

## IEEE P802.15 Wireless Personal Area Networks

Project	IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)	
Title	Signalling data modes and SYNC length	
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Re:	Contribution to TG4ab for IEEE 802.15.4ab	
Abstract	Core message content to allow agreement between devices of the data rates, codes and PSR lengths that they support and want to use.	
Purpose	Proposed message content (i.e., to include in an IE) to facilitate negotiation of supported/required data rates, codes and PSR lengths.	
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## Introduction

Where the dynamic PHR is employed, the transmitter can indicate using the PHR that the payload is modulated using any one of the five data rates defined in the 4ab standard, (1.95 Mb/s, 7.8 Mb/s, 31.2 Mb/s, 62.4 Mb/s and 124.8 Mb/s), and whether the payload is LDPC coded or not. The question asked (and answered here) is how the transmitter knows what the receiver supports (given that 124.8 Mb/s and LDPC coding are optional) and how does the transmitter know what SYNC length the receiver requires.

This is a proposed outline scheme for signalling and agreeing this information. The basic mechanism is for the transmitter device to indicate what data rates it supports or wants to use, and whether it supports/wants to use LDPC with those data rates. Then the receive device responds to say what data rates it supports, whether it supports LDPC, and what SYNC length it requires the transmitter to use for the transmissions.

For flexibility, we propose this to be indicated for each data rate.

### Signalling data modes and SYNC length - Transmitter

**Firstly**, we propose a message for a device indicate what data rates it wishes to use for its transmissions and whether it intends to use LPDC or not. To achieve this the following field can be included (in a suitable IE).

This consists of a Transmitter Rate/Code Specifier (TRCS), of 2 bits, for each TG4ab data rate, as shown:

Transmitter Data Modes Specifier (TDMS) field				
Bits 0-1	2-3	4-5	6-7	8-9
TRCS_1p95	TRCS_7p8	TRCS_31p2	TRCS_62p4	TRCS_124p8

**Figure 1 – TDMS field to signal the transmitter’s desired use of data rates and LDPC coding.**

Each 2-bit Transmitter Rate/Code Specifier (TRCS) is then formatted as shown below:

Bits 0	1
Data Rate Request Field	LDPC Coding Support Field

**Figure 2 – Encoding of Transmitter Rate/Code specifier (TRCS)**

For example, looking at three representative modes that were previously proposed at TG4ab, and how these may be signalled in the Transmitter Data Modes Specifier (TDMS) field:

**Mode-A**, PSDU rate constrained to be  $\geq 7.8$  Mb/s, with either LDPC or BCC allowed, is signalled as follows:

TDMS				
TRCS_1p95 b0, b1	TRCS_7p8 b0, b1	TRCS_31p2 b0, b1	TRCS_62p4 b0, b1	TRCS_124p8 b0, b1
0 x	1 1	1 1	1 1	1 1

The above decodes to specify that all data rates except 1.95 Mb/s will be used, along with LDPC.

**Mode-B**, rate of 1.95 Mb/s with BCC only; for  $>1.95$  Mb/s either LDPC or BCC allowed, signalled as follows:

TDMS				
TRCS_1p95 b0, b1	TRCS_7p8 b0, b1	TRCS_31p2 b0, b1	TRCS_62p4 b0, b1	TRCS_124p8 b0, b1
1 0	1 1	1 1	1 1	1 1

The above decodes to indicate that all data rates are supported by the transmitter, but that LDPC will only be used for rates of 7.8 Mb/s and above.

**Mode-C**, PSDU rate  $\geq 1.95$  Mb/s with either BCC or LDPC allowed, is signalled as follows:

TDMS				
TRCS_1p95 b0, b1	TRCS_7p8 b0, b1	TRCS_31p2 b0, b1	TRCS_62p4 b0, b1	TRCS_124p8 b0, b1

1 1	1 1	1 1	1 1	1 1
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The above decodes to indicate that all data rates are used/supported with LDPC.

### **Signalling data modes and SYNC length - Receiver**

**Secondly**, we propose a message that a device can use to respond to signal its receiver preferences:

The following defines a field that can be included (in a suitable IE) to indicate the data rates and coding that the receiver device supports and its PSR length requirements. Let us call this the Receiver Data Mode Specifier (RDMS) field, with format illustrated in Figure 3 below.

