Project	**IEEE 802.16 Broadband Wireless Access Working Group** <http://ieee802.org/16>	
Title	**Frame Structure for Bi-Directional Relay**	
Date Submitted	**2008-09-05**	
Source(s)	Masato Okuda, Yanling Lu and Kevin Power Fujitsu	E-mail: okuda@jp.fujitsu.com *<http://standards.ieee.org/faqs/affiliationFAQ.html>
Re:	SDD Session 56 Cleanup: Relay Frame Structure; in response to the IEEE 802.16m-08/033, Call for Contributions and Comments on Project 802.16m System Description Document (SDD)"	
Abstract	To propose relay frame structure to improve bandwidth usage efficiency.	
Purpose	To propose relay frame structures to be adopted to the 802.16m SDD	
Notice	*This document does not represent the agreed views of the IEEE 802.16 Working Group or any of its subgroups*. It represents only the views of the participants listed in the "Source(s)" field above. It is offered as a basis for discussion. It is not binding on the contributor(s), who reserve(s) the right to add, amend or withdraw material contained herein.	
Release	The contributor grants a free, irrevocable license to the IEEE to incorporate material contained in this contribution, and any modifications thereof, in the creation of an IEEE Standards publication; to copyright in the IEEE's name any IEEE Standards publication even though it may include portions of this contribution; and at the IEEE's sole discretion to permit others to reproduce in whole or in part the resulting IEEE Standards publication. The contributor also acknowledges and accepts that this contribution may be made public by IEEE 802.16.	
Patent Policy	The contributor is familiar with the IEEE-SA Patent Policy and Procedures: <http://standards.ieee.org/guides/bylaws/sect6-7.html#6> and <http://standards.ieee.org/guides/opman/sect6.html#6.3>. Further information is located at <http://standards.ieee.org/board/pat/pat-material.html> and <http://standards.ieee.org/board/pat>.	

Frame Structure for Bi-Directional Relay

Masato Okuda, Yanling Lu and Kevin Power
Fujitsu

Introduction

In the last meeting, two options of relay frame structure have been adopted to the SDD. As noted in the SDD, a single solution structure should be distilled for relay frame.

This contribution proposes to take the bi-directional relay frame structure (option-2) as a single solution for relay frame structure after clarifying several aspects below raised in the last meeting [1].

1. How would you do distributed scheduling
2. Control signaling
3. How would you do Power control
4. Need to investigate Interference DL to UL
5. Latency
6. Subchannelization scheme (DL/UL compatible)
7. Synchronization

Brief Introduction of Bi-directional Relay Frame Structure

The figure 1 shows an example of Bi-directional relay frame structure for a 2-hop relay system.

In the figure, it is assumed that BS and RS use different segments (frequency partitions) in order to avoid interference. That is, the BS uses segment#0 (frequency partition#0) to communicate with its subordinate MS and RS, while the RS uses segment#1 (frequency partition#1) to communicate with its subordinate MS.

During Bi-directional Receive or Transmit zone, the RS can receive or transmit radio signal from/to its superordinate and subordinate stations.

The distinct DL access zones in the BS and RS frames are used for synchronous transmission of preamble, MBS and so on.

