IEEE P802.15

Wireless Personal Area Networks

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| Abstract | [Pertinent Characteristics of all IEEE 802.15.4 Information Elements with examples] |
| Purpose | [For reference and possible insertion into 802.15.4 Guide] |
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# IE Tables

## Introduction

These tables are intended to guide the user in the use of IEEE 802.15.4 IEs. The tables are grouped by the IE types: Header, Group Payload, Nested Payload-short, and Nested Payload-long.

The descriptions for the column headers in each of the IE tables are:

### ID or sub ID

The identification number assigned by 802.15 ANA to the specific IE

### Frame Types

These fields for each IE shows the relationship between each frame type and the specific IE. Fields marked with an X indicate that the IE may be inserted into that frame. Fields that are not marked with an X indicate that the IE shall not be inserted into that frame.

### Formatting subclause

The cited subclause describes the formatting for the IE.

### Use descriptive subclause(s)

The cited subclause(s) describe how an IE is used by the standard.

### Apps/Modes used by

These are the special application spaces and operating modes that use the IEs

### RX: Used by

This field describes whether the MAC or the upper layer (UL) uses the information contained in the IE upon reception.

### TX: Built by

This field describes whether the MAC or the UL constructs the IE for transmission.

## Header IE Table

| Header IEs | ID | Enh Beacon | Enh Ack | Data | Multipurpose | Command | Formatting subclause(s) | Use Description subclause(s) | Apps/Modes used by | RX: Used by | TX: Built by |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Vendor Specific | 0x00 | X | X | X | X | X | 7.4.4.30 | Not standard | ALL | UL | UL |
| Device Announcement (DA) | 0x2b | X |  |  |  |  | 7.4.2.2 | 6.3.4,6.7.7 | TVWS | UL | UL |
| Coordinated Sample Listening (CSL) | 0x1a | X | X | X | X |  | 7.4.2.3 | 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 | X |  | X |  | X | 7.4.2.4 | 6.3.4 | LE | MAC | MAC |
| DSME PAN Descriptor | 0x1c | X |  |  |  |  | 7.4.2.5 | 5.8.1, 5.8.1.1,6.3.4, 6.11.2 | DSME | UL,MAC | UL |
| Rendezvous Time | 0x1d |  | X |  | X |  | 7.4.2.6 | 6.12.2 | LE | MAC | MAC |
| Time Correction | 0x1e |  | X |  |  |  | 7.4.2.7 | 6.5.3.1, 6.7.4.2 | TSCH | MAC | MAC |
| Extended DSME PAN Descriptor | 0x21 | X |  |  |  |  | 7.4.2.8 | 6.11.2 | DSME | UL,MAC | UL |
| Fragment Sequence Context Description | 0x22 |  |  | X | X |  | 7.4.2.9 | 23.3.1 | LECIM | MAC | MAC |
| Simplified Superframe Specification | 0x23 | X |  |  |  |  | 7.4.2.10 | [B2], 6.2.3 | LECIM | MAC | MAC |
| Simplified GTS Specification | 0x24 | X |  |  |  |  | 7.4.2.11 | [B2], 6.2.3 | LECIM | MAC | MAC |
| LECIM Capabilities | 0x25 | X |  | X | X | X | 7.4.2.12 | 10.1.2.10 | LECIM | UL | UL |
| TRLE Descriptor | 0x26 | X | X | X | X | X | F.5.1.1 | 6.3.4, F.4.2, F.4.3 | TRLE | MAC | MAC |
| RCC Capabilities | 0x27 | X |  | X | X |  | 7.4.2.13 | [B2], 3.9.1 | RCC | UL | UL |
| RCCN Descriptor | 0x28 | X |  |  |  |  | 7.4.2.14 | 6.2.9 | RCC | UL, MAC | UL |
| Global Time | 0x29 | X |  |  |  |  | 7.4.2.15 |  | RCC | UL | UL |
| Header Termination 1 | 0x7e | X | X | X | X | X | 7.4.2.16 | 7.4.1 | ALL | MAC | MAC |
| Header Termination 2 | 0x7f | X | X | X | X | X | 7.4.2.17 | 7.4.1 | ALL | MAC | MAC |

