**IEEE P802.15**

**Wireless Personal Area Networks**

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| Project | IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs) |
| Title | **Discussion of General MAC frame format of 802.15.4 from PAC point of view** |
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| Re: | P802.15.8/D0.8, Sub-clause 5.2.1 |
| Abstract | General MAC frame format of IEEE 802.15.4. |
| Purpose | Discussion |
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**Goal:**

To take the ‘General MAC frame format’ of IEEE 802.15.4 as a reference for IEEE 802.15.8 PAC.

**802.15.4 Text**

*---- Begin Text from 5.2.1 General MAC frame format, P802.15.4-2011 ----*

**5.2 MAC frame format**

This subclause specifies the format of the MAC frame (MPDU).

The frames in the MAC sublayer are described as a sequence of fields in a specific order. All frame formats in this subclause are depicted in the order in which they are transmitted by the PHY, from left to right, where the leftmost bit is transmitted first in time. Bits within each field are numbered from 0 (leftmost and least significant) to *k* – 1 (rightmost and most significant), where the length of the field is *k* bits. Fields that are longer than a single octet are sent to the PHY in the order from the octet containing the lowest numbered bits to the octet containing the highest numbered bits.

Unless otherwise specified in this Clause, all reserved bits shall be set to zero upon transmission and may be ignored upon receipt.

A device’s extended address shall be a 64-bit universal address, as defined by the IEEE Registration Authority.

*Note: Can adopt most text, except for the highlighted sentence.*

**5.2.1 General MAC frame format**

The general MAC frame shall be formatted as illustrated in Figure 35.



Figure 35—General frame format

The fields of the MHR appear in a fixed order; however, the addressing fields may not be included in all frames.

*Note: Probably, not all fields are relevant to PAC.*

**5.2.1.1 Frame Control field**

The Frame Control field contains information defining the frame type, addressing fields, and other control flags. The Frame Control field shall be formatted as illustrated in Figure 36.



Figure 36—Format of the Frame Control field

Note: Probably PAC needs this field. The internal format might be different.

**5.2.1.1.1 Frame Type field**

The Frame Type field shall be set as defined in Table 2.



*Note: Need this.*

**5.2.1.1.2 Security Enabled field**

The Security Enabled field 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 field is set to one.

*Discussion:*

**5.2.1.1.3 Frame Pending field**

The Frame Pending field shall be set to one if the device sending the frame has more data for the recipient, as described in 5.1.6.3. This field shall be set to zero otherwise.

The Frame Pending field shall be used only in beacon frames or frames transmitted either during the CAP by devices operating on a beacon-enabled PAN or at any time by devices operating on a nonbeacon-enabled PAN.

At all other times, it shall be set to zero on transmission and ignored on reception.

*Discussion: PAC has no beacon. Probably PAC needs this field (CAP). What about CFP? Probably yes.*

**5.2.1.1.4 Acknowledgment Request (AR) field**

The AR field specifies whether an acknowledgment is required from the recipient device on receipt of a data or MAC command frame. If this field is set to one, the recipient device shall send an acknowledgment frame only if, upon reception, the frame passes the filtering described in 5.1.6.2. If this field is set to zero, the recipient device shall not send an acknowledgment frame.

*Discussion: Possibly can handle this implicitly (by message type). Doesn’t hurt to have this field.*

**5.2.1.1.5 PAN ID Compression field**

The PAN ID Compression field specifies whether the MAC frame is to be sent containing only one of the PAN identifier fields when both source and destination addresses are present. If this field is set to one and both the source and destination addresses are present, the frame shall contain only the Destination PAN Identifier field, and the Source PAN Identifier field shall be assumed equal to that of the destination. If this field is set to zero, then the PAN Identifier field shall be present if and only if the corresponding address is present.

*Discussion: Addressing scheme needs to be fixed first.*

**5.2.1.1.6 Destination Addressing Mode field**

The Destination Addressing Mode field shall be set to one of the values listed in Table 3. If this field is equal to zero and the Frame Type field does not specify that this frame is an acknowledgment or beacon frame, the Source Addressing Mode field shall be nonzero, implying that the frame is directed to the PAN coordinator with the PAN identifier as specified in the Source PAN Identifier field.



*Discussion: Probably irrelevant to PAC.*

**5.2.1.1.7 Frame Version field**

The Frame Version field specifies the version number corresponding to the frame.

This field shall be set to 0x00 to indicate a frame compatible with IEEE Std 802.15.4-2003 and 0x01 to indicate an IEEE 802.15.4 frame. All other field values are reserved. Details on frame compatibility are described in 5.2.3.