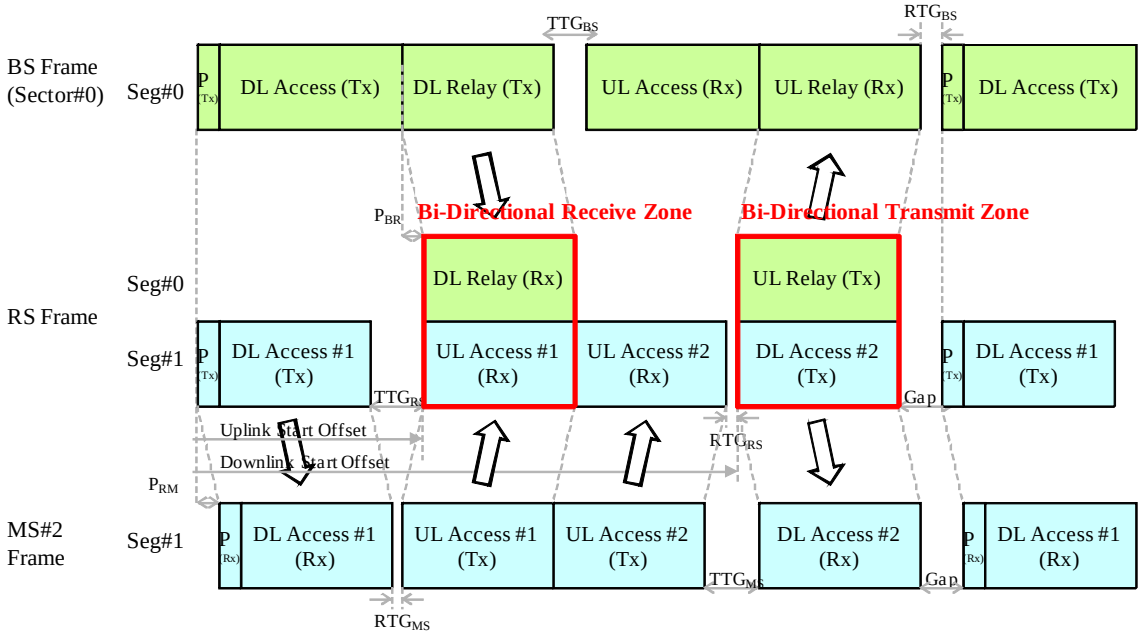


Figure 1 an example of bi-directional relay frame structure for 2-hop relay system

Clarification of Bi-directional Relay

1. How would you do distributed scheduling

A superordinate station should do scheduling to communicate with its subordinate stations.

In the figure 1, for example, BS should control DL/UL bandwidth allocation of the segment#0 (frequency partition#0), while RS should control bandwidth allocation of the segment#1 (frequency partition#1). In other words, during the bi-directional receive zone, the RS receives signal from the BS based on the DL-MAP sent by the BS while it receives signal from the MS based on the UL-MAP sent by the RS itself.

2. Control Signaling

In principle, a superordinate station always controls its subordinate stations.

3. How would you do Power control

A superordinate station should control transmission power of its subordinate stations.

In the bi-directional transmit zone, the RS' Tx power to its BS or its superordinate RS should controlled by the BS or the superordinate RS. On the other hand, the RS's Tx power to its subordinate stations should be configured by the BS or other management entity according to cell planning.

The figure 2 shows an example of transmission power control in two-hop relay system.

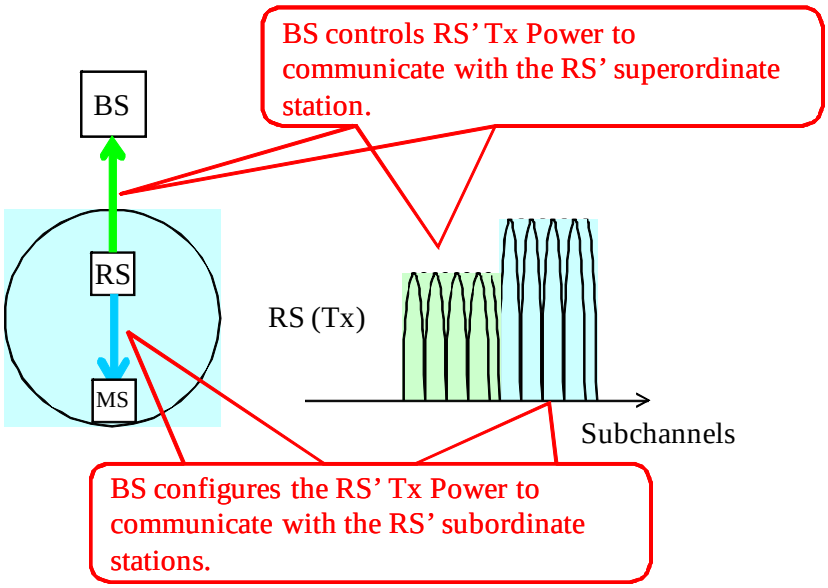


Figure 2 An example of Transmission Power Control

4. Need to investigate Interference DL to UL

The figure 3 shows possible interference from RS DL to BS UL.

This interference can be avoided by proper RS configuration considering;

- RS/BS antenna pattern
- RS Tx power control (DL and UL separately)
- Path Loss

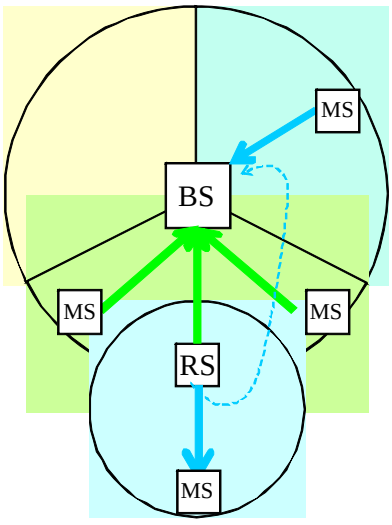


Figure 3 Interference from RS DL to BS UL

5. Latency

The figure 4 shows an example of relay latency.

