IEEE P802.15

Wireless Personal Area Networks

|  |  |  |
| --- | --- | --- |
| Project | IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs) | |
| Title | **IE Characteristic Table** | |
| Date Submitted | 26 August 2015 | |
| Source | [] [] [address] | Voice: [ ] Fax: [ ] E-mail: [pat.kinney@kinneyconsultingllc.com] |
| Re: | [This is a revision of 15-15-0090] | |
| Abstract | [Pertinent Characteristics of all IEEE 802.15.4 Information Elements with examples] | |
| Purpose | [For reference and possible insertion into 802.15.4 Guide] | |
| Notice | This document has been prepared to assist the IEEE P802.15. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) reserve(s) the right to add, amend or withdraw material contained herein. | |
| Release | The contributor acknowledges and accepts that this contribution becomes the property of IEEE and may be made publicly available by P802.15. | |

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 | UL MAC | UL |
| SUN FSK Generic PHY | 0x23 | O18 |  | O18 | O18 | O18 | 7.4.3.11 | 10.1.2.8, 20.2.3, 20.3 | SUN | UL MAC | 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 | UL MAC | 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.

Macintosh HD:Users:patrickkinney:MyDocuments:IEEE:802.15:SC-MAG:Sponsor Ballot:Beacon_Example.emf

## Data Frame and Acknowledgment frame (TSCH mode)

Macintosh HD:Users:patrickkinney:MyDocuments:IEEE:802.15:SC-MAG:Sponsor Ballot:Data-Frame_Example.emf