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Title	<b>A Proposal for combined A&amp;F and D&amp;F relaying</b>	
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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 without FEC decodings and reencodings, 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.

On the other hand, D&F method is more 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 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.

### 2.1. A&F zone

In order that RS relays signal from sender to receiver in one frame by using A&F, the zone where RS receives for A&F relaying should be allocated ahead of the zone where RS forwards.

Figure 1 shows the DL/UL subframe example of this proposal. For using both A&F and D&F on the same frame, A&F zone is defined and the other region is used for D&F relaying. First A&F zone on DL subframe is the zone where RS should receive signal or data from BS, and second A&F zone on DL subframe is the zone where RS should forward signal or data to MS under RS. The A&F zone on UL subframe is also similar. RS which receives signal from sender on the A&F zone forwards signal with only power boosting.

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.

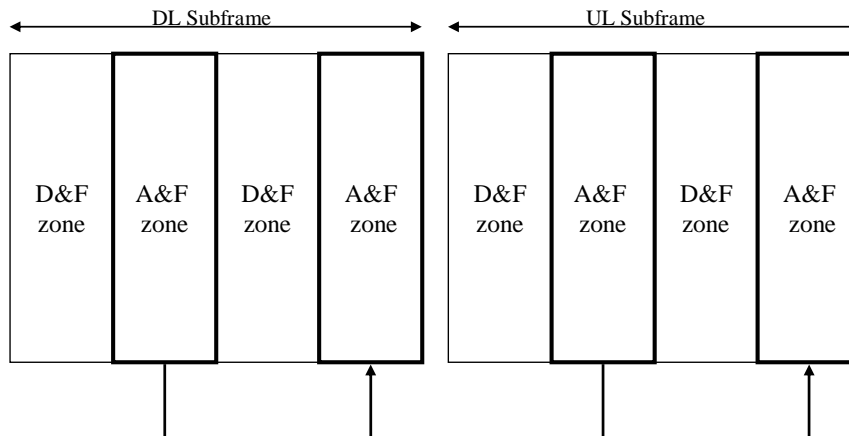


Figure 1 A&amp;F zone

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

## 2.2. IE for A&F zone

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

In this contribution, BS decides the A&F zone and the usage of this zone (e.g. Fast feedback is transmitted by using A&F), and notifies the information about the A&F zone to RS by DL/UL MAP including a value of frame offset parameter. RS starts to relay using A&F relaying 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 A&F 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

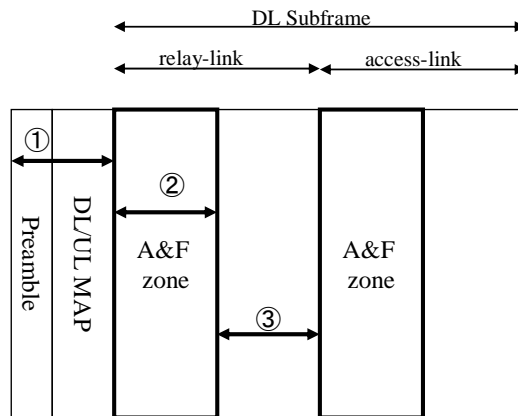


Figure 2 IE of A&F zone

RS receives these parameters relays signal from sender to receiver without decoding and reencoding on the zone indicated by these parameters. On the other region, RS relays data with decoding and reencoding referring to DL/UL MAP sent by BS.

### 2.3. Example of usage

Figure 3 shows the usage example of the A&F 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.

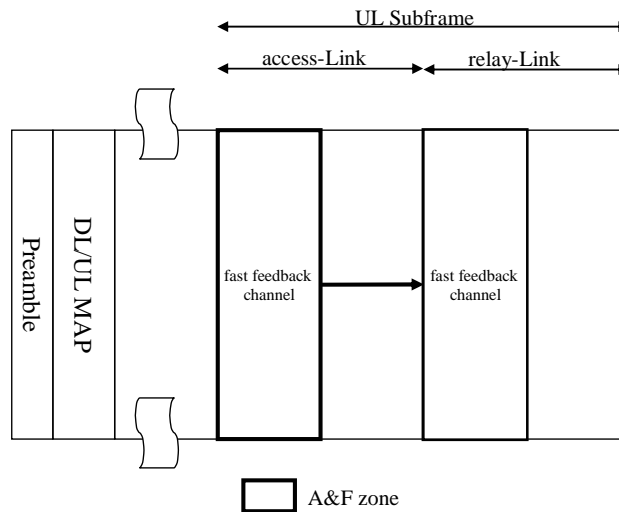


Figure 3 Usage of A&F zone

### 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
<u>0B</u>	<u>Direct Relaying DL Zone IE</u>
<del>0B - 0D</del>	<i>Reserved</i>
<u>0C-0D</u>	<i>Reserved</i>
0E	AAS_SDMA_DL_IE
0F	<i>Reserved</i>

*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

<u>Syntax</u>	<u>Size</u>	<u>Notes</u>
<u>Direct Relaying DL Zone IE() {</u>		
<u>Extended-2 DIUC=</u>	<u>4 bits</u>	<u>0x0B</u>

<u>Length</u>	<u>8 bits</u>	
<u>OFDMA Symbol offset</u>	<u>4 bits</u>	
<u>No. OFDMA symbols</u>	<u>4 bits</u>	
<u>Symbol offset for relaying</u>	<u>4 bits</u>	
<u>Period</u>	<u>3 bits</u>	
<u>Frame offset</u>	<u>3 bits</u>	
<u>Duration</u>	<u>6 bits</u>	
↓		

**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**

<b>Extended UIUC (hexadecimal)</b>	<b>Usage</b>
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	<del>Reserved</del> <a href="#">Direct Relaying Zone UL IE</a>
<a href="#">0C ... 0F</a>	<a href="#">Reserved</a>

*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

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

#### **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.

## **4. References**