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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Table of Contents

1 IE Tables 3

1.1 Introduction 3

**1.1.1** **ID or sub ID** 3

**1.1.2** **Length** 3

**1.1.3** **Frame Types** 3

**1.1.4** **Formatting subclause** 3

**1.1.5** **Use descriptive subclause(s)** 3

**1.1.6** **Apps/Modes used by** 3

**1.1.7** **RX: Used by** 3

**1.1.8** **TX: Built by** 3

1.2 Header IE Table 4

1.3 Group Payload IE Table 5

1.4 Nested Payload IEs – Short 5

1.5 Nested Payload IEs – Long 6

2 IE Termination Explanation 7

2.1 Case 1: No IEs, no Data Payload 7

2.2 Case 2: Header IE(s), no Data Payload 7

2.3 Case 3: Only Payload IE(s) (other than termination) 7

2.4 Case 4: Both Header and Payload IEs 7

2.5 Case 5: No IEs, with Data Payload 7

2.6 Case 6: Header IE and Data Payload 7

2.7 Case 7: Payload IE(s) and Data Payload 8

2.8 Case 8: Fully Loaded Frame 8

3 Examples 8

3.1 Enhanced Beacon frame (TSCH mode) 8

3.2 Data Frame and Acknowledgment frame (TSCH mode) 9

# 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. The definition of the values within these fields are:

#### Mandatory (M)

Mandatory frame(s) are the only frame type(s) specifically cited for the IE

#### Optional (O)

Optional frame types for the IE

#### Optionaln (On)

Support of at least one of the group of options labeled by the same numeral <n> is required

