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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-07/007r2.
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.
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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 if a relay zone amble is present (note this will only be indicated in the last transmitted 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 Bit #1: Subchannel group 1 Bit #2: Subchannel group 2 Bit #3: Subchannel group 3 Bit #4: Subchannel group 4 Bit #5: Subchannel group 5 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 0b01 = FUSC 0b10 = Optional FUSC 0b11 = AMC 2x3 (2 bins by 3 symbols)
Use all SC indicator	1 bit	0 = Do not use all subchannels 1 = Use all subchannels
STC	2 bits	0b00 = No STC 0b01 = STC using 2 antennas 0b10 = STC using 3 antennas 0b11 = STC using 4 antennas

Matrix indicator	2 bits	STC matrix (see 8.4.8.1.4)
		if (STC == 0b10 or STC == 0b11)
		{
		0b00 = Matrix A
		0b01 = Matrix B
		0b10 = Matrix C
		0b11 = *Reserved*
		}
		else if (STC == 0b01)
		{
		0b00 = Matrix A
		0b01 = Matrix B
		0b10-11 = *Reserved*
		}

DL_PermBase	5 bits	
PRBS_ID	2 bits	Values: 0..2. Refer to 8.4.9.4.1.
Relay amble presence	1 bits	0b00 = Not present 0b01 = Relay zone amble present
Dedicated pilots	1 bit	0 = Pilot symbols are broadcast 1 = Pilot symbols are dedicated. An RS should use only pilots specific to its burst for channel estimation.
}		

Relay amble presence

If the DL_Relay_Zone_IE does not describe the last transmitted relay zone in a DL subframe then this value shall be set to 0b0.

[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 0b01 = Optional PUSC 0b10 = AMC 2x3 (2 bins by 3 symbols) 0b11 = Reserved
UL_PermBase	7 bits	
Use all SC indicator	1 bit	0 = Do not use all subchannels 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-06/026r2, February 2007.
[2] IEEE Std. 802.16e-2005