IEEE P802.11
Wireless LANs

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| Short and long TRN subfield |
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Abstract

This document suggest text to add short and long TRN subfields

Changes are based on Draft 0.21

Discussion:

In the current version of the draft, TRN subfields are based on Golay sequences with length of 128 chips (72.2nsec) at the CB=1 bandwidth. We think that there is justification to add a shorter version, with half the length, which would allow for shorter TRN fields (currently the TRN fields for 128 AWVs is ~70usec). On the other hand, to support long delay spread channels, we also need long TRN fields, with double the length.

The TRN subfields in draft 0.2 are based on the sequence [GaiN, -GbiN, GaiN, GbiN, GaiN, -GbiN] where N is equal CB×128, where CB is the channel bonding (1,2,3,4), and *i* is the stream number (for *i=1,2*). We propose to enable two other lengths of basic training sequence. The long version will double every Golay sequence to enable long delay spreads. The short version will half every Golay sequence to enable shorter BRP packets.

***TGay Editor: Add the following field to the EDMG-Header-A table for SU PPDU:***

|  |  |  |  |
| --- | --- | --- | --- |
| Base TRN subfield Golay length | 2 | # | 1. Normal: Base TRN subfield Golay sequence length is 128×NCB
2. Long: Base TRN subfield Golay sequence length is 256×NCB
3. Short: Base TRN subfield Golay sequence length is 64×NCB
4. Reserved

NCB – channel bonding (channel width in units of 2.16GHz) |

***TGay Editor: Modify the text of 30.9.3.26.9 TRN subfield definition as follows (P151L17-23):***

The basic TRN subfield for the *i*th spatial stream, TRNibasic, is composed of 6 Golay complementary sequences GaiN and GbiN as follows TRNibasic = [GaiN, -GbiN, GaiN, GbiN, GaiN, -GbiN], where:

* N is the Golay sequence length and is equal to TRN\_BL × NCB; and
* NCB represents the integer number of contiguous 2.16 GHz channels over which the TRN subfield is transmistted and 1 ≤ NCB ≤ 4.
* TRN\_BL is set according the value of Base TRN subfield Golay length in the header. A value of 0 indicates TRN\_BL=128, a value of 1 indicates TRN\_BL=256 and a value of 2 indicates TRN\_BL=64. Only the value of TRN\_BL=0 is mandaroty.

The sequences (GAi64, GBi64), (Gai128, Gbi128), (Gai256, Gbi256), (Gai384, Gbi384), (Gai512, Gbi512), (Gai768, Gbi768) and (Gai1024, Gbi1024) are defined in subclause 30.10. These sequences shall be transmitted using rotated π/2-BPSK modulation.

***TGay Editor: Add the following field to the TXVECTOR and RXVECTOR parameters table:***

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| --- | --- | --- | --- | --- |
| TRN\_BASE\_GOLAY\_LEN |  | Indicates the length of the Golay sequence to be used as the base of the TRN subfield (see 29.9.3.26.9)Enumerated Type:Normal: The base Golay sequence has a length of 128×NCB.Long: The base Golay sequence has a length of 256×NCB.Short: The base Golay sequence has a length of 64×NCB.Where NCB is the integer number of contiguous 2.16 GHz channels over which the TRN subfield is transmistted and 1 ≤ NCB ≤ 4 | Y | Y |

***TGay Editor: Add the TRN fields capability to Figure 17 as bits 29 and 30***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | B0 B7 | B8 B14 | B15 B26 | B27 B28 | B29 B30 | B31 |
|  | Supported Channels Bitmap | A-MPDU Parameters | TRN Parameters | Supported MCS | TRNFieldscapabilitiies | Reserved |
| Bits: | 8 | 7 | 12 | 2 | 2 | 1 |



Figure 1- TRN Fields capabilities field

The TRN fields capabilities contains capabilities for support of TRN fields features. The short TRN subfields capability is set to 1 if the device is capable of receiving TRN subfields based on short Golay sequences, otherwise it is set to 0. The long TRN subfields capabilitiy is set to 1 if the device is capable of receiving TRN subfields based on long Golay seqeuences, otherwise it is set to 0. See ***30.9.3.26.9*** for details on how long and short Golay sequences are used.

***TGay Editor: Modify 29.10 as follows:***

**29.10 Golay sequences**

**29.10.2 Sequences of length 32, 64, 128, 256, 512 and 1024**

Golay sequences of length 32, 64, 128, 256, 512 and 1024 are generated using the procedure and notation specified in 20.11.

