**IEEE P802.15**

**Wireless Personal Area Networks**

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| Project | IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs) |
| Title | **Proposal of Annex A: Interfacing to IEEE 802.11 MAC** |
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| Re: |  |
| Abstract |  |
| Purpose | Aid non-beacon-enabled MAC mode |
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* **Annex A: Interfacing to IEEE 802.11 MAC**
1. **Interfacing concept**

Taking into account the close targets of IEEE 802.11 standards (e.g., IEEE P802.11bb) against IEEE 802.15.13, and the widely accepted ready-to-go features in the IEEE 802.11 stack, it will benefit the IEEE 802.15 compliant equipment if an interface between the two standard families can be established. Benefits include reusing services available in IEEE 802.11 such as association, authentication, handover, and etc. This subclause describes one possible solution.

The left side of Figure 1 shows the lower layers of an IEEE 802.11 device. The right side of Figure 1 shows the two lowest layers of IEEE 802.15.13 devices, the 802.11 lower MAC and the 802.11 PHY are to be replaced by the Non-beacon-enabled channel access (See 5.4) and the LB-PHY (See 10).



Figure 1 Protocol stack interfacing to IEEE 802.11 standard

The IEEE 802.11 MAC frames coming from/going to the upper MAC are passed through unmodified by the lower two layers on the right side in Figure 1 except the frame control field. The transmitter address and the receiver address of the 802.11 frames are used to identify stations and direct the frames to the correct destination. The PSDU of the LB-PHY are 802.11 MAC frames.

Referring to Fig. 15 in 5.4.1(Figure 2), the process remains the same as the default. However, the frame content and format are specified as follows.



Figure 2 Non-beacon-enabled channel access

**Poll frame**: If an IEEE 802.11 MAC Management/Data frame from the higher layer is ready to be transmitted to the station, this frame is transmitted and serves as a Poll frame. If no such frame is ready, an 802.11 NULL frame is transmitted as a poll frame.

**Poll response frame**: If an IEEE 802.11 MAC Management/Data frame from the higher layer is ready to be transmitted to the coordinator, this frame is transmitted and serves as a poll response frame. If no such frame is ready, an 802.11 NULL frame is transmitted as a poll response frame.

**Control frame (RA)**: Instead of the Control frame (RA) proposed in Clause 5, the Control frame (RA) used for the interfacing mode is sent by AP with similar frame body as beacons in IEEE 802.11. On the station side, received Control frames (RA) are forwarded to the higher layer.

**Poll request frame**: This frame is used by the stations to request connection with the coordinator. It has the header of the 802.11 NULL frame, but a four octets payload. The four octets are reserved for future use and set to zero.

1. **Frame formats comparison between IEEE 802.11 and 802.15.13**
	1. IEEE 802.11 MAC Management/Data frame

See 6.3 for Data frame format (Figure 4) or 6.4 for Management frame format (Figure 6).

The information in the Duration field in IEEE 802.11 will be transmitted in the field of Poll ACK in IEEE 802.15.13. The information in the Address 3 field in IEEE 802.11 will be transmitted in the field of Auxiliary Address in IEEE 802.15.13. The optional fields (Address 4, QoS Control and HT Control) are not relevant to the use case.



Figure 3 Data frame format in IEEE 802.11



Figure 4 Data frame format in IEEE P802.15.13



Figure 5 Management frame format in IEEE 802.11



Figure 6 Management frame format in IEEE P802.15.13

* 1. IEEE 802.11 NULL frame

See 6.3 for Data frame format (Figure 4).

The information in the Duration field in IEEE 802.11 will be transmitted in the field of ACK information in IEEE 802.15.13. The information in the Address 3 field in IEEE 802.11 will be transmitted in the field of Auxiliary Address in IEEE 802.15.13.

* 1. IEEE 802.11 beacon frame

See 6.4 for Management frame format (Figure 6) for the header format. The information in the Duration field in IEEE 802.11 will be transmitted in the field of ACK information in IEEE 802.15.13. The information in the Address 3 field in IEEE 802.11 will be transmitted in the field of Auxiliary Address in IEEE 802.15.13.

See 9.3.3.3 in IEEE 802.11-2016 for the beacon body format.

* 1. Poll request frame

See 6.3 for Data frame format (Figure 4).