#### Not Recommended (N/R)

Frame type(s) so marked could cause unforeseen events when carrying the IE

#### X

Prohibited, frame(s) so marked are not allowed to carry the specific IE

### **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 | O1 | O1 | O1 | O1 | O1 | 7.4.4.30 | Not standard | ALL | UL | UL |
| Device Announcement (DA) | 0x2b | M |  |  |  |  | 7.4.1.2 | 6.3.4,6.7.7 | TVWS | UL | UL |
| Coordinated Sample Listening (CSL) | 0x1a | O2 | O2 | O2 | O2 |  | 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 | O3 |  | O3 |  | O3 | 7.4.1.4 | 6.3.4 | LE | MAC | MAC |
| DSME PAN Descriptor | 0x1c | M |  |  |  |  | 7.4.1.5 | 5.8.1, 5.8.1.1,6.3.4, 6.11.2 | DSME | UL,MAC | UL |
| Rendezvous Time | 0x1d |  | O4 |  | O4 |  | 7.4.1.6 | 6.12.2 | LE | MAC | MAC |
| Time Correction | 0x1e |  | M |  |  |  | 7.4.1.7 | 6.5.3.1, 6.7.4.2 | TSCH | MAC | MAC |
| Extended DSME PAN Descriptor | 0x21 | M |  |  |  |  | 7.4.1.8 | 6.11.2 | DSME | UL,MAC | UL |
| Fragment Sequence Context Description | 0x22 |  |  | O5 | O5 |  | 7.4.1.9 | 23.3.1 | LECIM | MAC | MAC |
| Simplified Superframe Specification | 0x23 | M |  |  |  |  | 7.4.1.10 | [B2], 6.2.3 | LECIM | MAC | MAC |
| Simplified GTS Specification | 0x24 | M |  |  |  |  | 7.4.1.11 | [B2], 6.2.3 | LECIM | MAC | MAC |
| LECIM Capabilities | 0x25 | O6 |  | O6 | O6 | O6 | 7.4.1.12 | 10.1.2.10 | LECIM | UL | UL |
| TRLE Descriptor | 0x26 | O7 | O7 | O7 | O7 | O7 | F.5.1.1 | 6.3.4, F.4.2, F.4.3 | TRLE | MAC | MAC |
| RCC Capabilities | 0x27 | O8 |  | O8 | O8 |  | 7.4.1.13 | [B2], 3.9.1 | RCC | UL | UL |
| RCCN Descriptor | 0x28 | M |  |  |  |  | 7.4.1.14 | 6.2.9 | RCC | UL, MAC | UL |
| Global Time | 0x29 | M |  |  |  |  | 7.4.1.15 |  | RCC | UL | UL |
| Header Termination 1 | 0x7e | O9 | O9 | O9 | O9 | O9 | 7.4.2.16 | 7.4.1 | ALL | MAC | MAC |
| Header Termination 2 | 0x7f | O10 | O10 | O10 | O10 | O10 | 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 | O11 |  | O11 | O11 | O11 | 7.4.3.1 | Container for UL data | ALL | UL | UL |
| MLME | 0x1 | O12 | O12 | O12 | O12 | O12 | 7.4.3.2 | Container for Nested IEs | ALL | MAC | MAC |
| Vendor Specific | 0x2 | O13 |  | O13 | O13 | O13 | 7.4.4.30 | Not Standard | ALL | UL | UL |
| Payload Termination | 0xf | O14 | O14 | O14 | O14 | O14 | 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  | M |  |  |  |  | 7.4.3.2 | 6.3.6, 6.3.4 | TSCH | MAC | MAC |
| TSCH Slotframe and Link | 0x1b  | M |  |  |  |  | 7.4.3.3 | 6.3.6, 6.3.4 | TSCH | UL | UL |
| TSCH Timeslot  | 0x1c  | M |  |  |  |  | 7.4.3.4 | 6.3.6, 6.5.3, 6.3.4 | TSCH | UL | MAC |
| Hopping timing | 0x1d  | M |  |  |  |  | 7.4.3.5 | 6.3.4, 6.2.10 | Non-beacon enabled | MAC | MAC |
| Enhanced Beacon Filter | 0x1e  |  |  |  |  | M | 7.4.3.6 | 6.3.4 | Non-beacon enabled | MAC | UL |
| MAC Metrics | 0x1f  | O15 |  | O15 | O15 |  | 7.4.3.7 | 8.4.2.6 | All modes | UL | MAC |
| All MAC Metrics | 0x20  | O16 |  | O16 | O16 |  | 7.4.3.8 | 8.4.2.6 | All modes | UL | MAC |
| Coexistence Specification | 0x21  | M |  |  |  |  | 7.4.3.9 | 6.2.3, 6.3.3.1, 6.3.4, 6.14 | SUN | UL | MAC |
| SUN Device Capabilities | 0x22  |  |  | O17 | O17 |  | 7.4.3.10 | [B2],3.9.1 | SUN | ULMAC | UL |
| SUN FSK Generic PHY  | 0x23  | O18 |  | O18 | O18 | O18 | 7.4.3.11 | 10.1.2.8,20.2.3, 20.3 | SUN | ULMAC | UL |
| Mode Switch Parameter | 0x24  | O19 |  | O19 | O19 | O19 | 7.4.3.12 | 20.2.3,20.5 | SUN | MAC | UL |
| PHY Parameter Change | 0x25  | O20 |  |  | O20 |  | 7.4.3.13 | 6.10 | MBAN | MAC | UL |
| O-QPSK PHY Mode | 0x26  |  |  | O21 | O21 |  | 7.4.3.14 | 6.10 | MBAN | MAC | UL |
| PCA Allocation | 0x27  | M |  |  |  |  | 7.4.3.15 | 6.2.5.4 | PCA | MAC | UL |
| DSSS Operating Mode | 0x28  |  |  | O22 | O22 |  | 7.4.3.16 | 6.10 | LECIM | MAC | UL |
| FSK Operating Mode | 0x29  |  |  | O23 | O23 |  | 7.4.3.17 | 6.10 | LECIM | MAC | UL |
| TVWS PHY Operating Mode Description | 0x2b  |  |  |  | M |  | 7.4.3.18 | 6.15 | TVWS | MAC | UL |
| TVWS Device Capabilities | 0x2c  | O24 |  | O24 | O24 |  | 7.4.3.19 | 6.15 | TVWS | ULMAC | UL |
| TVWS Device Category | 0x2d  | M |  |  |  |  | 7.4.3.20 | 6.15 | TVWS | UL | UL |
| TVWS Device Identification | 0x2e  | M |  |  |  |  | 7.4.3.21 | 6.15 | TVWS | UL | UL |
| TVWS Device Location | 0x2f  | M |  |  |  |  | 7.4.3.22 | 6.15 | TVWS | UL | UL |
| TVWS Channel Information Query | 0x30  | M |  |  |  |  | 7.4.3.23 | 6.15 | TVWS | UL | UL |
| TVWS Channel Information Source | 0x31  | M |  |  |  |  | 7.4.3.24 | 6.15 | TVWS | UL | UL |
| Channel Timing Management (CTM) | 0x32  | M |  |  |  |  | 7.4.3.25 | 6.16 | TVWS | UL | UL |
| Timestamp | 0x33  | M |  |  |  |  | 7.4.3.26 | 6.9.5 | TVWS | MAC | MAC |
| Timestamp Difference | 0x34  | M |  |  |  |  | 7.4.3.27 | 6.9.5, 6.7.2.4 | TVWS | MAC | MAC |
| TVWS multichannel cluster tree PAN (TMCTP) Specification | 0x35  | M |  |  |  |  | 7.4.3.28 | 5.8.1.3, 6.13 | TVWS | UL | UL |
| RCC PHY Operating Mode | 0x36  |  |  | O25 | O25 |  | 7.4.3.29 | 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 | O26 |  | O26 | O26 | O26 | 7.4.4.30 | Not Standard | All | UL | UL |
| Channel Hopping | 0x9 | M |  |  |  |  | 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)