The value of the DK vector for each of the EDMG sequences are as follows:

* For GA*i*32 and GB*i*32: DK = [2 1 4 8 16]
* For Ga*i*64 and Gb*i*64: DK = [2 1 4 8 16 32]
* For GA*i*64 and GB*i*64: DK = [1 8 2 4 16 32]
* For Ga*i*128 and Gb*i*128: DK = [1 8 2 4 16 32 64]
* For GA*i*128 and GB*i*128: DK = [2 1 4 8 16 32 64]
* For Ga*i*256 and Gb*i*256: DK = [1 8 2 4 16 32 64 128]
* For Ga*i*512 and Gb*i*512: DK = [1 8 2 4 16 32 64 128 256]
* For Ga*i*1024 and Gb*i*1024: DK = [1 8 2 4 16 32 64 128 256 512]
1. The sequences GA*i*32, GB*i*32, GA*i*64, GB*i*64, GA*i*128, GB*i*128, are different than the corresponding Ga*i*32, Gb*i*32, Ga*i*64, Gb*i*64, Ga*i*128, Gb*i*128 sequences defined in 20.11 for the DMG PHY.
2. For *i* = 1, the sequences Ga*i*64 and Gb*i*64 are equal to the corresponding Ga64 and Gb64 sequences defined in 20.11 for the DMG PHY. Similarly, for *i* = 1, the sequences Ga*i*128 and Gb*i*128 are equal to the corresponding Ga128 and Gb128 sequences defined in 20.11 for the DMG PHY.

As opposed to the DK vector, the value of the WK vector depends on the spatial stream number used to define the Golay pair (GaiN, GbiN) for *i*th stream. Table 1 and Table 2 show the value of the WK vector defined for each spatial stream and corresponding sequence length.

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1. —WK vector value to generate Golay sequences, N = 32, 64, 128

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| --- | --- | --- | --- | --- | --- |
| Spatial stream number | WK for GA*i*32 and GB*i*32 | WK for Ga*i*64 and Gb*i*64 | WK for GA*i*64 and GB*i*64 | WK for Ga*i*128 and Gb*i*128 | WK for GA*i*128 and GA*i*128 |
| 1 | [+1,+1,-1,-1,+1] | [+1,+1,-1,-1,+1,-1] | [-1,-1,-1,-1,+1,-1] | [-1,-1,-1,-1,+1,-1,-1] | [+1,+1,-1,-1,+1,+1,+1] |
| 2 | [-1,+1,-1,-1,+1] | [-1,+1,-1,-1,+1,-1] | [+1,-1,-1,-1,+1,-1] | [+1,-1,-1,-1,+1,-1,-1] | [-1,+1,-1,-1,+1,+1,+1] |
| 3 | [-1,-1,-1,-1,-1] | [-1,-1,-1,-1,-1,-1] | [-1,-1,-1,+1,-1,-1] | [-1,-1,-1,+1,-1,-1,+1] | [-1,-1,-1,-1,-1,+1,+1] |
| 4 | [+1,-1,-1,-1,-1] | [+1,-1,-1,-1,-1,-1] | [+1,-1,-1,+1,-1,-1] | [+1,-1,-1,+1,-1,-1,+1] | [+1,-1,-1,-1,-1,+1,+1] |
| 5 | [-1,-1,-1,-1,+1] | [-1,-1,-1,-1,+1,-1] | [-1,-1,-1,+1,-1,+1] | [-1,-1,-1,+1,-1,+1,+1] | [-1,-1,-1,-1,+1,+1,+1] |
| 6 | [+1,-1,-1,-1,+1] | [+1,-1,-1,-1,+1,-1] | [+1,-1,-1,+1,-1,+1] | [+1,-1,-1,+1,-1,+1,+1] | [+1,-1,-1,-1,+1,+1,+1] |
| 7 | [-1,-1,-1,+1,-1] | [-1,-1,-1,+1,-1,-1] | [-1,-1,-1,+1,+1,+1] | [-1,-1,-1,+1,+1,+1,-1] | [-1,-1,-1,+1,-1,+1,+1] |
| 8 | [+1,-1,-1,+1,-1] | [+1,-1,-1,+1,-1,-1] | [+1,-1,-1,+1,+1,+1] | [+1,-1,-1,+1,+1,+1,-1] | [+1,-1,-1,+1,-1,+1,+1] |