As shown in the figure, relaying within a frame can be possible. On the other hand, option 1 cannot support data relaying within a frame.

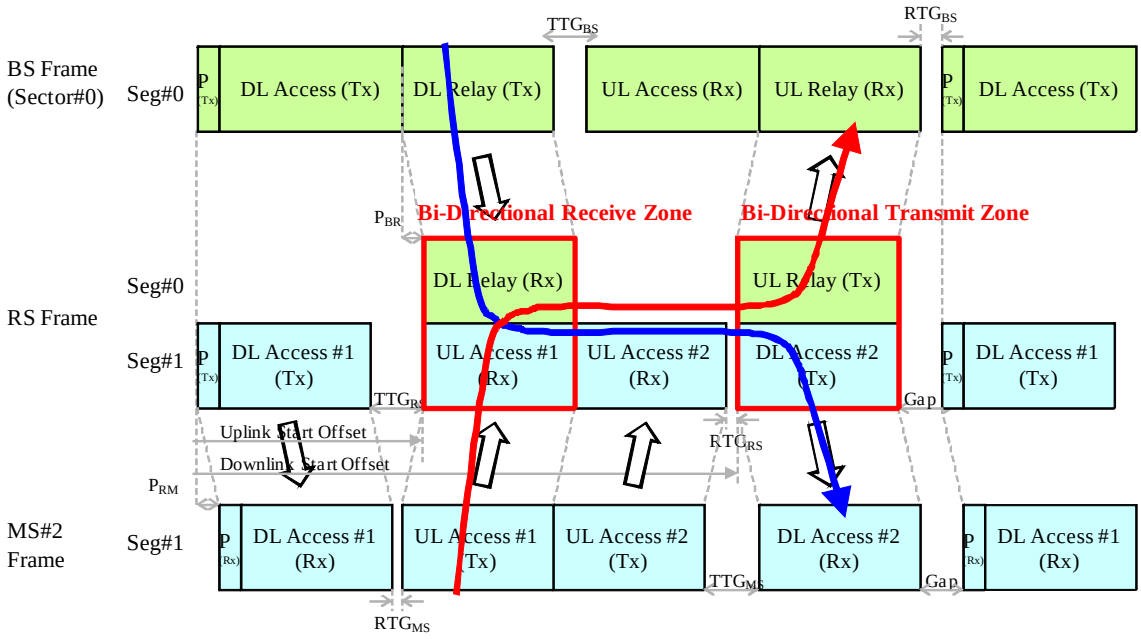


Figure 4 Relay Latency

6. Subchannelization scheme (DL/UL compatible)

According to the SDD, Subcarriers are divided into multiple frequency partitions. Each frequency partition can be used for uplink and downlink, since physical resource unit (PRU) size of DL and UL is same. Within the frequency partition, subchannelization and pilot structure can be defined.

The figure 5 shows subcarrier to resource unit mapping defined in the SDD.