The information in the Duration field in IEEE 802.11 will be transmitted in the field of ACK information in IEEE 802.15.13. The information in the Address 3 field in IEEE 802.11 will be transmitted in the field of Auxiliary Address in IEEE 802.15.13.

The payload of the Poll request frames for this mode consists of a four octets payload. The four octets are set to 0 by default and reserved for future use.

* 1. Frame control field in all above-mentioned frames

See 6.2.2 for Frame Control field format (Figure 8).



Figure 7 Frame Control field format in IEEE 802.11



Figure 8 Frame Control field format in IEEE P802.15.13

The mapping of the subfields of IEEE 802.11 and IEEE 802.15.13 are listed as follows:

Table 1 Mapping subfileds in Frame control filed

|  |  |
| --- | --- |
| **Subfield in IEEE 802.11** | **Subfield in IEEE 802.15.13** |
| **Protocol version** | **Frame version** |
| **To DS** | **To Backhaul** |
| **From DS** | **From Backhaul** |
| **More Fragments** | **Reserved** |
| **Retry** | **ACK Request** |
| **Power Management** | **Non-beacon-enabled** |
| **More Data** | **Short Addressing** |
| **Protected Frame** | **Last Fragment** |
| **+HTC/Order** | **Reserved** |

1. **Subtypes for the IEEE 802.11 frames**

Use type 3 (the reserved 16 subtypes) for 14 Management frames and 2 Data frames in IEEE 802.11. The subtypes for Type 3 frames are listed in Table 2. When a device receives such type 3 frames, it uses a local entry table to map them to either type 0 or type 2 frames in order to decode and use them as usual in IEEE 802.11. The example local entry table is given in Table 3.

Table 2 Type 3 and subtype combinations

|  |  |  |  |
| --- | --- | --- | --- |
| **Type** | **Type****description** | **Subtype** | **Subtype****description** |
| 11 | Management | 0000 | Association Request |
| 11 | Management | 0001 | Association Response |
| 11 | Management | 0010 | Reassociation Request |
| 11 | Management | 0011 | Reassociation Response |
| 11 | Management | 0100 | Probe Request |
| 11 | Management | 0101 | Probe Response |
| 11 | Management | 0110 | Timing Advertisement |
| 11 | Management | 0111 | Beacon |
| 11 | Management | 1000 | ATIM |
| 11 | Management | 1001 | Disassociation |
| 11 | Management | 1010 | Authentication |
| 11 | Management | 1011 | Deauthentication |
| 11 | Management | 1100 | Action |
| 11 | Management | 1101 | Action No Ack |
| 11 | Data | 1110 | Data |
| 11 | Data | 1111 | Null |

