IEEE P802.15

Wireless Personal Area Networks

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| Abstract | [Pertinent Characteristics of all IEEE 802.15.4 Information Elements] |
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# **Header IE Table**

| Header IEs | ID | Size ≤129 | Enh Beacon | Enh Ack | Data | Multipurpose | Command | Formatting subclause(s) | Use Description subclause(s) | Modes used by | RX: Used by | TX: Built by |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Vendor Specific | 0x00 | ≥3 | X | X | X | X | X | 7.4.4.30 | Proprietary | ALL | UL | UL |
| Device Announcement (DA) | 0x2b | ≥7 | X |  |  |  |  | 7.4.1.2 | 6.3.4,6.7.7 | TVWS | UL | MAC |
| Coordinated Sample Listening (CSL) | 0x1a | 6, 8 | X | X | X | X |  | 7.4.1.3 | 6.12.2, 6.12.2.3,6.12.2.4, 6.12.2.5, 6.3.4  | LE | MAC | MAC |
| Receiver Initiated Transmission (RIT) | 0x1b | 6 | X |  | X |  | X | 7.4.1.4 | 6.3.4 | LE | MAC | MAC |
| DSME PAN Descriptor | 0x1c | ≥24 | X |  |  |  |  | 7.4.1.5 | 5.8.1, 5.8.1.1,6.3.4, 6.11.2 | DSME | UL,MAC | UL |
| Rendezvous Time | 0x1d | 6 |  | X |  | X |  | 7.4.1.6 | 6.12.2 | LE | MAC | MAC |
| Time Correction | 0x1e | 4 |  | X |  |  |  | 7.4.1.7 | 6.5.3.1, 6.7.4.2 | TSCH | MAC | MAC |
| Extended DSME PAN Descriptor | 0x21 | ≥26 | X |  |  |  |  | 7.4.1.8 | 6.11.2 | DSME | UL,MAC | UL |
| Fragment Sequence Context Description | 0x22 | >6 |  |  | X | X |  | 7.4.1.9 | 23.3.1 | LECIM | MAC | MAC |
| Simplified Superframe Specification | 0x23 | 8 | X |  |  |  |  | 7.4.1.10 | [B2], 6.2.3 | LECIM | MAC | MAC |
| Simplified GTS Specification | 0x24 | ≥5 | X |  |  |  |  | 7.4.1.11 | [B2], 6.2.3 | LECIM | MAC | MACCheck? |
| LECIM Capabilities | 0x25 | 6, 10 | X |  | X | X | X | 7.4.1.12 | 10.1.2.10 | LECIM | UL | UL |
| TRLE Descriptor | 0x26 | 4 | X | X | X | X | X | F.5.1.1 | 6.3.4, F.4.2, F.4.3 | TRLE | MAC | MACCheck? |
| RCC Capabilities | 0x27 | 8 | X |  | X | X |  | 7.4.1.13 | [B2], 3.9.1 | RCC | UL | UL |
| RCCN Descriptor | 0x28 | ≥13 | X |  |  |  |  | 7.4.1.14 | 6.2.9 | RCC | UL, MAC | UL |
| Global Time | 0x29 | 4 | X |  |  |  |  | 7.4.1.15 | Ben’s head | RCC | UL | UL |
| Header Termination 1 | 0x7e | 2 | X | X | X | X | X | 7.4.2.16 | 7.4.1 | ALL | UL, MAC | UL, MAC |
| Header Termination 2 | 0x7f | 2 | X | X | X | X | X | 7.4.2.17 | 7.4.1 | ALL | UL, MAC | UL, MAC |

# **Group Payload IE Table**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Payload IEs - Group | ID | Size ≤2049 | Enh Beacon | Enh Ack | Data | Multipurpose | Command | Formatting subclause(s) | Use Description subclause(s) | Modes used by | RX: Used by | TX: Built by |
| Encapsulated Service Data Unit (ESDU) | 0x0 | ≥3 | X |  | X | X | X | 7.4.3.1 | Container for UL data | ALL | UL | UL |
| MLME | 0x1 | NestedIEs + 2 | X | X | X | X | X | 7.4.3.2 | Container for Nested IEs | ALL | UL,MAC | UL,MAC |
| Vendor Specific | 0x2 | ≥6 | X |  | X | X | X | 7.4.4.30 | Proprietary | ALL | UL | UL |
| Payload Termination | 0xf | 2 | X | X | X | X | X | 7.4.3.3 | 7.4.1 | ALL | UL,MAC | UL,MAC |

# **Nested Payload IEs - Short**

| Nested IEs – Short | Sub ID | Size ≤ 257 | Enh Beacon | Enh Ack | Data | Multipurpose | Command | Formatting subclause(s) | Use Description subclause(s) | Modes used by | RX: Used by | TX: Built by |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TSCH Synchronization | 0x1a  | 8 | X |  |  |  |  | 7.4.3.2 | 6.3.6, 6.3.4 | TSCH | MAC | MAC |
| TSCH Slotframe and Link | 0x1b  | ≥12 | X |  |  |  |  | 7.4.3.3 | 6.3.6, 6.3.4 | TSCH | UL | UL |
| TSCH Timeslot  | 0x1c  | 3, 28, 30 | X |  |  |  |  | 7.4.3.4 | 6.3.6, 6.5.3, 6.3.4 | TSCH | UL | MAC |
| Hopping timing | 0x1d  | 7 | X |  |  |  |  | 7.4.3.5 | 6.3.4, 6.2.10 | Non-beacon enabled | MAC | MAC |
| Enhanced Beacon Filter | 0x1e  | 3 - 8 |  |  |  |  | X | 7.4.3.6 | 6.3.4 | Non-beacon enabled | MAC | UL |
| MAC Metrics | 0x1f  | 5 | X |  | X | X |  | 7.4.3.7 | 8.4.2.6 | All modes | UL | UL |
| All MAC Metrics | 0x20  | 42 | X |  | X | X |  | 7.4.3.8 | 8.4.2.6 | All modes | UL | UL |
| Coexistence Specification | 0x21  | 7 | X |  |  |  |  | 7.4.3.9 | 6.2.3, 6.3.3.1, 6.3.4, 6.14 | SUN | UL | MAC |
| SUN Device Capabilities | 0x22  | ≥9 |  |  | X | X |  | 7.4.3.10 | [B2],3.9.1 | SUN | ULMAC | UL |
| SUN FSK Generic PHY  | 0x23  | 18 | X |  | X | X | X | 7.4.3.11 | 10.1.2.8,20.2.3,20.3 | SUN | ULMAC | UL |
| Mode Switch Parameter | 0x24  | 5 | X |  | X | X | X | 7.4.3.12 | 20.2.3,20.5 | SUN | MAC | UL |
| PHY Parameter Change | 0x25  | 10 | X |  |  | X |  | 7.4.3.13 | 6.10 | MBAN | MAC | UL |
| O-QPSK PHY Mode | 0x26  | 4 |  |  | X | X |  | 7.4.3.14 | 6.10 | MBAN | MAC | UL |
| PCA Allocation | 0x27  | 5 | X |  |  |  |  | 7.4.3.15 | 6.2.5.4 | PCA | MAC | UL |
| DSSS Operating Mode | 0x28  | 10 |  |  | X | X |  | 7.4.3.16 | 6.10 | LECIM | MAC | UL |
| FSK Operating Mode | 0x29  | 10 |  |  | X | X |  | 7.4.3.17 | 6.10 | LECIM | MAC | UL |
| TVWS PHY Operating Mode Description | 0x2b  | 11 |  |  |  | X |  | 7.4.3.18 | 6.15 | TVWS | MAC | UL |
| TVWS Device Capabilities | 0x2c  | ≥10 | X |  | X | X |  | 7.4.3.19 | 6.15 | TVWS | ULMAC | UL |
| TVWS Device Category | 0x2d  | 3 | X |  |  |  |  | 7.4.3.20 | 6.15 | TVWS | UL | UL |
| TVWS Device Identification | 0x2e  | ≥5 | X |  |  |  |  | 7.4.3.21 | 6.15 | TVWS | UL | UL |
| TVWS Device Location | 0x2f  | ≥20 | X |  |  |  |  | 7.4.3.22 | 6.15 | TVWS | UL | UL |
| TVWS Channel Information Query | 0x30  | ≥4 | X |  |  |  |  | 7.4.3.23 | 6.15 | TVWS | UL | UL |
| TVWS Channel Information Source | 0x31  | 3 -35 | X |  |  |  |  | 7.4.3.24 | 6.15 | TVWS | UL | UL |
| Channel Timing Management (CTM) | 0x32  | ≥18 | X |  |  |  |  | 7.4.3.25 | 6.16 | TVWS | UL | UL |
| Timestamp | 0x33  | 6 | X |  |  |  |  | 7.4.3.26 | 6.9.5 | TVWS | MAC | MAC |
| Timestamp Difference | 0x34  | 6 | X |  |  |  |  | 7.4.3.27 | 6.9.5, 6.7.2.4 | TVWS | MAC | MAC |
| TVWS multichannel cluster tree PAN (TMCTP) Specification | 0x35  | ≥5 | X |  |  |  |  | 7.4.3.28 | 5.8.1.3, 6.13 | TVWS | UL | UL |
| RCC PHY Operating Mode | 0x36  | 6 |  |  | X | X |  | 7.4.3.29 | 6.10 | RCC | MAC | UL |

# **Nested Payload IEs – Long**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Nested IEs - Long | Sub ID | Size <2049 | Enh Beacon | Enh Ack | Data | Multipurpose | Command | Formatting subclause(s) | Use Description subclause(s) | Modes used by | RX: Used by | TX: Built by |
| Vendor Specific | 0x8 | ≥6 | X |  | X | X | X | 7.4.4.30 | Proprietary | All | UL | UL |
| Channel Hopping | 0x9 | 3, ≥18[[1]](#footnote-1) | X |  |  |  |  | 7.4.3.31 | 6.3.6, 6.3.4, 6.2.10 | TSCH, ALL | MAC | MAC |

# **IE Termination Explanation**

The following section explains how to terminate IE lists, when termination is required, and those allowed cases that are not non-best practices.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Name | IE Present | Header IEs  | Payload IEs  | Non-IE MAC Payload  | Header IE Terminations (HT1, HT2)  | Payload IE Termination (PT)  |
| Case 1 | No | No | No | No | None | None |
| Case 2 | Yes | Yes | No | No | None | None |
| Case 3 | Yes | No | Yes | No | HT1 | Optional |
| Case 4 | Yes | Yes | Yes | No | HT1 | Optional |
| Case 5 | No | No | No | Yes | None | None |
| Case 6 | Yes | Yes | No | Yes | HT2 | None |
| Case 7 | Yes | No | Yes | Yes | HT1 | PT |
| Case 8 | Yes | Yes | Yes | Yes | HT1 | PT |

## Case 1: No IEs, no MAC Payload

Possible uses: Legacy Ack, useless data frame, empty MP frame, enhanced beacon of PAN coordinator in ‘non beacon’ PAN (advertises PAN ID).

## Case 2: Header IEs, no payload

Possible uses: Enhanced ACK with status or timing information (non-secured). Data frame with only Header IEs (being used as a pseudo-control frame); Enhanced Beacon.

Notes: As stated in 7.4.1 no termination “is required”; You know you’ve hit the end of the frame by the frame length and CRC type. While slightly ambiguous, which Header IE termination you use in this case is not defined (7.4.1) so the strict interpretation s/b no termination is used or expected in this case. The wise implementation will ignore an extraneous terminator.

## Case 3: Only Payload IEs (other than termination)

Possible uses: Secure Acknowledgement w/information (TSCH); Data frame with encapsulated payload; Multipurpose frame; Enhanced Beacon (TSCH, DSME, RCCN, other); Command frame;

Notes: Header IE Termination 1 is required to signal end of the MHR and beginning of the Payload IE list.

## Case 4: Both Header and Payload IEs

Possible uses: Any frame w/appropriate version.

Notes: Header IE Termination 1 is required; Payload IE termination is not required but is allowed (“may be omitted”).

## Case 5: No IEs, with non-encapsulated MAC Payload

Possible uses: Any frame except Version 0 or 1 Ack (can’t have any payload).

Notes: No IE lists present, no termination; only here for completeness.

## Case 6: Header IE and non-encapsulated MAC Payload

Possible uses: Any frame that can carry IEs.

Notes: Header IE Termination 2 is used in this case to signal end of the MHR and beginning of the MAC Payload.

## Case 7: Payload IEs and non-encapsulated MAC Payload

Possible uses: Any frame that can carry IEs;

Notes: This case may be avoided since when Payload IEs are present all payload (except for security MIC) can be encapsulated in IEs (we defined an IE for this purpose).

## Case 8: Fully Loaded Frame

Possible uses: Any frame that can carry IEs. See note for Case 7.

# **Examples**

## TSCH Beacon



## TSCH Data Frame and Acknowledgment



1. 3/44/46 octets is the length for O-QPSK (default/15/16 channels respectively) in the 2.4 GHz band [↑](#footnote-ref-1)