IEEE P802.22
Wireless RANs

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| TGb LB1 CID 218 Comment Resolution  |
| Date: 2014-03-12 |
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Abstract

Proposed resolution for Comment ID 218, as listed in the TGb Letter Ballot 1 comment database, DCN: 22-13/158r0 (or latest revision).

R0: Initial draft regarding new approach to handle segmentation

R1: Extra text considering how variable-sized segments could be handled.

R2: Extending defintion of configuration-specific preambles to include specific preambles to indicate which PHY Mode a zone is operated in

R3: made a modification to definition of legacy frame preamble to indicate that the Local Frame Preamble Types are ignored by legacy CPEs, added text to clarify frequency domain correlation performance

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**Introduction**

This document proposes a resolution to CID 218 in the TGb LB1 ballot. The resolution to this comment falls in line with the resolution to CID 216 as detailed in DCN 22-14/26r1. The comment database is located in DCN: 22-13/158r0 (or latest revision) and is listed as follows:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 218 | Ranga Reddy | Self | 7 | 7.4b2 | 1 | 22 | 1 | T | The are a few issues with the segmentation concept described in Figure E1. 1) The title of Figure E1, indicates an example frame strucuture, indicating a segmentation/sharing of the channel in (frequency) for during the DRZ. However, on pg 20, 3rd paragraph of 7.4b2 the text provided is confusing in nature. 2) Text that follows (later) in the draft indicates that segmentation capabilitiy is in fact not an example scheduling mode, see definition of segment-specific preambles in 9a4.1.1 that support 3 specific segments. 3) This segmentation concept is a lot of complexity and overhead, and in the end it ends up replicating some of what we can do with centralized relays without as much flexibility. |

**Proposed Resolution**

With the segmentation, we can have 1, 2, or 3 segments to divide up the channel. The proposal is to develop and employ the use of specific sets of preambles that are used to identify what segmentation scheme is going on. The following examples illustrate this concept:

* ***One Segment:*** In this case there is only one segment (0), that occupies the whole channel. We can use the (legacy) Frame Preamble from the base standard to indicate the existence of the DRZ. Advanced-CPEs would see this preamble, and realize there’s only one segment that occupies the entire channel (all 60 sub channels). Legacy CPE’s would see the (legacy) Frame Preamble and act accordingly (as defined in IEEE Std 802.22-2011).
* ***Two Segments:*** In this case there are two segments (0 and 1). One way to structure the segments is to have each segment splits the channel evenly, e.g. Segment0 occupies sub channels 1-30, and Segment1 occupies sub channels 31-60. If we were to support variable-sized segments, additional configuration signaling and/or processing would be required in scanning the FCH of each segment. In either case we need a local frame preamble, specific to each of 2 segments in a 2 segment configuration. For example, I would call these LocalFramePreambleA and LocalFramePreambleB. An R-CPE can only occupy a single segment in a given zone.
* ***Three Segments:*** In this case there are three segments (0, 1, and 2). One way to structure the segments is to have each segment splits the channel evenly, e.g. Segment0 occupies sub channels 1-20, and Segment1 occupies sub channels 21-40, and Segment2 occupies sub channels 41-60. If we were to support variable-sized segments, additional configuration signaling and/or processing would be required in scanning the FCH of each segment. In either case, we need a local frame preamble, specific to each of 3 segments in a 3 segment configuration. For example, I would call these LocalFramePreambleC, LocalFramePreambleD, and LocalFramePreambleE. An R-CPE can only occupy a single segment in a given zone.

In considering using segment-specific preambles to help identify the segmentation scheme, whereby the segments are even in size, we must consider how this affects Advanced CPEs. When the segmentation setup is signaled to the R-CPE, the MR-BS would have the R-CPE on how many segments are enabled, in addition to which segment it is assigned to. So if a R-CPE is told that there are 3 segments and it is assigned segment 2, that R-CPE will transmit LocalFramePreambleE, and will occupy sub channels 41-60 (with the new FCH/MAPs will start at subchannel 41). Advanced-CPEs closer to the R-CPE would detect/sync to LocalFramePreambleE and know exactly where to look for that segment’s FCH/MAP starting at subchannel 41. If only 1 segment is enabled in the zone an R-CPE is assigned to, then the R-CPE would only transmit the (legacy) Frame Preamble as defined in IEEE Std. 802.22-2011. In single segment situations, when the Advanced CPEs detect the (legacy) Frame Preamble, they would know to search for FCH/MAPs starting on subchannel 1. Advanced CPEs can also attach directly to the MRBS if they detect the MRBS’s (legacy) Frame Preamble transmission to be stronger than a R-CPE’s.

