Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: Presentation on improvements to the 15.4q draft

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Abstract: Presentation on improvements to the 15.4q draft

Purpose: Providing direction towards a ULP PHY standard

Summary:

Two improvements are proposed:

- Reduced overhead in MAC controlled by the ULP-PHR
- Improved frame integrity by FCS re-seeding

Both improvements are proposed as optional

Motivation:

- Additional energy savings by reducing overhead in the MAC.
- Provide improved frame integrity

ULP PHR:

In addition to the mandatory PHR and the short PHY header a third optional PHR is proposed called ULP-PHR.

The ULP-PHR supports packet lengths up to 128 Bytes.

2 Byte FCS shall be used

Bit string	0-1	2	3	4-5	6	7	8	9-15
Bit mapping	PT	RS	FR	UFT	SE	FP	AR	L_9-L_{15}
Field name	PHR Type	Rate Switch	FCS reseeding	ULP Frame Type	Security enabled	Frame Pending	ACK Req	Frame Length

Bit string	0-1	2	3	4-5	6	7	8	9-15
Bit mapping	PT	RS	FR	UFT	SE	FP	AR	L_9-L_{15}
Field name	PHR Type	Rate Switch	FCS reseeding	ULP Frame Type	Security enabled	Frame Pending	ACK Req	Frame Length

PHR Type:

PT	RS (Rate Switch)	PHR type
00	0	Mandatory MR-FSK/ULP-GFSK
01	RS	ULP-PHR (optional)
10	RS	Short-PHR (optional)
11	Reserved	Reserved

Bit string	0-1	2	3	4-5	6	7	8	9-15
Bit mapping	PT	RS	FR	UFT	SE	FP	AR	L_9-L_{15}
Field name	PHR Type	Rate Switch	FCS reseeding	ULP Frame Type	Security enabled	Frame Pending	ACK Req	Frame Length

FCS reseeding:

FR	
0	Use seed zero as defined in 802.15.4-2011
1	Use seed as provided by IE

Seed may be provided in a secured frame improving the frame integrity of non-secured frames (e.g. short and ULP-ACK)

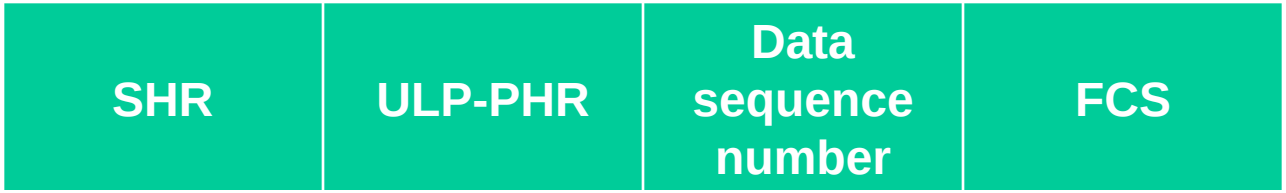
Bit string	0-1	2	3	4-5	6	7	8	9-15
Bit mapping	PT	RS	FR	UFT	SE	FP	AR	L_9-L_{15}
Field name	PHR Type	Rate Switch	FCS reseeding	ULP Frame Type	Security enabled	Frame Pending	ACK Req	Frame Length

ULP-Frame Type:

UFT_4-UFT_5	ULP Frame Type
00	Transparent, Frame Control field same as 802.15.4-2011
01	ULP-ACK
10	Bonding Code Data Frame
11	Bonding Code MAC command frame

ULP-ACK:

- 2 Byte FCS
- 1 Byte zero padding required in FCS



- No Frame Control → 2 Bytes saved

If the length of the calculation field is less than 2 octets, the FCS computation shall assume padding the calculation field by appending a zero value octet to the most significant bits to make the calculation field length exactly 2 octets

BC Data Frame:

Bonding Code is a two Byte code which replaces:

- Source and Destination addressing modes
- Source and Destination address
- Source and Destination PAN identifiers

Savings when using BC Data Frame:

The 2 Byte Bonding Code provides the following savings:

- No Frame Control Field → 2 Bytes
- No address field → 8 to 20 Bytes

Information Elements:

- Bonding Code capability
- FCS reseeding capability
- Bonding Code (2 Byte)
- FCS seed (2 Byte)

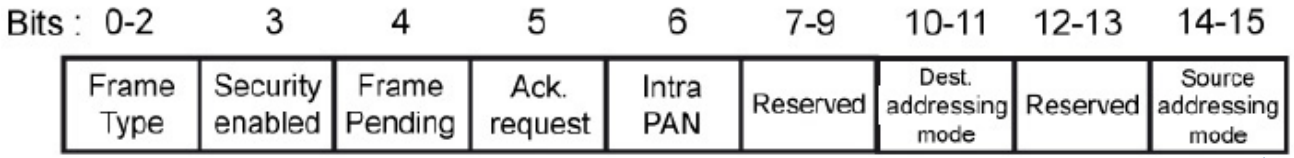
When FCS reseeding is supported the seed shall be:

- All zeros when there is no bonding code and no FCS seed
- The Bonding Code when there is no FCS seed
- The FCS seed when available

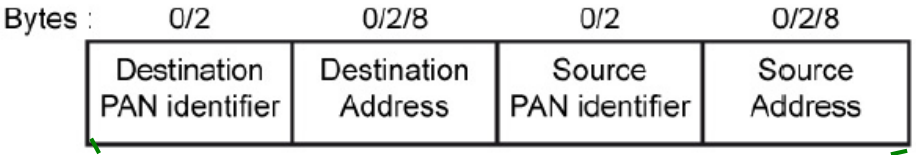
Back-up slides

Overview of MAC frame (802.15.4-2011):

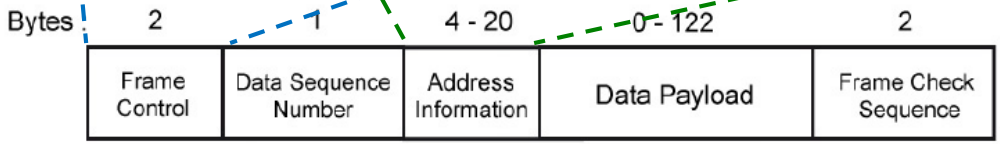
Frame control field:



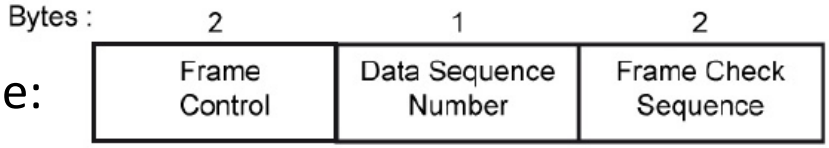
Address information:



MAC data frame:



Acknowledgement frame:



Mandatory PHY Header (PHR):

The ULP-FSK PHY shall support the PHY Header as shown in Figure 114 [1].

Bit string index	0	1–2	3	4	5–15
Bit mapping	MS	R_1–R_0	FCS	DW	L_{10}–L_0
Field name	Mode Switch	Reserved	FCS Type	Data Whitening	Frame Length

Figure 114—Format of the PHR (without mode switching) for MR-FSK

- This PHY Header is also mandatory for MR-FSK
- In MR-FSK: "*All reserved fields shall be set to zero upon transmission and shall be ignored upon reception*"
- R1-R0 are used by the ULP-GFSK PHY

Short PHR:

In addition to the mandatory PHR the Short PHR as shown below may be supported as well as the Mode Switching PHR as described in section 18.1.1.4 [1]

Bit string index	0	1	2	3-7
Bit mapping	MS	SPH	DDR	L_4-L_0
Field name	Mode Switch	Short PHY Header	Double Data Rate	Frame Length

The short PHR supports packet lengths up to 32 Byte

REFERENCES:

[1] IEEE802.15.4-2011