IEEE P802.15
Wireless Specialty Networks

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| IEEE 802.15.13 Text proposal for MAC general frame structure |
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Abstract

# This document contains a text proposal for MAC general frame structure.

1. **Overview**
2. **Normative references**
3. **Definitions, acronyms, and abbreviations**
4. **General description**
5. **MAC protocol specification**
	1. **MAC functional description**
	2. **General MAC frame format**

The MAC frame format is composed of a MHR, a MSDU, and a MFR. The fields of the MHR appear in a fixed order; however, the addressing fields may not be included in all frames. The general MAC frame shall be formatted as illustrated in Figure xx.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
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|  |  |  |  |  |  |  |
|  |  |  |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Octet: 2** | **0/2** | **6** | **0/6** | **0/6** | **0/2** | **0/6** | **0/5/6/10****/14** | **variable** | **4** |
| Frame control | ACK information  | Receiver Address | Transmitter Address | Auxiliary Address 1 | Sequence control | Auxiliary Address 2 | Auxiliary security header | Frame payload | FCS |
| MHR | MSDU | MFR |

* + 1. **Frame control field**

The frame control field is 2 octets in length and contains information defining the frame type, addressing
fields, and other control flags. The frame control field shall be formatted as illustrated in Figure xx. Reserved bits are set to zero on transmission and ignored on reception.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Bits: 0-1**  | **2-7** | **8** | **9** | **10** | **11** | **12** | **13** | **14 -15** |
| Frame version | Frame type / subtype | To backhaul | From backhaul  | Security enabled | ACK request | ACK info | Last fragment | Reserved |

* + - 1. **Frame Version subfield**

Text proposal (bit number; meaning of each bit/state)

The Frame Version subfield specifies the version number corresponding to the frame. This subfield shall be set to ‘00’ to indicate a frame compatible with IEEE P802.15.13. All other subfield values shall be reserved for future use.

* + - 1. **Frame type / subtype subfield**

Text proposal (bit number, meaning of each bit/state)

The Type field is 2 bits in length, and the Subtype field is 4 bits in length. The Type and Subtype fields together identify the function of the frame. There are three frame types in the current MAC layer protocol description: data, control and management. Each of the frame types has a number of defined subtypes. Table xx defines the valid combinations of type and subtype. (The numeric values in Table xx are shown in binary.)

|  |  |  |  |
| --- | --- | --- | --- |
| **Type value b3 b2** | **Type description** | **Subtype value b7 b6 b5 b4** | **Subtype description** |
| 00 | Management | 0000 | Association request |
| 00 | Management | 0001 | Association response |
| 00 | Management | 0010 | Reassociation request |
| 00 | Management | 0011 | Reassociation response |
| 00 | Management | 0100 | Probe request |
| 00 | Management | 0101 | Probe response |
| 00 | Management | 0110-0111 | Reserved |
| 00 | Management | 1000 | Beacon |
| 00 | Management | 1001 | Disassociation notification |
| 00 | Management | 1010 | Authentication |
| 00 | Management | 1011 | Deauthentication |
|  | Management |  | Clock rate change notification |
|  | Management |  | Beacon request |
|  | Management |  | Additional beacon request |
|  | Management |  | Coordinator alignment |
|  | Management |  | Data request |
|  | Management |  | GTS request |
|  | Management |  | GTS response |
|  | Management |  | Neighboring OWPAN report request |
|  | Management |  | Neighboring OWPAN report indication |
|  | Management |  | OWPAN ID conflict notification |
|  | Management |  | Scan-over-backhaul request |
|  | Management |  | Scan-over-backhaul confirmation |
| 00 | Management | 1100-1111 | Reserved |
| 01 | Control | 0000 | Waveform Control |
| 01 | Control | 0001 | Advanced Modulation Control |
| 01 | Control | 0010 | CSI Control |
| 01 | Control | 0011 | High reliability control |
| 01 | Control | 0100 | Acknowledgement |
|  | Control |  | RTS |
|  | Control |  | CTS |
| 01 | Control | 0100-1111 | Reserved |
| 10 | Data | 0000 | Data |
| 10 | Data | 0001 | Null (no data) |
| 10 | Data | 0010-1111 | Reserved |
| 11 | Reserved | 0000-1111 | Reserved |

* + - 1. **To ~~DS~~backhaul and From backhaul subfields**

The two subfields are needed to indicate if the transmission of frame involves coordinated topology. The settings for the combinations of the two sub-fields for data frames are given in Table 1.