Using the previous example as a template, we must also consider how variable-sized segments affect Advanced CPEs. With variable-sized segments we can support a total of 2 or 3 total segments. Upon detection the Local Frame Preamble type specific to the segment # and total # of segments, the Advanced CPE can navigate the segments in one of two ways:

1. Starting with the beginning of the 1st segment, which starts at subchannel 1, scan each segment’s DRZ-FCH to learn the bounds of each segment. Then advanced to the next segment, and continue scanning segment FCHs until you reach the start of the segment indicated by the Local Frame Preamble type.
2. Add additional information to the 1st segment’s DRZ-FCH. This additional fields or an IE would define where the start of each region is. Then the Advanced CPE would only have to scan the 1st segment’s DRZ-FCH in addition to its own.

In considering using segment-specific preambles to help identify the segmentation scheme, we must consider how this affects legacy CPEs. Legacy CPEs would only be able to attach through distributed R-CPE or MR-BS, if the zone the distributed R-CPE is assigned is configured to only use 1 segment. When only 1 segment is enabled, the distributed R-CPE transmission of the (legacy) Frame Preamble from the based standard, precedes the DRZ. Otherwise, legacy CPEs can attach directly to the MRBS if they detect the MRBS’s (legacy) Frame Preamble transmission to be stronger than the distributed R-CPE’s.

Concerning the operation of PHY Mode 1 and 2, we use a specific preamble to indicate the PHY mode as well as segment configuration for the AZ, CRZ, and DRZ/DRZ-segments. We add a configuration item to the DS Multi-Zone Configuration IE to inform a R-CPE what PHY mode to operate zone it’s being configured for. We do not add the same configuration item to the US Multi-zone Configuration IE, under the assumption the PHY mode for the US portion of a zone is the same used for the DS portion of the same zone.

The Legacy CPEs only recognize the Legacy Frame Preamble. If the Legacy CPE detects the Legacy Frame Preamble, it operates it will operate its’ own PHY as defined in the base standard. The Legacy CPE would ignore any of the Local Frame Preamble Types. If the Advanced CPE detects the Legacy Frame Preamble, it immediately notes that there is a single segment in the zone that zone is operated in PHY Mode 1. If the Advanced CPE detects any of the Local Frame Preamble Types, it configures the segmentation and PHY mode of the zone as defined in the “Local Frame Preamble Configurations” table below.

The following issues need to be considered when evaluating this document as a proposed method to resolve Comment 218 and clarify the segmentation operation in DRZ (***issues highlighted in bold & italics still remain open***):

1. The proposed solutions above assume that a distributed R-CPE can operate on only a single segment of a specific zone. For a distributed R-CPE to operate on multiple segments, it would have to be configured (via the DS Multizone Configuration message) to operate a segment in each unique zone assigned to it.
2. We need to explicately indicate that the MR-BS will still have to make use of and transmit the (legacy) Frame Preamble from the base standard. If this point is adequately covered in the draft (in its’ current state), then no additional text of modification of existing text is necessary. Inidicating use of the (legacy) Frame Preamble, is important. It’s required to facilitate servicing legacy CPE’s, if those legacy CPEs are not near an R-CPE that has segmentation disabled (e.g. only 1 segment) or is only near R-CPEs that have segmentation enabled (e.g. set up with 2 or 3 segments).
3. The proposed solution supposes that either 1, 2, or 3 segements are present in a given zone, and that given the number of segments assigned to zone, the number of subchannels is distributed evenly between the zones.
4. Based on some earlier discussion, the Local Cell concept may not persist past this version of the draft. The proposed solution discussed above presupposes that the Local Cell concept is redundant with the unique identifier of each R-CPE (i.e. the R-CPE’s Station ID).
5. It is technically feasible to support variable sized segments. However, doing so would either add processing complexity or introduce delay with regard to the how each Advanced CPE processes the control information broadcast in each segment. ***So at this time, the Proposed Text Modifications in the next section of this document reflect a static, equally sized segments***.
6. ***We are adding a more complete set of Local Frame Preamble Types, each of which is differentiated by a sequence mapped to a specific set of subcarriers. Splitting up to 10 ways, as we have specified in the “Local Frame Preamble configurations” table below, may deteriorate correlation performance in the frequency domain. An alternate way of using the sequence or mapping the sequence to a set of subcarriers for each Local Frame Preamble Type or will have to be discussed before this proposal can be accepted as a way to handle CID 218 and 216.***