## Group Payload IE Table

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Payload IEs - Group | ID | Enh Beacon | Enh Ack | Data | Multipurpose | Command | Formatting subclause(s) | Use Description subclause(s) | Apps/Modes used by | RX: Used by | TX: Built by |
| Encapsulated Service Data Unit (ESDU) | 0x0 | X |  | X | X | X | 7.4.3.1 | Container for UL data | ALL | UL | UL |
| MLME | 0x1 | X | X | X | X | X | 7.4.3.2 | Container for Nested IEs | ALL | MAC | MAC |
| Vendor Specific | 0x2 | X |  | X | X | X | 7.4.4.30 | Not Standard | ALL | UL | UL |
| Payload Termination | 0xf | X | X | X | X | X | 7.4.3.3 | 7.4.1 | ALL | MAC | MAC |

## Nested Payload IEs – Short

| Nested IEs – Short | Sub ID | Enh Beacon | Enh Ack | Data | Multipurpose | Command | Formatting subclause(s) | Use Description subclause(s) | Apps/Modes used by | RX: Used by | TX: Built by |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TSCH Synchronization | 0x1a  | X |  |  |  |  | 7.4.4.2 | 6.3.6, 6.3.4 | TSCH | MAC | MAC |
| TSCH Slotframe and Link | 0x1b  | X |  |  |  |  | 7.4.4.3 | 6.3.6, 6.3.4 | TSCH | UL | UL |
| TSCH Timeslot  | 0x1c  | X |  |  |  |  | 7.4.4.4 | 6.3.6, 6.5.3, 6.3.4 | TSCH | UL | MAC |
| Hopping timing | 0x1d  | X |  |  |  |  | 7.4.4.5 | 6.3.4, 6.2.10 | Non-beacon enabled | MAC | MAC |
| Enhanced Beacon Filter | 0x1e  |  |  |  |  | X | 7.4.4.6 | 6.3.4 | Non-beacon enabled | MAC | UL |
| MAC Metrics | 0x1f  | X |  | X | X |  | 7.4.4.7 | 8.4.2.6 | All  | UL | MAC |
| All MAC Metrics | 0x20  | X |  | X | X |  | 7.4.4.8 | 8.4.2.6 | All  | UL | MAC |
| Coexistence Specification | 0x21  | X |  |  |  |  | 7.4.4.9 | 6.2.3, 6.3.3.1, 6.3.4, 6.14 | SUN | UL | MAC |
| SUN Device Capabilities | 0x22  |  |  | X | X |  | 7.4.4.10 | [B2],3.9.1 | SUN | ULMAC | UL |
| SUN FSK Generic PHY  | 0x23  | X |  | X | X | X | 7.4.4.11 | 10.1.2.8,20.2.3, 20.3 | SUN | ULMAC | UL |
| Mode Switch Parameter | 0x24  | X |  | X | X | X | 7.4.4.12 | 20.2.3, 20.5 | SUN | MAC | UL |
| PHY Parameter Change | 0x25  | X |  |  | X |  | 7.4.4.13 | 6.10 | MBAN | MAC | UL |
| O-QPSK PHY Mode | 0x26  |  |  | X | X |  | 7.4.4.14 | 6.10 | MBAN | MAC | UL |
| PCA Allocation | 0x27  | X |  |  |  |  | 7.4.4.15 | 6.2.5.4 | PCA | MAC | UL |
| DSSS Operating Mode | 0x28  |  |  | X | X |  | 7.4.4.16 | 6.10 | LECIM | MAC | UL |
| FSK Operating Mode | 0x29  |  |  | X | X |  | 7.4.4.17 | 6.10 | LECIM | MAC | UL |
| TVWS PHY Operating Mode Description | 0x2b  |  |  |  | X |  | 7.4.4.18 | 6.15 | TVWS | MAC | UL |
| TVWS Device Capabilities | 0x2c  | X |  | X | X |  | 7.4.4.19 | 6.15 | TVWS | ULMAC | UL |
| TVWS Device Category | 0x2d  | X |  |  |  |  | 7.4.4.20 | 6.15 | TVWS | UL | UL |
| TVWS Device Identification | 0x2e  | X |  |  |  |  | 7.4.4.21 | 6.15 | TVWS | UL | UL |
| TVWS Device Location | 0x2f  | X |  |  |  |  | 7.4.4.22 | 6.15 | TVWS | UL | UL |
| TVWS Channel Information Query | 0x30  | X |  |  |  |  | 7.4.4.23 | 6.15 | TVWS | UL | UL |
| TVWS Channel Information Source | 0x31  | X |  |  |  |  | 7.4.4.24 | 6.15 | TVWS | UL | UL |
| Channel Timing Management (CTM) | 0x32  | X |  |  |  |  | 7.4.4.25 | 6.16 | TVWS | UL | UL |
| Timestamp | 0x33  | X |  |  |  |  | 7.4.4.26 | 6.9.5 | TVWS | MAC | MAC |
| Timestamp Difference | 0x34  | X |  |  |  |  | 7.4.4.27 | 6.9.5, 6.7.2.4 | TVWS | MAC | MAC |
| TVWS multichannel cluster tree PAN (TMCTP) Specification | 0x35  | X |  |  |  |  | 7.4.4.28 | 5.8.1.3, 6.13 | TVWS | UL | UL |
| RCC PHY Operating Mode | 0x36  |  |  | X | X |  | 7.4.4.29 | 6.10 | RCC | MAC | UL |

