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Re:	This contribution is response to call for technical proposal (IEEE 802.16j-06/027)
Abstract	This contribution proposes combined A&F and D&F relaying.
Purpose	For discussion and approval of inclusion of the proposed text into the P802.16j baseline document.
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A Proposal for combined A&F and D&F relaying

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1. Introduction

This contribution introduces a method of combined A&F and D&F relaying. A&F method is used for fast transmission such as fast feedback, and D&F method is used for user data transmission which needs more radio resource.

Whilst the combined A&F and D&F relaying introduced does require changes to the existing BS specification, it does not require any changes in the standard in terms of MS/SS features.

2. Proposed Method

There are two relaying methods as follows,

- A&F (Amplify and Forward)
- D&F (Decode and Forward)

Since A&F method is relaying signal or data from sender to receiver in time domain (i.e. without FFT, demodulation and FEC decoding) RS can relay signal or data with minimum delay by using A&F method. However Burst Profile for A&F relaying may be dominated by the radio link that has the worst condition between relay link and access link.

D&F method further classified two types which performs FEC decoding and reencoding (decoding and forward) and which does not perform FEC decoding and reencoding (demodulation and forward).

Decoding and forward is the most robust, hence higher modulation schemes can be used, because the Burst Profile on relay link and the Burst Profile on access link can be set individually. However it takes time to decode and reencode data in RS, RS takes a few frames to relay data from sender to receiver. In demodulation and forward method RS performs FFT and demodulation but not FEC decoding. It is possible to change the modulation scheme between relay link and access link, but coding rate can not be changed. The processing time of demodulation and forward method is much shorter than the decoding and forward method. But it is still longer than A&F method.

In this contribution, a combined A&F and D&F relaying is proposed. A&F method is used for fast transmission such as fast feedback, and D&F method is used for user data transmission which needs more efficient modulation scheme. In order to use both A&F and D&F method on the same frame, BS should decide the zone of frame for each relaying method, and notify the information about the region of frame to RS.

We should let the implementation issue that which type of relaying method is possible for use.

2.1. Direct relaying zone

In order that RS relays signal from sender to receiver in one frame by using A&F or D&F, the zone where RS receives the data should be allocated ahead of the zone where RS forwards. It can be specified either using DL/UL MAP or DCD/UCD.

Figure 1 shows the DL/UL subframe example of this proposal. Two direct relaying zones are defined. First direct relaying zone on DL subframe is the zone where RS should receive signal or data from BS, and second direct relaying zone on DL subframe is the zone where RS should forward signal or data to MS under RS. The direct relaying zone on UL subframe is also similar.

The other region of frame is used to transmit by using D&F method. On this region, RS encodes Burst(s) and decodes data by Burst Profile which is suitable for the forwarding link condition.

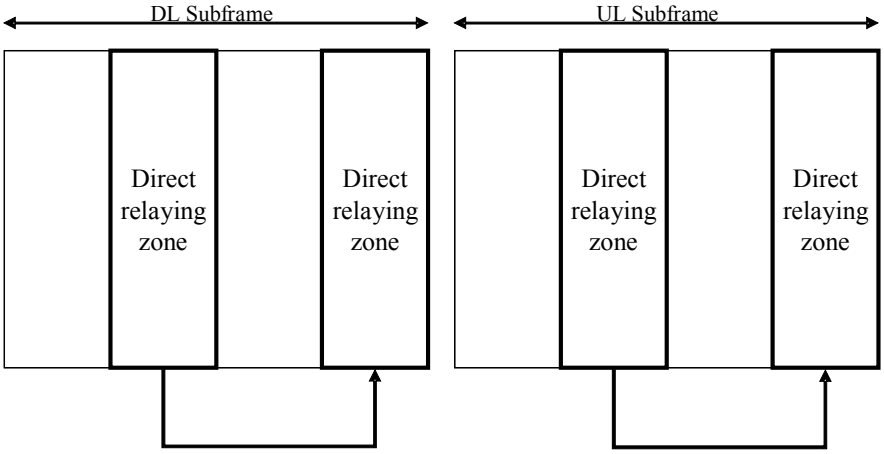

Figure 1 Direct relaying zones

In frame structure where access link zone is ahead of relay link zone, receiving direct relaying zone should be allocated on access link and forwarding direct relaying zone should be allocated on relay-link zone.

2.2. IE for Direct relaying zone

To realize combined in-frame A&F and D&F relaying, RS should recognize the direct relaying zone in advance. Since BS controls the communication between BS and RS, BS should decide the direct relaying zone of the frame and notify the information about the direct relaying zone to RS.

In this contribution, BS decides the direct relaying zone and the usage of this zone (e.g. Fast feedback is transmitted by using A&F), and notifies the information about the direct relaying zone to RS by DL/UL MAP including a value of frame offset parameter. RS starts to relay indicated by DL/UL MAP at frame defined by the value of frame offset. The value of frame offset is defined by the decoding delay of DL/UL MAP on RS. And the other parameters that BS notifies RS about the direct relaying zone are the following and figure 2 shows the relation these parameters and the frame.