Table 1 To/From backhaul combinations in Data frames

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **To backhaul and From backhaul values** | **Meaning** | **Receiver address** | **Transmitter address** | **Auxiliary address 1** | **Auxiliary address 2** |
| To backhaul = 0From backhaul = 0 | A Data frame from one device to another device within the same OWPAN.  | RA=DA | TA=SA | OWPAN ID | - |
| To backhaul = 1From backhaul = 0 | A Data frame destined for the backhaul.  | OWPAN ID | TA=SA | DA | - |
| To backhaul = 0From backhaul = 1 | A Data frame exiting the backhaul. | RA=DA | OWPAN ID | SA | - |
| To backhaul = 1From backhaul = 1 | Reserved  | - | - | - | - |

For control frames, To backhaul and From backhaul, when present, are both zero.

For management frames, all combinations of the two sub-fields are reserved.

* + - 1. **Security enabled subfield**

The Security Enabled subfield is 1 bit in length, and it shall be set to one if the frame is protected by the MAC sublayer and shall be set to zero otherwise. The Auxiliary Security Header field of the MHR shall be present only if the Security Enabled subfield is set to one.

* + - 1. **ACK request subfield**

Text proposal (bit number, meaning of each bit/state)

The Acknowledgment Request subfield is 1 bit in length and specifies whether an acknowledgment is required from the recipient device on receipt of a data or MAC management/control frame. If this subfield is set to ‘1’, the recipient device shall send an acknowledgment frame. If this subfield is set to ‘0’, the recipient device shall not send an acknowledgment frame.

* + - 1. **ACK info subfield**

The ACK info subfield is 1 bit in length, and it shall be set to one if the frame has ACK information field following Frame Control field, and shall be set to zero otherwise.

* + - 1. **Last fragment subfield**

The last fragmetn subfield is 1 bit in length, and it shall be set to ‘1’ if the frame is the last fragment; otherwise ‘0’.

* + 1. **ACK information field**

|  |  |  |
| --- | --- | --- |
| **Bits: 0-4** | **5-13** | **14-15** |
| Device address (to be confirmed) | Sequence number | ACK |

In all existing frame types and subtypes (except the Beacon frame), the ACK Info field contains the information necessary to identify the MSDU sequence number and the station which transmitted the acknowledged information. The information in this field has the format depicted in Figure xx.

* + - 1. **Device address subfield**

Text proposal (bit number, meaning of each bit/state)

Bits 0 to 4 contain the short address of the device which transmitted the packet. The device with such address is to be acknowledged by this ACK information field. In the uplink transmission, these bits identify the device transmitting the current packet as the acknowledgment can be only for packets transmitted by the coordinator.

* + - 1. **Sequence number subfield**

Text proposal (bit number, meaning of each bit/state)

Bits 5 to 13 identify the sequence number of the packet which is being acknowledged.

* + - 1. **ACK subfield**

Text proposal (bit number, meaning of each bit/state)Bit 14 is set to '1' when a packet is being acknowledged with the current frame, and set to '0' otherwise. Bit 15 ­is set to '1' when the last Beacon frame reception is being acknowledged, and set to '0' otherwise.

* + 1. **Addressing**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Octets:**  | **6** |  | **0/6** | **0/6** | **0/6** |
| Destination OWPAN ID (optional) | Receiver address | Source OWPAN ID (optional) | Transmitter address | Auxiliary address 1 | Auxiliary address 2 |

* + - 1. **Destination OWPAN ID subfield**

Text proposal (bit number, meaning of each bit/state)

* + - 1. **Receiver address subfield**

The Receiver Address field is a 48-bit field. It contains an IEEE MAC individual or group address that identifies the intended immediate recipient device(s) for the information contained in the frame body field.