## Nested Payload IEs – Long

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Nested IEs - Long | Sub ID | Enh Beacon | Enh Ack | Data | Multipurpose | Command | Formatting subclause(s) | Use Description subclause(s) | Apps/Modes used by | RX: Used by | TX: Built by |
| Vendor Specific | 0x8 | X |  | X | X | X | 7.4.4.30 | Not Standard | All | UL | UL |
| Channel Hopping | 0x9 | 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 | Header IEs Present  | Payload IEs Present | Data Payload Present | Header IE Terminations (HT1, HT2)  | Payload IE Termination (PT)  |
| Case 1 | No | No | No | None | None |
| Case 2 | Yes | No | No | None | None |
| Case 3 | No | Yes | No | HT1 | Optional |
| Case 4 | Yes | Yes | No | HT1 | Optional |
| Case 5 | No | No | Yes | None | None |
| Case 6 | Yes | No | Yes | HT2 | None |
| Case 7 | No | Yes | Yes | HT1 | PT |
| Case 8 | Yes | Yes | Yes | HT1 | PT |

## Case 1: No IEs, no Data Payload

Possible uses: Imm-Ack frame, empty Data frame, empty MP frame, Enhanced Beacon frame from the PAN coordinator in a nonbeacon-enabled PAN to advertise its PAN ID.

## Case 2: Header IE(s), no Data Payload

Possible uses: Enh-Ack with status or timing information (non-secured), Data frame with only Header IEs; and Enhanced Beacon frame.

Notes: As stated in 7.4.1 no termination “is required” since the end of the frame can be determined by the frame length and CRC type.

## Case 3: Only Payload IE(s) (other than termination)

Possible uses: Secure Enh-Ack frame with TSCH Synchronization IE, Data frame with ESDU IE; MP frame with TVWS PHY Operating Mode Description IE, Enhanced Beacon frame (TSCH, DSME, RCCN, other), and Command frame with SUN FSK Generic PHY IE.

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 while the Payload IE Termination is not required (i.e. it may be elided) but is allowed.

## Case 5: No IEs, with Data Payload

Possible uses: Any frame except for Imm-Ack (since it can’t have a payload).

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

## Case 6: Header IE and Data 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 IE(s) and Data Payload

Possible uses: Any frame that can carry IEs;

Notes: This case may be avoided when Payload IEs are present (except for security MIC) since the payload can be encapsulated in IEs (e.g. ESDUs).

## Case 8: Fully Loaded Frame

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

# Examples

## Enhanced Beacon frame (TSCH mode)

Timing figures are based upon O-QPSK in the 2450 MHz band, 250 kb/s.



## Data Frame and Acknowledgment frame (TSCH mode)