1 symbol offset
2 number of symbol
3 interval symbols between receiving and forwarding

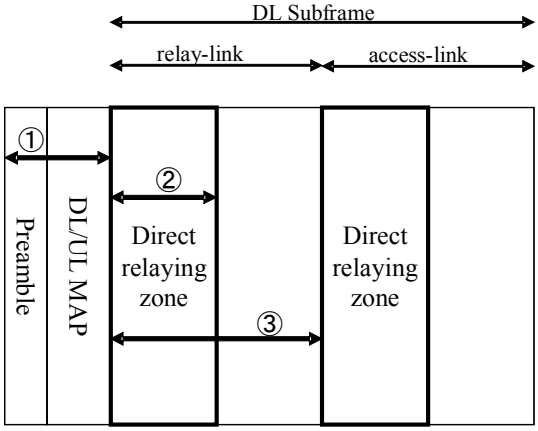

Figure 2 IE for Direct relaying zone

RS receives these parameters relays signal from sender to receiver on the zone indicated by these parameters. On the other region, RS relays data referring to DL/UL MAP sent by BS. Direct relaying zones can also be specified by DCD/UCD.

2.3. Example of usage

Figure 3 shows the usage example of direct relaying zone. In this example, fast feedback channel is relayed by using A&F method, and the other region is relayed by using D&F method. Since RS relays fast feedback signal without decoding and reencoding, RS is able to relay fast feedback signal to BS in the same frame where RS receives signal from MS.

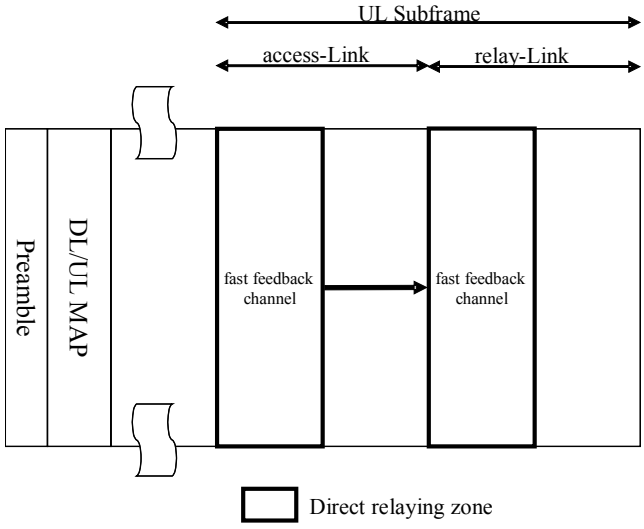

Figure 3 Usage of Direct Relaying zone

3. Specific text changes

[Change Table 277c as indicated.]

Table 277c—Extended-2 DIUC code assignment for DIUC=14

Extended-2 DIUC (hexadecimal)	Usage
00	MBS_MAP_IE
01	HO_Anchor_Active_DL_MAP_IE
02	HO_Active_Anchor_DL_MAP_IE
03	HO_CID_Translation_MAP_IE
04	MIMO_in_another_BS_IE
05	Macro-MIMO_DL_Basic_IE
06	Skip_IE
07	HARQ DL MAP IE
08	HARQ ACK IE
09	Enhanced DL MAP IE
0A	Closed-loop MIMO DL Enhanced IE
0B	Direct Relaying_DL Zone IE
~~0B-0D~~	~~*Reserved*~~
0C-0D	*Reserved*
0E	AAS_SDMA_DL_IE
0F	*Reserved*

Insert a new subclause 8.4.5.3.28

8.4.5.3.28 Direct Relaying DL Zone_IE format

This IE is sent by BS to RS to notify the zone for relaying without decoding and reencoding in RS on down link.

Table 286za - Direct Relaying DL Zone IE

Syntax	Size	Notes
Direct Relaying_DL_Zone IE() {		
Extended-2 DIUC=	4 bits	0x0B
Length	8 bits	
OFDMA Symbol offset	4 bits	

No. OFDMA symbols	4 bits	
Symbol offset for relaying	4 bits	
Period	3 bits	
Frame offset	3 bits	
Duration	6 bits	
}		

OFDMA Symbol offset
The offset of OFDMA symbols in which RS starts to receive signal from BS.
No. OFDMA symbols
The number of OFDMA symbols used for carrying signal from BS to RS.
Symbol offset for relaying
The offset of OFDMA symbols in which RS relays signal carried from BS.
Period(p)
RS relays signal indicated by this IE in every p frames.
Frame offset
RS starts to relay signal indicated by this IE at the frame defined by Frame offset from the current frame.
Duration(d)
RS relays signal indicated by this IE for d frames. If d==0b000, this zone is deallocated. If d==0b111, the RS should relay indicated by this IE until BS command for the RS to stop.

[Change Table 290a as indicated.]

