offered and the source device should attempt a new data transfer within the field value..

### Y.y.2 Fragment Data IE

The Fragment Data IE shall be formatted as a Payload IE as defined in { 802.15.4e-2012 5.2.4.3} with Element ID set to FragmentData {*request an assigned Payload IE ID from 802.15 ANA*} and Length field set to the appropriate value for the format shown in Figure 2.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Bit:0 | 1 | 2-7 | Octets: 1 | 2 | Octets:1-n |
| More | Re-Try | Reserved | Fragment Number | Fragment Transaction ID | Fragment Data |

Figure 2: Fragment Data IE

The More field shall be set to 0 if this Fragment Data IE carries the last fragment in the fragment sequence identified by the value of the Fragment Transaction ID field, otherwise, the More field shall be set to 1.

The Re-Try field shall be set to 1 to indicate the frame carrying the current Fragment Data IE has been re-transmitted, otherwise the Re-Try field shall be set to 0.

The Fragment Number field shall be set to the index of the fragment carried in the Fragment Data field in the sequence of fragments identified by the value of the Fragment Transaction ID field. The first fragment in the sequence shall have index value of 0.

The Fragment Data field shall be set to the set of octets constituting the fragment identified by the Fragment Number and Fragment Transaction ID field values.

## Z.z MAC PIB Attributes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute | Type | Range | Default Value | Description |
| macFragmentThreshold | Integer | - | 1023 | Largest un-fragmented MSDU size |
| macFragmentReTryCount | Integer | - | 2 | Maximum number of re-transmission attempts for a fragment |
| macFragmentTimeOut | Integer | - | 10 seconds | Maximum time between received fragments in a fragment sequence, as referenced to the end of the frame carrying the last received fragment |

Figure 2: MAC IB Attributes