**Proposed Text Modifcations to draft**

***Modify the 4th paragraph, pg 312 of section 9.4 “Superframe and frame structures” in IEEE Std. 802.22-2011 as follows***

The other allocated frames of the superframe that the BS transmits, shall contain successively a frame preamble, the FCH and the DS-MAP, US-MAP, DCD, and UCD messages when needed, and the data bursts. Concerning the operations of the MR-BS and distributed R-CPEs, the other allocated frames of the superframe and segments within relay zones of those frames shall make use of the (legacy) Frame Preamble (9.4.1.1), and may use of the Local Frame Preamble Types A-K (see 9.4.1.5) to indicate the start of that frame or zone. After the transmission of a (legacy) Frame Preamble or a Local Frame Preamble Type (see 9.4.1.5), the frames or segments within relay zones of those frames shall be followed by the FCH, DS-/US-MAPs, DCD/UCD messages, and data bursts.

***Insert new field into Table F1 before “Used Segment Bitmap” as follows***

|  |  |  |
| --- | --- | --- |
| # of segments | 2 bits | 00 = 1 segment01 = 2 segments10 = 3 segments11 = If ‘Zone Mode’ is set to Access or Centralized Relay Zone |

***Modify “Used Segment Bitmap” field of Table F1 as follows***

|  |  |  |
| --- | --- | --- |
| Used Segment ~~Bitmap~~Indicator | ~~4~~2 bits | 00~~Bit 1~~: Segment 001~~Bit 2~~: Segment 110~~Bit 3~~: Segment 211~~Bit 4~~: ~~Reserved~~~~Segmentation is only used in distributed relay zone~~If ‘Zone Mode’ is set to Access or Centralized Relay Zone |

***Insert new field into Table F1 after “Used Segment Inidcator” as follows***

|  |  |  |
| --- | --- | --- |
| PHY Mode for Zone | ~~4~~ bits | 0x0: PHY Mode 10x1: PHY Mode 20x2-0xF: Reserved |

***Modify the text on lines 61-65 on pg 20, section 7.4b2 as follows***

For the IEEE 802.22b MR-WRAN on either PHY mode ~~2~~, the subchannels of the DRZs in the downstream and upstream subframes can be grouped by up to 3 segments with the same number of subchannels as shown in Figure E1. The available subchannels are evenly distributed between each segement when segmentation is configured. For two segments-per-zone configuration the first segment occupies subchannels 1-30, and the second occupies subchannels 31-60. For three segments-per-zone configuration, the first segment occupies subchannels 1-20, the second occupies subchannels 21-40, and the third occupies subchannels 41-60. The segmentation can be scheduled by the MR-BS, and each segment is assigned to the different distributed scheduling R-CPEs. This segmentation is used to increase network capacity.

***Insert the following paragraph and table after line 47, pg 185 in section 9a4.1.1***

In distributed relay zone, R-CPEs will transmit their own Local Frame Preamble. The Local Frame Preamble chosen shall be dependent upon the number of segments configured, what segment a R-CPE is assigned to (see DS Multizone Configuration IE section x.x.x.x), as well was indicating what PHY mode is being operated in the zone. Table xx indicates the various operations for segmentation and PHY mode configuration and which Local Frame Preamble is applicable to each one.