Table 3 Local entry table for the mapping between IEEE 802.11 and 802.15.13

|  |  |
| --- | --- |
| **IEEE 802.11** | **IEEE 802.15** |
| **Type** | **Subtype** | **Frame name** | **Type** | **Subtype** | **Frame name** |
| 00 | 0000 | Association Request | 11 | 0000 | Association Request |
| 00 | 0001 | Association Response | 11 | 0001 | Association Response |
| 00 | 0010 | Reassociation Request | 11 | 0010 | Reassociation Request |
| 00 | 0011 | Reassociation Response | 11 | 0011 | Reassociation Response |
| 00 | 0100 | Probe Request | 11 | 0100 | Probe Request |
| 00 | 0101 | Probe Response | 11 | 0101 | Probe Response |
| 00 | 0110 | Timing Advertisement | 11 | 0110 | Timing Advertisement |
| 00 | 0111 | Reserved | Not mapped | Not mapped | Not mapped |
| 00 | 1000 | Beacon | 11 | 0111 | Beacon |
| 00 | 1001 | ATIM | 11 | 1000 | ATIM |
| 00 | 1010 | Disassociation | 11 | 1001 | Disassociation |
| 00 | 1011 | Authentication | 11 | 1010 | Authentication |
| 00 | 1100 | Deauthentication | 11 | 1011 | Deauthentication |
| 00 | 1101 | Action | 11 | 1100 | Action |
| 00 | 1110 | Action No Ack | 11 | 1101 | Action No Ack |
| 00 | 1111 | Reserved | Not mapped | Not mapped | Not mapped |
| 01 | 0000 | Reserved | Not mapped | Not mapped | Not mapped |
| 01 | 0001 | Reserved | Not mapped | Not mapped | Not mapped |
| 01 | 0010 | Reserved | Not mapped | Not mapped | Not mapped |
| 01 | 0011 | Reserved | Not mapped | Not mapped | Not mapped |
| 01 | 0100 | Beamforming Report Poll | Not mapped | Not mapped | Not mapped |
| 01 | 0101 | VHT NDP Announcement | Not mapped | Not mapped | Not mapped |
| 01 | 0110 | Control Frame Extension | Not mapped | Not mapped | Not mapped |
| 01 | 0111 | Control Wrapper | Not mapped | Not mapped | Not mapped |
| 01 | 1000 | Block Ack Request (BlockAckReq) | Not mapped | Not mapped | Not mapped |
| 01 | 1001 | Block Ack (BlockAck) | Not mapped | Not mapped | Not mapped |
| 01 | 1010 | PS-Poll | Not mapped | Not mapped | Not mapped |
| 01 | 1011 | RTS | Not mapped | Not mapped | Not mapped |
| 01 | 1100 | CTS | Not mapped | Not mapped | Not mapped |
| 01 | 1101 | Ack | Not mapped | Not mapped | Not mapped |
| 01 | 1110 | CF-End | Not mapped | Not mapped | Not mapped |
| 01 | 1111 | CF-End +CF-Ack | Not mapped | Not mapped | Not mapped |
| 10 | 0000 | Data | 11 | 1110 | Data |
| 10 | 0001 | Data +CF-Ack | Not mapped | Not mapped | Not mapped |
| 10 | 0010 | Data +CF-Poll | Not mapped | Not mapped | Not mapped |
| 10 | 0011 | Data +CF-Ack +CF-Poll | Not mapped | Not mapped | Not mapped |
| 10 | 0100 | Null (no data) | 11 | 1111 | Null (no data) |
| 10 | 0101 | CF-Ack (no data) | Not mapped | Not mapped | Not mapped |
| 10 | 0110 | CF-Poll (no data) | Not mapped | Not mapped | Not mapped |
| 10 | 0111 | CF-Ack +CF-Poll (no data) | Not mapped | Not mapped | Not mapped |
| 10 | 1000 | QoS Data | Not mapped | Not mapped | Not mapped |
| 10 | 1001 | QoS Data +CF-Ack | Not mapped | Not mapped | Not mapped |
| 10 | 1010 | QoS Data +CF-Poll | Not mapped | Not mapped | Not mapped |
| 10 | 1011 | QoS Data +CF-Ack +CF-Poll | Not mapped | Not mapped | Not mapped |
| 10 | 1100 | QoS Null (no data) | Not mapped | Not mapped | Not mapped |
| 10 | 1101 | Reserved | Not mapped | Not mapped | Not mapped |
| 10 | 1110 | QoS CF-Poll (no data) | Not mapped | Not mapped | Not mapped |
| 10 | 1111 | QoS CF-Ack +CF-Poll (no data) | Not mapped | Not mapped | Not mapped |
| 11 | 0000 | DMG Beacon | Not mapped | Not mapped | Not mapped |
| 11 | 0001 | S1G Beacon(11ah) | Not mapped | Not mapped | Not mapped |
| 11 | 0010 | Reserved | Not mapped | Not mapped | Not mapped |
| 11 | 0011 | Reserved | Not mapped | Not mapped | Not mapped |
| 11 | 0100 | Reserved | Not mapped | Not mapped | Not mapped |
| 11 | 0101 | Reserved | Not mapped | Not mapped | Not mapped |
| 11 | 0110 | Reserved | Not mapped | Not mapped | Not mapped |
| 11 | 0111 | Reserved | Not mapped | Not mapped | Not mapped |
| 11 | 1000 | Reserved | Not mapped | Not mapped | Not mapped |
| 11 | 1001 | Reserved | Not mapped | Not mapped | Not mapped |
| 11 | 1010 | Reserved | Not mapped | Not mapped | Not mapped |
| 11 | 1011 | Reserved | Not mapped | Not mapped | Not mapped |
| 11 | 1100 | Reserved | Not mapped | Not mapped | Not mapped |
| 11 | 1101 | Reserved | Not mapped | Not mapped | Not mapped |
| 11 | 1110 | Reserved | Not mapped | Not mapped | Not mapped |
| 11 | 1111 | Reserved | Not mapped | Not mapped | Not mapped |