* + - 1. **Source OWPAN ID subfield**

Text proposal (bit number, meaning of each bit/state)

* + - 1. **Transmitter address subfield**

The Transmitter Address field is a 48-bit field. It contains an IEEE MAC address that identifies the device that has transmitted the MPDU contained in the frame body field.

* + - 1. **Auxiliary address 1 subfield**

Text proposal (bit number, meaning of each bit/state)

The auxiliary address 1 subfield is to offer extra information that is needed for data frame transmission. It could be OWPAN ID, source address or destination address, which is defined by 5.2.1.3.

The Destination address subfield is a 48-bit field. It contains an IEEE MAC individual or group address that identifies the MAC entity or entities intended as the final recipient(s) of the MSDU (or fragment thereof) or A-MSDU, contained in the frame body field.

The Source address subfield is a 48-bit field. It contains an IEEE MAC individual address that identifies the MAC entity from which the transfer of the MSDU (or fragment thereof) or A-MSDU, contained in the frame body field was initiated.

* + - 1. **Auxiliary address 2 subfield**

The auxiliary address 2 subfield is to offer extra information that is needed for data frame transmission. It could be source address, which is defined by 5.2.1.3.

* + 1. **Sequence control field**

Text proposal (bit number, meaning of each bit/state)

In data frames, the Sequence Control field contains the information necessary to identify the MSDU sequence number. The information in this field has the format depicted in Figure xx. Bits 4 to 15 identify the packet sequence number, while bits 0 to 3 are for packet fragmentation support.



* + 1. **Auxiliary Security Header field**

The Auxiliary Security Header field has a variable length and specifies information required for security processing, including how the frame is actually protected (security level) and which keying material from the MAC security PIB is used (see TBD). This field shall be present only if the Security Enabled subfield is set to one. For details on formatting, see TBD.

* + 1. **Frame Payload field**

Text proposal

The Frame Payload is a variable length field that contains information specific to individual frame types and subtypes as defined in subclause 5.2.1.2. The minimum frame body is 0 octet. The maximum length of the frame body is constrained or affected by the following:

* The maximum MSDU, A-MSDU, and MPDU sizes supported by the recipient(s) for the PPDU format in use, as specified in Table 1
* The fields present in the MAC header
* The presence of security encapsulation

Table 2 Maximum data unit sizes (in octets)

|  |  |  |  |
| --- | --- | --- | --- |
|  | PM-PHY PPDU | LB-PHY PPDU | HB-PHY PPDU |
| MSDU size |  | 2304 |  |
| A-MSDU size |  | PSDU size |  |
| MPDU size |  | No direct constraint on the maximum MPDU size; indirectly constrained by the maximum A-MSDU size and MSDU size. |  |
| PSDU size |  | = 2047 |  |

* + 1. **FCS field**

Text proposal

The FCS field is a 32-bit field containing a 32-bit CRC. The FCS is calculated over all the fields of the MAC header and the Frame Body field. These are referred to as the calculation fields.

The FCS is calculated using the following standard generator polynomial of degree 32:

The FCS is the ones complement of the sum (modulo 2) of the following:

1. The remainder of ) divided (modulo 2) by , where is the number

of bits in the calculation fields, and

1. The remainder after multiplication of the contents (treated as a polynomial) of the calculation fields by and then divided by .

The FCS field is transmitted commencing with the coefficient of the highest-order term.

As a typical implementation, at the transmitter, the initial remainder of the division is pre-set to all ones and is then modified by division of the calculation fields by the generator polynomial . The ones complement of this remainder is transmitted, with the highest-order bit first, as the FCS field. At the receiver, the initial remainder is pre-set to all ones and the serial incoming bits of the calculation fields and FCS, when divided by , results in the absence of transmission errors, in a unique nonzero remainder value. The unique remainder value is the polynomial: