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| Title | **Signaling support for two-hop and multihop frame structure** |
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| Re: | Call for technical proposals 802.16j-06/034. |
| Abstract | The contribution defines the signaling required to enable definition of DL & UL relay zones, as introduced in the baseline document in meeting #46. It also defines the structure of the DL_Frame_Prefix message conveyed in the R-FCH. |
| Purpose | For discussion and approval of inclusion of the proposed text into the P802.16j baseline document. |
| Notice |  |
| Release |  |
| Patent Policy and Procedures |  |

# Signaling support for two-hop and multihop frame structure

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## Introduction

The baseline document [1] includes the definition of a new type of zone, referred to as a "relay zone", in the downlink and uplink subframe in order to facilitate MR-BS and RS to RS communication. As stated in [1] it is possible to include a multitude of relay zones in both the downlink and uplink subframes.

In order to support definition of these zones, clarification is required to define the messages that signal the existence, location and format of these zones within the subframe.

To this end, this contribution provides a text proposal for the baseline document that introduces two new MAP IEs that can be included into the DL and UL map messages transmitted by an MR-BS or RS on the access DL. These messages borrow much of their content and structure from the DL and UL zone switch IEs [2], however there are some small differences in the requirements between an access zone and relay zone, hence new messages are proposed to support proper definition.

Also proposed in this contribution is the message to be conveyed in the R-FCH [1] transmitted by the MR-BS or RS in the DL relay zone.

Finally, the two new IEs outlined above are also proposed to be supported in the R-MAP messages in order to define the existence, location and format of these zones in the subsequent frame.

## Proposed Messages

This contribution proposes two IEs for use in the DL-MAP and UL-MAP to indicate where a relay zone is located in the DL and UL subframes. These IEs can also be used in the R-DL-MAP and R-UL-MAP to indicate the location of the relay zones in the next frame, allowing the higher layers to control the relative amount of resource allocated to the access and relay links. The proposed IEs are shown in detail in the text proposal, in short they borrow much of their content from the zone switch IEs [2] but also indicate whether a relay zone preamble or relay postamble is present (note this will only be indicated in the first zone defined in the downlink, for all other zones this indicator is not supported).

If the RS does not successfully receive the R-DL-MAP and R-UL-MAP information in the relay link in any one frame, and hence looses the definition of the subsequent frame, it can always refer to the MAP in the access link to find the location again, resulting in minimal impact on performance in future frames.

In the R-FCH it is proposed to convey an R-DL-Frame_Prefix message, which is similar to the DL_Frame_Prefix message [2]. It contains the used subchannel bitmap indication for the case the zone was defined by a DL_Relay_Zone_IE with PUSC and 'use all subchannel indicator' set to zero. It also defines the modulation and encoding rate and type to be applied to the R-DL-MAP message as well as the R-DL-MAP message length. Unlike the access link where the DL-MAP is transmitted using a known modulation and coding rate, the R-FCH provides the capability to assign the effective modulation and coding rate, as well as coding type, to the R-DL-MAP. In the case the RSs attached to an MR-BS or RS all have good link quality, this enables a significant reduction in the MAP overhead to be achieved. Unlike in the access link and with the DL-MAP message , the MR-BS or RS will already have knowledge of the stations wishing to receive the R-DL-

MAP message, hence it is feasible that the MR-BS or RS would be able to intelliegently adjust the FEC encoding type applied to the R-DL-MAP.

Finally, the R-DL-MAP and R-UL-MAP message is proposed to be carried only in the first relay zone on the DL. The MAP IEs within the messages will then define the bursts on all relay zones. This minimizes overhead in the case more than one relay zone is defined at a station in a subframe. Consequently, it is also proposed that the R-FCH only be contained in the first relay zone on the downlink, as this will provide the necessary information to receive the R-DL-MAP information, which then specifies the necessary information to define all bursts in all relay zones.

## Conclusion

In conclusion the message required to support the frame structure defined in [1] is described in this contribution. The following text proposal therefore enables flexible definition of a multitude of relay zones.

## Proposed text changes

8.4.4.7.2.1 MR-BS frame structure

***[Change the third paragraph as indicated:]***

The first DL Relay_Zone in the subframe shall include an R-FCH and an R-MAP. In the DL Relay_Zone, the subchannel allocation may be the same as that in the DL Access_Zone. The R-FCH may be the same as the FCH in the DL Access_Zone. Other attributes of the MR-BS frame and the RS frame such as transition between modulation and coding, presence of multiple zones, may be the same as those described in 8.4.4.2.

***[Insert the following text at the end of subclause:]***

The R-FCH contains the DL Relay_Zone_Prefix described in Section 8.4.4.7.3, which specifies the burst profile used to encode the R-DL-MAP message and the R-DL-MAP message length that immediately follows the DL Relay_Zone Prefix.

The relay zones in the downlink and uplink subframes are defined by the DL_Relay_Zone_IE and UL_Relay_Zone_IE respectively in the DL-MAP and UL-MAP messages. The DL_Relay_Zone_IE and UL_Relay_Zone_IE are used in the R-DL-MAP and R-UL-MAP to define the relay zones in the next frame.

***[Insert new subclause 8.4.4.7.3:]***

8.4.4.7.3 Downlink relay zone prefix

The DL_Relay_Zone_Prefix is a data structure transmitted in the first relay zone in the downlink subframe and contains information regarding the zone in which it is included and is mapped to the R-FCH.

Table x – Downlink relay zone prefix

| Syntax | Size | Notes |
|---|---|---|
| DL_Relay_Zone_Prefix() { | | |

| | | |
|---|---|---|
| **Used subchannel bitmap** | 6 bits | Bit #0: Subchannel group 0<br>Bit #1: Subchannel group 1<br>Bit #2: Subchannel group 2<br>Bit #3: Subchannel group 3<br>Bit #4: Subchannel group 4<br>Bit #5: Subchannel group 5<br>Bit #6: Subchannel group 6 |
| **R-DL-MAP FEC type** | 8 bits | Burst profile (FEC type see 11.4.2) used on R-DL-MAP message |
| **R-DL-MAP_Length** | 8 bits | |
| *Reserved* | 2 bits | Shall be set to zero |
| } | | |

**Used subchannel bitmap**
A bitmap indicating which groups of subchannels are used on the zone and on all other relay zones using PUSC in which 'Use all SC indicator' is set to '0' in DL_Relay_Zone_IE(). Value of '1' means used by this segment and '0' means not used by this segment.

**R-DL-MAP FEC Type**
Indicates the burst profile used for the R-DL-MAP (see 11.4.2).

**R-DL-Map_Length**
Defines the length in slots of the R-DL-MAP message that follows immediately the R-DL_Frame_Prefix.

***[Change the items in Table 277a in Section 8.4.5.3.2.1 as indicated:]***

09 DL_Relay_Zone_IE
~~09~~ 0A *Reserved*

***[Insert new subclause 8.4.5.3.28:]***

8.4.5.3.28 DL_Relay Zone_IE

In the DL-MAP on the access link, an MR-BS or RS may transmit DIUC = 15 with the DL_Relay_Zone_IE() to define a relay zone in the DL subframe. In the R-DL-MAP, an MR-BS or RS may transmit DIUC = 15 with the DL_Relay_Zone_IE() to define a relay zone in the next frame.

In the case the IE defines the first relay zone in a DL subframe, it also defines whether a relay zone preamble is present at the start of this zone or whether a relay postamble is present at the end of the DL subframe.

Table 286xx – DL_Relay Zone_IE

| Syntax | Size | Notes |
|---|---|---|
| DL_Relay_Zone IE(){ | | |
| Extended DIUC | 4 bits | DL_Relay_Zone_IE = 0x09 |
| Length | 4 bits | |

| | | |
|---|---|---|
| OFDMA symbol offset | 8 bits | Denotes the start of the zone (counting from the frame preamble and starting from 0) |
| Permutation | 2 bits | 0b00 = PUSC<br>0b01 = FUSC<br>0b10 = Optional FUSC<br>0b11 = AMC 2x3 (2 bins by 3 symbols) |
| Use all SC indicator | 1 bit | 0 = Do not use all subchannels<br>1 = Use all subchannels |
| STC | 2 bits | 0b00 = No STC<br>0b01 = STC using 2 antennas<br>0b10 = STC using 3 antennas<br>0b11 = STC using 4 antennas |
| Matrix indicator | 2 bits | STC matrix (see 8.4.8.1.4)<br>if (STC == 0b10 or STC == 0b11)<br>{<br>0b00 = Matrix A<br>0b01 = Matrix B<br>0b10 = Matrix C<br>0b11 = *Reserved*<br>}<br>else if (STC == 0b01)<br>{<br>0b00 = Matrix A<br>0b01 = Matrix B<br>0b10-11 = *Reserved*<br>} |
| DL_PermBase | 5 bits | |
| PRBS_ID | 2 bits | Values: 0..2. Refer to 8.4.9.4.1. |
| Relay amble presence | 2 bits | 0b00 = Not present<br>0b01 = Relay zone preamble<br>0b10 = Relay postamble<br>0b11 = *Reserved* |
| Dedicated pilots | 1 bit | 0 = Pilot symbols are broadcast<br>1 = Pilot symbols are dedicated. An RS should use only pilots specific to its burst for channel estimation. |
| Reserved | 7 bits | |
| } | | |

**Relay amble presence**

If the DL_Relay_Zone_IE does not describe the first relay zone in a subframe then this value shall be set to 0b00. Otherwise it specifies whether a relay amble in the form of either a relay zone preamble or relay postamble is present.

***[Change the items in Table 290a in Section 8.4.5.4.4.1 as indicated:]***

0B UL_Relay_Zone_IE
0~~B~~C … 0F *Reserved*

***[Insert new subclause 8.4.5.4.29:]***

8.4.5.4.29 UL_Relay_Zone_IE

In the UL-MAP on the access link, an MR-BS or RS may transmit UIUC = 15 with the UL_Relay_Zone_IE() to define a relay zone in the UL subframe. In the R-UL-MAP, an MR-BS or RS may transmit UIUC = 15 with the UL_Relay_Zone_IE() to define a relay zone in the next frame._

Table 286xx – UL_Relay_Zone_IE

| Syntax | Size | Notes |
|---|---|---|
| UL _Relay_Zone_IE(){ | | |
| Extended DIUC | 4 bits | UL_Relay_Zone_IE = 0x0B |
| Length | 4 bits | |
| OFDMA symbol offset | 7 bits | |
| Permutation | 2 bits | 0b00 = PUSC<br>0b01 = Optional PUSC<br>0b10 = AMC 2x3 (2 bins by 3 symbols)<br>0b11 = Reserved |
| UL_PermBase | 7 bits | |
| Use all SC indicator | 1 bit | 0 = Do not use all subchannels<br>1 = Use all subchannels |
| *Reserved* | 7 bits | Shall be set to zero |
| } | | |

## References

[1] IEEE 802.16 Relay TG, “Baseline Document for Draft Standard for Local and Metropolitan Area Networks Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems: Multihop Relay Specification”, IEEE 802.16j-06/026r1, 1 December 2006.

[2] IEEE Std. 802.16e-2005