*Discussion: Probably PAC need this: For example, for future amendment. Or to support low-mobility and high-mobility PHYs if there is a minor differences between them.*

**5.2.1.1.8 Source Addressing Mode field**

The Source Addressing Mode field shall be set to one of the values listed in Table 3.

If this field is equal to zero and the Frame Type field does not specify that this frame is an acknowledgment frame, the Destination Addressing Mode field shall be nonzero, implying that the frame has originated from the PAN coordinator with the PAN identifier as specified in the Destination PAN Identifier field.

*Discussion: Probably irrelevant to PAC.*

**5.2.1.2 Sequence Number field**

The Sequence Number field specifies the sequence identifier for the frame.

For a beacon frame, the Sequence Number field shall specify a BSN. For a data, acknowledgment, or MAC command frame, the Sequence Number field shall specify a DSN that is used to match an acknowledgment frame to the data or MAC command frame.

*BSN: beacon sequence number*

*DSN: data sequence number*

*Discussion:*

**5.2.1.3 Destination PAN Identifier field**

The Destination PAN Identifier field, when present, specifies the unique PAN identifier of the intended recipient of the frame. A value of 0xffff in this field shall represent the broadcast PAN identifier, which shall be accepted as a valid PAN identifier by all devices currently listening to the channel.

This field shall be included in the MAC frame only if the Destination Addressing Mode field is nonzero.

*Discussion: Group ID for PAC?*

*PAC has application ID, too.*

**5.2.1.4 Destination Address field**

The Destination Address field, when present, specifies the address of the intended recipient of the frame. A value of 0xffff in this field shall represent the broadcast short address, which shall be accepted as a valid address by all devices currently listening to the channel.

This field shall be included in the MAC frame only if the Destination Addressing Mode field is nonzero.

*Discussion: Device ID?*

**5.2.1.5 Source PAN Identifier field**

The Source PAN Identifier field, when present, specifies the unique PAN identifier of the originator of the frame. This field shall be included in the MAC frame only if the Source Addressing Mode field is nonzero and the PAN ID Compression field is equal to zero.

The PAN identifier of a device is initially determined during association on a PAN but may change following a PAN identifier conflict resolution, as described in 5.1.2.2.

*Discussion: Source group ID for PAC?*

**5.2.1.6 Source Address field**

The Source Address field, when present, specifies the address of the originator of the frame. This field shall be included in the MAC frame only if the Source Addressing Mode field is nonzero.

*Discussion: Source device ID?*

**5.2.1.7 Auxiliary Security Header field**

The Auxiliary Security Header field specifies information required for security processing. This field shall be present only if the Security Enabled field is set to one. The formatting of the Auxiliary Security Header field is described in 7.4.

*Discussion: Probably PAC needs this?*

**5.2.1.8 Frame Payload field**

The Frame Payload field contains information specific to individual frame types. If the Security Enabled field is set to one, the frame payload the frame may be cryptographically protected, as described in Clause 7.

*Discussion: Need this.*

**5.2.1.9 FCS field**

The FCS field contains a 16-bit ITU-T CRC. The FCS is calculated over the MHR and MAC payload parts of the frame.

The FCS shall be calculated using the following standard generator polynomial of degree 16:

*G*16*x*= *x*16 + *x*12 + *x*5 + 1

The FCS shall be calculated for transmission using the following algorithm:

* Let *M**x**b*0*xk-1 +* *b*1*xk-2*  + … + *bk* – 2*x* + *bk* – 1 be the polynomial representing the sequence of bits for which the checksum is to be computed.
* Multiply *M**x* by *x*16, giving the polynomial *x*16 ×*M**x*.
* Divide *x*16 ×*M**x*modulo 2 by the generator polynomial, G16(x), to obtain the remainder polynomial, *R**x*= *r*0*x*15 + *r*1*x*14 + …+ *r*14*x* + *r*15
* The FCS field is given by the coefficients of the remainder polynomial, R(x).

Here, binary polynomials are represented as bit strings, in highest polynomial degree first order.

As an example, consider an acknowledgment frame with no payload and the following 3 byte MHR:



The FCS for this case would be the following:



A typical implementation is depicted in Figure 37.



*Discussion: High-mobility PHY already has this defined. Low-mobility PHY plans to adopt it from high-mobility PHY after review.*

*---- Begin Text from 5.2.1 General MAC frame format, P802.15.4-2011 ----*