Table 290a—Extended UIUC Code Assignment for UIUC=15

Extended UIUC (hexadecimal)	Usage
00	Power_control_IE
01	Mini-subchannel_allocation_IE
02	AAS_UL_IE
03	CQICH_Alloc_IE
04	UL Zone IE
05	PHYMOD_UL_IE
06	MIMO_UL_Basic_IE
07	UL-MAP_Fast_Tracking_IE
08	UL_PUSC_Burst_Allocation_in_Other_Segment_IE
09	Fast_Ranging_IE
0A	UL Allocation Start IE
0B~~… 0F~~	~~*Reserved*~~ Direct Relaying Zone UL IE
0C … 0F	*Reserved*

Insert a new subclause 8.4.5.4.29

8.4.5.4.29 Direct Relaying Zone UL_IE format

This IE is sent by BS to RS to notify the zone about relaying without decoding and reencoding on up link.

Table 302w - Direct Relaying UL Zone IE

Syntax	Size	Notes
Direct Relaying UL Zone IE() {		
Extended UIUC=	4 bits	0x0B
Length	4 bits	
OFDMA Symbol offset	4 bits	
No. OFDMA symbols	4 bits	
Symbol offset for relaying	4 bits	
Period	3 bits	
Frame offset	3 bits	
Duration	6 bits	
}		

OFDMA Symbol offset
The offset of OFDMA symbols in which RS starts to receive signal from MS
No. OFDMA symbols
The number of OFDMA symbols used for carrying signal from MS to RS
Symbol offset for relaying
The offset of OFDMA symbols in which RS relays signal carried from MS.
Period(p)
RS relays signal indicated by this IE in every p frames.
Frame offset
RS starts to relay signal indicated by this IE at the frame defined by Frame offset from the current frame.
Duration(d)
RS relays signal indicated by this IE for d frames. If d==0b000, this zone is deallocated. If d==0b111, the RS should relay indicated by this IE until BS command for the RS to stop.

11.3 UCD management message encodings
11.3.1 UCD channel encodings

[Change Table 349 in 11.3.1 "UCD channel encodings", as shown:]

Names	Type(1byte)	Length	Value (variable length)	PHY scope
Direct relaying zone	TBD	variable	Num region(6bits for the number of regions, 2 bit reserved) For (i=0; i< Num region; i++){ OFDMA symbol offset(4bits) No. OFDMA symbols(4bits)	

			Symbol offset for relaying(4 bits) }	

Demod + dec region	35	variable	Num region(for the number of regions, 2 bit reserved)
			For (i=0; i< Num region; i++){
			OFDMA symbol offset(8bits)
			subchannel offset(6bits)
			No. OFDMA symbols(8bits)
			No. subchannels(6bits)
			}	

Demod region	36	variable	Num region(6bits for the number of regions, 2 bit reserved)
			For (i=0; i< Num region; i++){
			OFDMA symbol offset(8bits)
			subchannel offset(6bits)
			No. OFDMA symbols(8bits)
			No. subchannels(6bits)
			}	

Mod region	37	variable	Num region(6bits for the number of regions, 2 bit reserved)
			For (i=0; i< Num region; i++){
			OFDMA symbol offset(8bits)
			subchannel offset(6bits)
			No. OFDMA symbols(8bits)
			No. subchannels(6bits)
			}	

Enc + Mod region	38	variable	Num region(6bits for the number of regions, 2 bit reserved)
			For (i=0; i< Num region; i++){
			OFDMA symbol offset(8bits)
			subchannel offset(6bits)
			No. OFDMA symbols(8bits)
			No. subchannels(6bits)
			}	

11.4 DCD management message encodings
11.4.1 DCD channel encodings

[Change Table 358 in 11.4.1 "DCD channel encodings", as shown:]

Direct relaying zone	TBD	variable	Num region(6bits for the number of regions, 2 bit reserved) For (i=0; i< Num region; i++){ OFDMA symbol offset(4bits) No. OFDMA symbols(4bits)	

			Symbol offset for relaying(4 bits) }	

Demod+dec region	35	variable	Num region(6bits for the number of regions, 2 bit reserved)
			For (i=0; i< Num region; i++){
			OFDMA symbol offset(8bits)
			subchannel offset(6bits)
			No. OFDMA symbols(8bits)
			No. subchannels(6bits)
			}	

Demod region	36	variable	Num region(6bits for the number of regions, 2 bit reserved)
			For (i=0; i< Num region; i++){
			OFDMA symbol offset(8bits)
			subchannel offset(6bits)
			No. OFDMA symbols(8bits)
			No. subchannels(6bits)
			}	

Mod region	37	variable	Num region(6bits for the number of regions, 2 bit reserved)
			For (i=0; i< Num region; i++){
			OFDMA symbol offset(8bits)
			subchannel offset(6bits)
			No. OFDMA symbols(8bits)
			No. subchannels(6bits)
			}	

Enc+mod region	38	variable	Num region(6bits for the number of regions, 2 bit reserved)
			For (i=0; i< Num region; i++){
			OFDMA symbol offset(8bits)
			subchannel offset(6bits)
			No. OFDMA symbols(8bits)
			No. subchannels(6bits)
			}	

4. References