When only one segement is configured, the distributed R-CPE makes use of the Legacy Frame Preamble (see 9.4.1.1) or Local Frame Preamble Type A. Advanced CPEs shall treat transmission and detection of the Legacy Frame Preamble, as detection of a single segment that occupies the entire channel for the given zone and is configured to operate in PHY Mode 1. Advanced CPEs shall treat the transmission and detection of Local Frame Preamble Type A, as detection of a single segment that occupies the entire channel for the given zone and is configured to operate in PHY Mode 2.

Only Advanced S-CPEs, centralized R-CPEs, and distributed R-CPEs shall process Local Frame Preamble Type A-K.

Legacy CPEs shall treat detection of the Legacy Frame Preamble transmission by an distributed R-CPE as they would treat the Legacy Frame Preamble from the BS/MRBS (as defined in 9.4.1.1. Legacy CPEs will ignore the Local Frame Preamble Types A-K (see Table xx).

Table xx - Local Frame Preamble Configurations

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Local Frame Preamble Type** | **Number of segments** | **Segment ID (as recognized by Advanced CPE)** | **PHY Mode for Zone** | **n** | **Wk (Series to modulate)** |
| Frame Preamble (9.4.1.1) | 1 | 0 | 1 | N/A | N/A |
| Local Frame Preamble Type A | 1 | 0 | 2 | 0 | 0xA6F294537B285E1844677D133E4D53CCB1F182DE00489E53E6B6E77065C7EE7D0ADBEAF |
| Local Frame Preamble Type B | 2 | 0 | 1 | 1 | 0x668321CBBE7F462E6C2A07E8BBDA2C7F7946D5F69E35AC8ACF7D64AB4A33C467001F3B2 |
| Local Frame Preamble Type C | 2 | 1 | 1 | 2 | 0x1C75D30B2DF72CEC9117A0BD8EAF8E0502461FC07456AC906ADE03E9B5AB5E1D3F98C6E |
| Local Frame Preamble Type D | 3 | 0 | 1 | 3 | 0x5F9A2E5CA7CC69A5227104FB1CC2262809F3B10D0542B9BDFDA4A73A7046096DF0E8D3D |
| Local Frame Preamble Type E | 3 | 1 | 1 | 4 | 0x82F8A0AB918138D84BB86224F6C342D81BC8BFE791CA9EB54096159D672E91C6E13032F |
| Local Frame Preamble Type F | 3 | 2 | 1 | 5 | 0xEE27E59B84CCF15BB1565EF90D478CD2C49EE8A70DE3 68EED7C9420B0C6FFAF9AF035FC  |
| Local Frame Preamble Type G | 2 | 0 | 2 | 6 | 0xC1DF5AE28D1CA6A8917BCDAF4E73BD93F931C44F93C 3F12F0132FB643EFD5885C8B2BC  |
| Local Frame Preamble Type H | 2 | 1 | 2 | 7 | 0xFCA36CCCF7F3E0602696DF745A68DB948C57DFA9575B EA1F05725C42155898F0A63A248  |
| Local Frame Preamble Type I | 3 | 0 | 2 | 8 | 0x024B0718DE6474473A08C8B151AED124798F15D1FFCCD 0DE574C5D2C52A42EEF858DBA5  |
| Local Frame Preamble Type J | 3 | 1 | 2 | 9 | 0xD4EBFCC3F5A0332BEA5B309ACB04685B8D1BB4CB49F 9251461B4ABA255897148F0FF238  |
| Local Frame Preamble Type K | 3 | 2 | 2 | 10 | 0xEEA213F429EB926D1BDEC03ABB67D1DE47B4738F3E92 9854F83D18B216095E6F546DADE  |

***Modify text on line 58, pg 185 defined as follows***

n is the designating number of the preamble carrier-set indexed 0~~, 1, and 2~~ thru 10 (see Table xx)

***Modify text starting on line 63, pg 185 thru line 11 on pg 186 as follows***

Each segment uses a preamble composed of a single carrier-set in the following manner:

— ~~Segment 0~~Local Frame Preamble Type A uses preamble carrier-set 0 (n =0).