This consists of a Receiver Rate/Code/Sync specifier (RRCS), of 5 bits, for each TG4ab data rate, as shown:

Receiver Data Mode Specifier (RDMS) field				
Bits 0–4	5–9	10–14	15–19	20–24
RRCS_1p95	RRCS_7p8	RRCS_31p2	RRCS_62p4	RRCS_124p8

**Figure 3 – RDMS field to signal supported data rates, coding, and sync length requirements**

Each 5-bit Receiver Rate/Code/Sync specifier (RRCS), is then formatted as shown in Figure 4 below:

Bits 0–3	4
SYNC Support Field	LDPC Coding Support Field

**Figure 4 – encoding of Receiver Rate/Code/Sync specifier (RRCS)**

The single bit LDPC Coding Support field (bit 4 of each RRCS) indicates when set to one that LDPC is supported/allowed and, indicates when set to zero that LDPC should not be used.

A coding of the 4-bit SYNC Support field is shown in Figure 5 below. (Illustrative of principle)

SYNC Support field value	Meaning
0	Data rate not supported or not to be used
1	PSR = 16
2	PSR = 24
3	PSR = 32
4	PSR = 48
5	PSR = 64
6	PSR = 96
7	PSR = 128
8	PSR = 192
9	PSR = 256
10 to 15	Reserved

**Figure 5 –Sync Support Field values (RCS)**

NOTE: SFD could similarly be selected by the receiver. We assume this would be fixed and common for all data rates. This could be achieved by a 2-bit Receiver SFD Specifier field, (sent in same IE as the RDMS field), that would select one of the four HRP-ERDEV SFD options in 4z table 15-7c.

Example use cases are given below for the modes under discussion at TG4ab.

For example, looking at three representative modes that were previously proposed at TG4ab, and how these may be signalled in the Receiver Data Mode Specifier (RDMS) field:

**Mode-A**, PSDU rate constrained to be  $\geq 7.8$  Mb/s, with either LDPC or BCC allowed, is signalled as follows:

RDMS				
RRCS_1p95 b0-b4	RRCS_7p8 b0-b4	RRCS_31p2 b0-b4	RRCS_62p4 b0-b4	RRCS_124p8 b0-b4
0 0 0 0 x	1 1 0 0 1	1 1 0 0 1	1 1 0 0 1	1 1 0 0 1

The above decodes to indicate that all data rates except 1.95 Mb/s are supported/allowed, with SYNC PSR = 32 to be used for all, and LDPC coding can be used/supported. [In these example bit patterns, the bits are lsb on left as per usual IEEE transmit ordering, and the 'x' denotes a don't care ).

**Mode-B**, rate of 1.95 Mb/s with BCC only; for  $\geq 7.8$  Mb/s either LDPC or BCC allowed, signalled as follows:

RDMS				
RRCS_1p95 b0-b4	RRCS_7p8 b0-b4	RRCS_31p2 b0-b4	RRCS_62p4 b0-b4	RRCS_124p8 b0-b4
1 0 1 0 0	1 0 1 0 1	1 0 1 0 1	1 0 1 0 1	1 0 1 0 1

The above decodes to indicate that all data rates are supported but that LDPC is allowed only for rates of 7.8 Mb/s and higher; and that SYNC PSR = 64 is to be used for all.

**Mode-C**, PSDU rate  $\geq 1.95$  Mb/s with both BCC and LDPC allowed, is signalled as follows:

RDMS				
RRCS_1p95 b0-b4	RRCS_7p8 b0-b4	RRCS_31p2 b0-b4	RRCS_62p4 b0-b4	RRCS_124p8 b0-b4
1 0 0 1 1	1 0 0 1 1	1 0 0 1 1	1 0 0 1 1	1 0 0 1 1

The above decodes to indicate that all rates supported with LDPC, with SYNC PSR = 256 to be used for all.

#### **OTHER:**

As an additional example to illustrate the flexibility of this approach, a receiver might signal its capability as follows:

RDMS				
RRCS_1p95 b0-b4	RRCS_7p8 b0-b4	RRCS_31p2 b0-b4	RRCS_62p4 b0-b4	RRCS_124p8 b0-b4
1 1 1 0 1	1 0 1 0 1	1 0 1 0 1	1 0 1 0 1	0 0 0 0 x

The above decodes to indicate that the receiver wants PSR 128 for 1.95 Mb/s rate, does not support 124.8 Mb/s, and supports 7.8 Mb/s, 31.2 Mb/s and 62.4 Mb/s with PSR of 64, and supports LDPC with all data rates.

#### **Final note:**

Since the receiver may indicate different SYNC PSR values for different data rates, the requirement we propose to embed in the 4ab standard with respect to the operation subsequent to a TDMS/RDMS exchange is:

The transmitter shall only use those payload data rates and coding methods that the receiver has indicated it can support, and the transmitter shall use a SYNC length that is no shorter than that requested by the receiver for the selected payload data rate and no longer than the largest SYNC indicated in the Receiver Data Mode Specifier (RDMS) for any data rate.

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