1. —WK vector value to generate Golay sequences, N = 256, 512, 1024

|  |  |  |  |
| --- | --- | --- | --- |
| Spatial stream number | WK for Ga*i*256 and Gb*i*256 | WK for Ga*i*512 and Gb*i*512 | WK for Ga*i*1024 and Gb*i*1024 |
| 1 | [-1,-1,-1,-1,+1,-1,-1,+1] | [-1,-1,-1,-1,+1,-1,-1,+1,+1] | [-1, -1, -1, -1, +1, -1, -1, +1, +1, +1] |
| 2 | [+1,-1,-1,-1,+1,-1,-1,+1] | [+1,-1,-1,-1,+1,-1,-1,+1,+1] | [+1, -1, -1, -1, +1, -1, -1, +1, +1, +1] |
| 3 | [-1,-1,-1,+1,-1,-1,+1,-1] | [-1,-1,-1,+1,-1,-1,+1,-1,+1] | [-1, -1, -1, +1, -1, -1, +1, -1, +1, +1] |
| 4 | [+1,-1,-1,+1,-1,-1,+1,-1] | [+1,-1,-1,+1,-1,-1,+1,-1,+1] | [+1, -1, -1, +1, -1, -1, +1, -1, +1, +1] |
| 5 | [-1,-1,-1,+1,-1,+1,+1,-1] | [-1,-1,-1,+1,-1,+1,+1,-1,+1] | [-1, -1, -1, +1, -1, +1, +1, -1, +1, +1] |
| 6 | [+1,-1,-1,+1,-1,+1,+1,-1] | [+1,-1,-1,+1,-1,+1,+1,-1,+1] | [+1, -1, -1, +1, -1, +1, +1, -1, +1, +1] |
| 7 | [-1,-1,-1,+1,+1,+1,-1,-1] | [-1,-1,-1,+1,+1,+1,-1,-1,+1] | [-1, -1, -1, +1, +1, +1, -1, -1, +1, +1] |
| 8 | [+1,-1,-1,+1,+1,+1,-1,-1] | [+1,-1,-1,+1,+1,+1,-1,-1,+1] | [+1, -1, -1, +1, +1, +1, -1, -1, +1, +1] |

1. —The sequence GA*i*1024(n)

**29.10.3 Sequences of length 96, 192, 384, and 768**

The Golay sequences of length 96, 192, 384 and 768 use a quadri-phase complex Golay complementary pair and are generated using the following recursive procedure, where *i* is the index of the stream number:

* *Ga3* = [+1, +1, -1]
* *Gb3* = [+1, +j, +1]
* *If (i = 1, 3, 5 or 7) then (A0(n), B0(n))* = (+*Ga3(2-n), +Gb3(2-n)). Otherwise if (i = 2, 4, 6 or 8) then (A0(n), B0(n))* = (+conj(*Gb3(n)), -conj(Ga3(n)))*
* *Ak(n)* = WkAk-1(n) + *Bk-1(n-Dk)*
* *Bk(n)* = WkAk-1(n) - *Bk-1(n-Dk)*

Starting with n = 3 and making 5, 6, 7 and 8 iterations, corresponding sequences of length 96, 192, 384 and 768 are obtained.

The value of the DK vector for each of the sequences are defined as follows, where *i* is the stream number and 1 ≤ *i* ≤ 8:

* For Ga*i*96 and Gb*i*96: DK = [3 24 6 12 48]
* For Ga*i*192 and Gb*i*192: DK = [3 24 6 12 48 96]
* For Ga*i*384 and Gb*i*384: DK = [3 24 6 12 48 96 192]
* For Ga*i*768 and Gb*i*768: DK = [3 24 6 12 48 96 192 384]

As opposed to the DK vector, the value of the WK vector depends on the spatial stream number used to define the Golay pair (GaiN, GbiN) for *i*th stream. Table 3 shows the value of the WK vector defined for each spatial stream.

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1. —WK vector value to generate Golay sequences, N = 96, 192, 384, 768

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Spatial stream number | WK for Ga*i*96 and Gb*i*96 | WK for Ga*i*192 and Gb*i*192 | WK for Ga*i*384 and Gb*i*384 | WK for Ga*i*768 and Gb*i*768 |
| 1 | [-1,-1,-1,-1,+1] | [-1,-1,-1,-1,+1,+1] | [-1,-1,-1,-1,+1,-1,-1] | [-1, -1, -1, -1, +1, -1, -1, +1] |
| 2 |
| 3 | [-1,-1,-1,+1,-1] | [-1,-1,-1,+1,-1,+1] | [-1,-1,-1,+1,-1,-1,+1] | [-1, -1, -1, +1, -1, -1, +1, +1] |
| 4 |
| 5 | [-1,-1,+1,-1,-1] | [-1,-1,+1,-1,-1,+1] | [-1,-1,-1,+1,-1,+1,+1] | [-1, -1, -1, +1, -1, +1, +1, +1] |
| 6 |
| 7 | [-1,-1,+1,+1,-1] | [-1,-1,+1,+1,-1,+1] | [-1,-1,-1,+1,+1,+1,-1] | [-1, -1, -1, +1, +1, +1, -1, +1] |
| 8 |

**References:**