— ~~Segment 1~~Local Frame Preamble Type B uses preamble carrier-set 1 (n =1).

* ~~Segment 2~~Local Frame Preamble Type C uses preamble carrier-set 2 (n =2) .
* Local Frame Preamble Type D uses preamble carrier-set 3 (n =3) .
* Local Frame Preamble Type E uses preamble carrier-set 4 (n =4) .
* Local Frame Preamble Type F uses preamble carrier-set 5 (n =5) .
* Local Frame Preamble Type G uses preamble carrier-set 6 (n =6) .
* Local Frame Preamble Type H uses preamble carrier-set 7 (n =7) .
* Local Frame Preamble Type I uses preamble carrier-set 8 (n =8) .
* Local Frame Preamble Type J uses preamble carrier-set 9 (n =9) .
* Local Frame Preamble Type K uses preamble carrier-set 10 (n =10) .

In the case of Local Frame Preamble Type A and C~~segment 0~~, the DC carrier will not be modulated at all, and the appropriate PN will be discarded. Therefore, the DC carrier shall always be zeroed.

Each segment eventually modulates each third subcarrier. As an example, Figure BL1 depicts ~~the preamble of~~ Local Frame Preamble Type A (used when a segment 0 in a two segment configuration). In this figure, subcarrier 0 corresponds to the first subcarrier used in the preamble symbol.

***Modify the text on lines 27-34, pg 186 as follows***

The PN series modulating the preamble carrier-set is defined in Table XX. The series modulated depends on the segment ID used, ~~and~~ the number of segments configured~~IDcell parameter~~, and what PHY mode the zone is operated in. The defined series shall be mapped onto the preamble subcarriers in ascending order. ~~Figure BB1~~ Table XX includes the PN sequence in a~~n~~ hexadecimal format. The value of the PN is obtained by converting the series to a binary series (Wk) and mapping the PN starting from the MSB of each symbol to the LSB (0 mapped to +1 and 1 mapped to –1). For example, for Local Frame Preamble Type A (applied to segment 0 in two segment configuration for the zone), ~~Index = 0, IDcell=0, and Segment = 0 (~~the binary series to be applied is defined in the first row of Table XX~~BB1~~), Wk = 101001101111..., and the mapping shall follow: –1 +1 –1 +1 +1 –1 –1 +1 –1 –1 –1 –1....

***Remove Table BB1***

***After applying changes to 9a4.1.1, change # and title of section 9a4.1.1 “Frame Preamble” to “9.4.1.5 Local Frame Preamble for Distributed R-CPE & MR-BS”, move this section to after section 9.4.1.4 in the IEEE Std 802.22-2011***

***Add the following text after line 52, pg 193 section 9a4.2.1***

When distributed R-CPEs are configured to use segmentation the FCH is transmitted (starting) in the first available subchannel in the start of the segment. This means that when 2 segments are configured for the zone, segment 0’s FCH is transmitted starting the 1st subchannel, and segment 1’s FCH is transmitted on the 31st subchannel. When 3 segments are configured for the zone, segment 0’s FCH is transmitted starting on the 1st subchannel, segment 1’s FCH is transmitted starting on the 21st subchannel, and segment 2’s FCH is transmitted on the 41st subchannel.

***Modify text on line 56, pg 193, section 9a4.2.2.2 as follows***

The length of the DS-MAP PDU is variable and is defined in the FCH (9.4.1.5~~9a.4.2.1~~). This PDU shall be encoded

***Add the following after line 65, pg 193, section 9a4.2.2.2***

When distributed R-CPEs are configured to use segmentation the DS-MAP, US-MAP, DCD, and UCD are transmitted immediately following the the subchannel occupied for the FCH of that segment.

**References:**

[1] IEEE P802.22b WRAN Amendment: Enhancement for broadband services and monitoring applications Draft 1.0 WG Letter Ballot Template, DCN 22-13/158r2, https://mentor.ieee.org/802.22/dcn/13/22-13-0158-02-000b-802-22b-letter-ballot-1-comment-database.xls