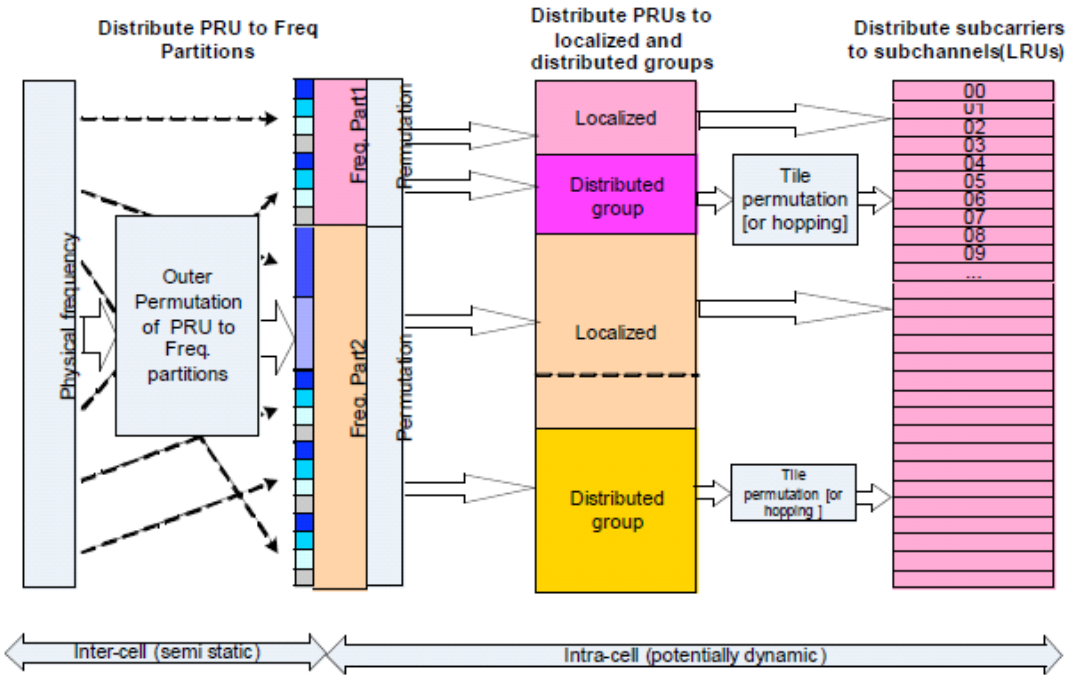


Figure 5 Subcarrier Mapping

7. Synchronization

Superordinate station may transmit ‘Relay amble’ to its subordinate RS in the bi-directional transmit zone every n-frames.

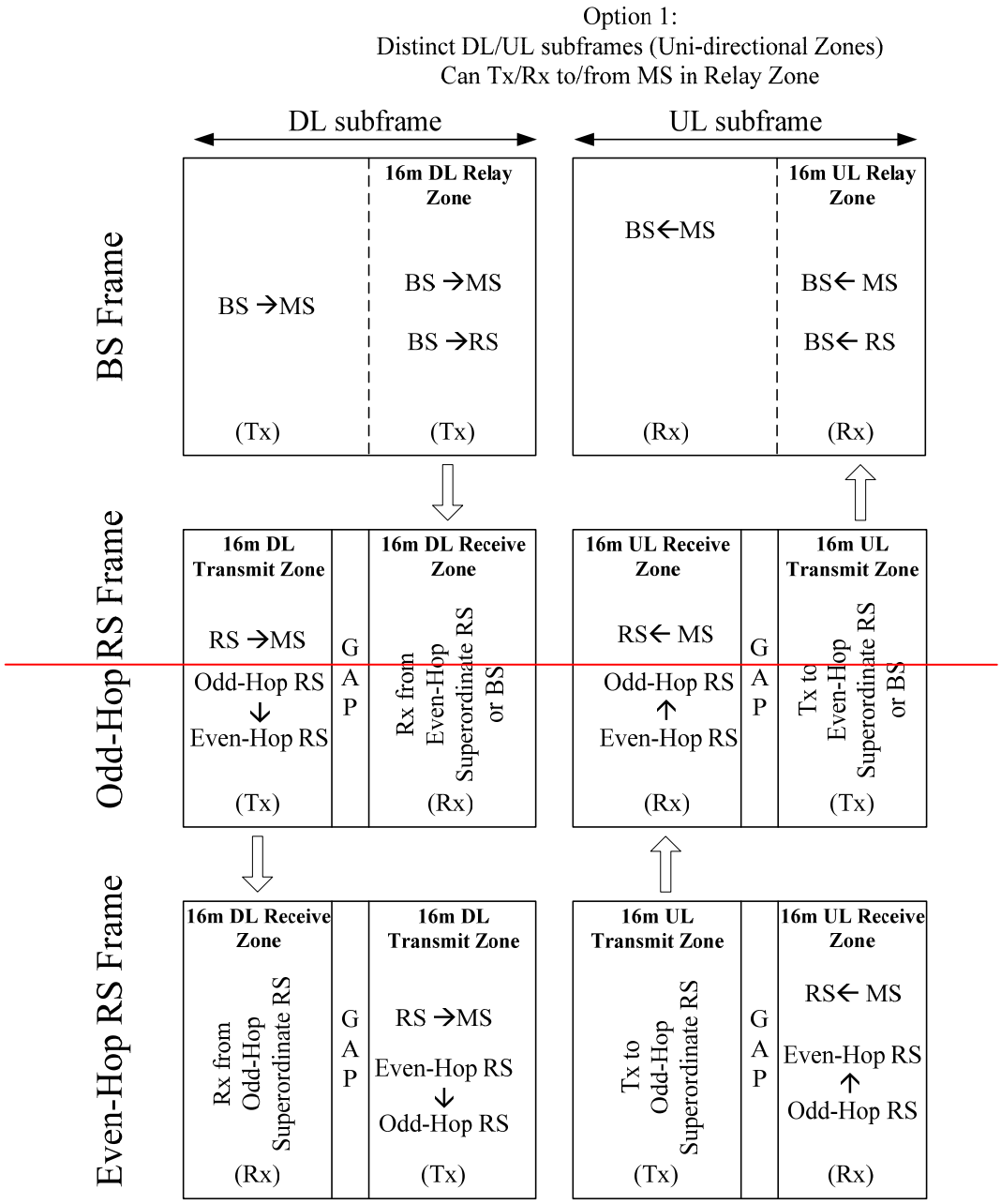
Proposed Text to the SDD

[Change the following text at the line 7-8 page 39 in the subclause 11.4.4 (Relay Support in Frame Structure) as indicated]

~~There are two options for the Relay frame structure. These are captured in Figure 23 and Figure 24. Further study is required to distill a single frame structure from among these two options.~~

Figure 24 shows the Relay frame structure.

[Delete the following figure and text at page 40-41 in the subclause 11.4.4 (Relay Support in Frame Structure)]



~~Figure 1 ***Relay Frame structure option 1***~~

~~Definitions corresponding to Option 1 shown in Figure 23~~

- ~~DL Relay Zone: An integer multiple of subframes located in the 16m zone of the DL of the BS frame, where a 16m BS can transmit to the 16m RSs and the 16m MSs.~~
- ~~UL Relay Zone: An integer multiple of subframes located in the 16m zone of the UL of the 16m BS frame, where a 16m BS can receive from the 16m RSs and the 16m MSs.~~
- ~~DL Transmit Zone: An integer multiple of subframes located in the 16m zone of the DL of the 16m RS frame, where a 16m RS can transmit to subordinate 16m RSs and the 16m MSs.~~
- ~~DL Receive Zone: An integer multiple of subframes located in the 16m zone of the DL of the 16m RS~~

~~frame, where a 16m RS can receive from its superordinate station.~~

- ~~UL Transmit Zone: An integer multiple of subframes located in the 16m zone of the UL of the 16m RS frame, where a 16m RS can transmit to its superordinate station.~~
- ~~UL Receive Zone: An integer multiple of subframes located in the 16m zone of the UL of the 16m RS frame, , where a 16m RS can receive from its subordinate 16m RSs and the 16m MSs.~~

[Delete the following text on the top of the figure 24 in the subclause 11.4.4 (Relay Support in Frame Structure)]

~~Option 2:~~

~~Bi-Directional Zones~~

~~Distinct DL/UL Access Zone~~

[Change the title of the figure 24 in the subclause 11.4.4 (Relay Support in Frame Structure) as indicated]

Figure 24 Relay Frame structure ~~option 2~~

[Delete the following text at the line 3 the page 42 in the subclause 11.4.4 (Relay Support in Frame Structure)]

~~Notes related to Figure 24: An explicit access zone may or may not be present.~~

[Change the text from the line 5 the page 42 in the subclause 11.4.4 (Relay Support in Frame Structure) as indicated]

Definitions of zones ~~corresponding to Option 2~~ shown in Figure 24

- Bi-directional Transmit Zone: An integer multiple of subframes located in the 16m zone of the RS frame where transmission to superordinate as well as subordinate station takes place on different frequency partitions. Synchronization signal (known as ‘relay amble’ in the 16j) may be transmitted to subordinate RS.
- Bi-directional Receive Zone: An integer multiple of subframes located in the 16m zone of the RS frame where reception from superordinate as well as subordinate station takes place on different frequency partitions. Synchronization signal (known as ‘relay amble’ in the 16j) may be transmitted by the superordinate station.
- 16m DL Access Zone: An integer multiple of subframes in the 16m zone where 16m BS or a 16m RS transmits to the 16m MSs.
- 16m UL Access Zone: An integer multiple of subframes in the 16m zone where BS or an RS receives from the MSs.

References

[1] C802.16m-08_848r2, “IEEE 802.16m Relay Ad HoC Group – Final Report”.

[2] IEEE802.16m-08_003r4, “The Draft IEEE 802.16m System Description Document”