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Re:	Call for Technical Comments and Contributions regarding IEEE Project P802.16j (IEEE 802.16j-07/007r2)	
Abstract	This contribution proposes zone sharing between access and relay zones.	
Purpose	Adoption of proposed text into P802.16j	
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Sharing relay zone with access link

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1 Introduction

In the 16j baseline document [1], access zone and relay zone were defined in a MR frame. To enable flexible PHY scheduling, the zone boundary between access and relay zones may change frequently. As an alternative of the PHY scheduling that does not change the position of zone boundary, zone sharing is proposed.

2 Frame structure discussion

2.1 Reference Model

Figure 1 shows a simple network model of two-hop relay with four mobile stations (MSs).

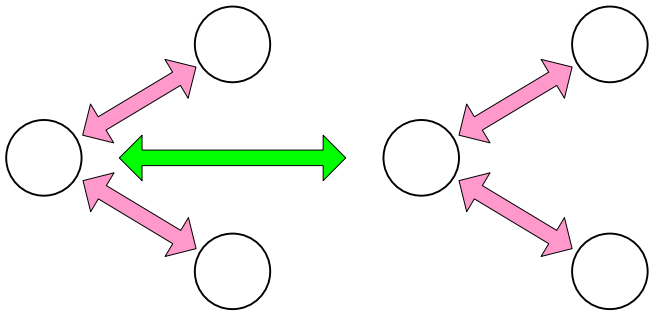

Figure 1 A Simple Two-hop Multihop Relay Network Model

Example of frame structure of the Figure 1 is described in Figure 2.

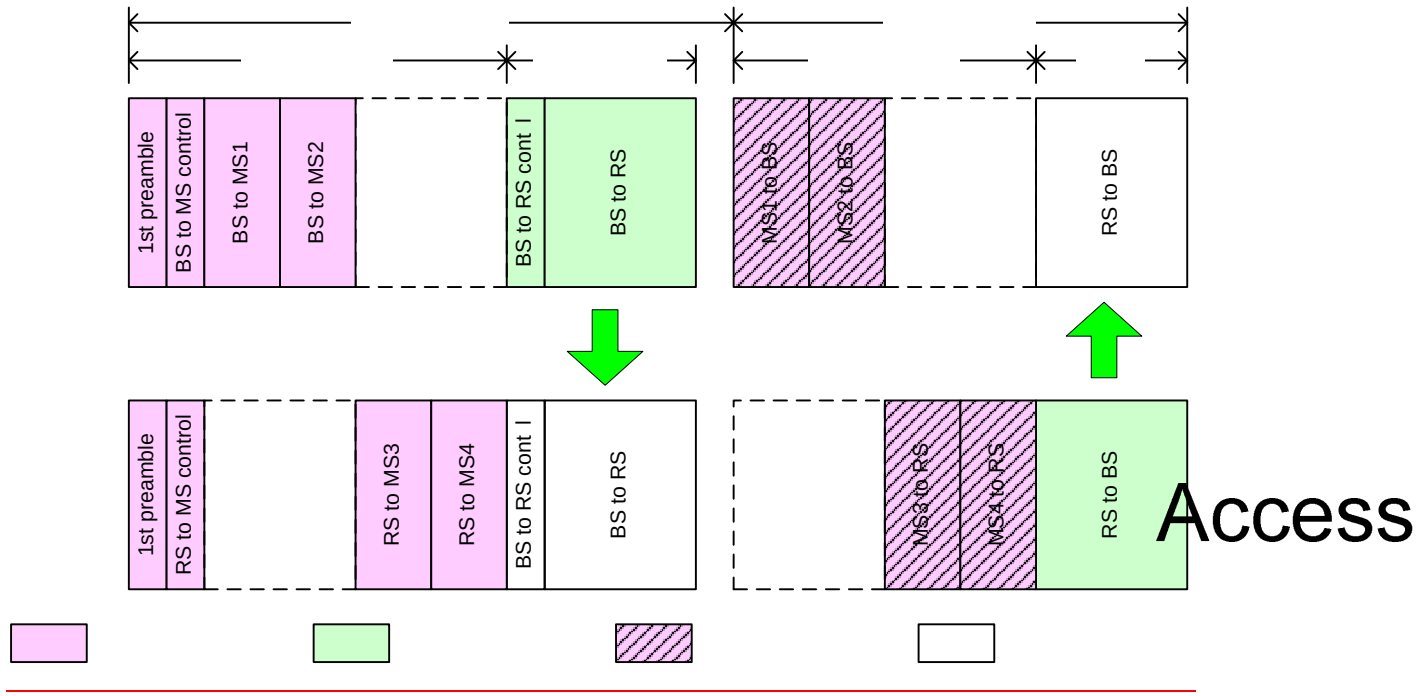

Figure 2. Frame structure example

Assumptions

To focus on PHY scheduling matter and to make the discussion simpler, followings are assumed in this document.

- No RS amble is considered
- All access links and relay links use same burst profile
- Fair scheduling that all MSs communicate with same data rate
- Transition gaps between zones are not considered here
- No intra-cell interference is considered

2.2 Case study for relay

2.2.1 Case study: MS2 dropping

To discuss PHY scheduling, the case when one MS is dropping is studied. Figure 3 shows the network model with three MSs. The BS communicates directly with MS1 and indirectly with MS3 and MS4 through RS.

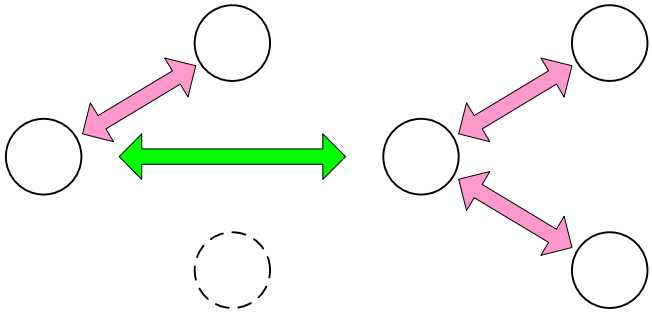

Figure 3. Case Study 1

Figure 4 shows expected frame structure for case study 1.

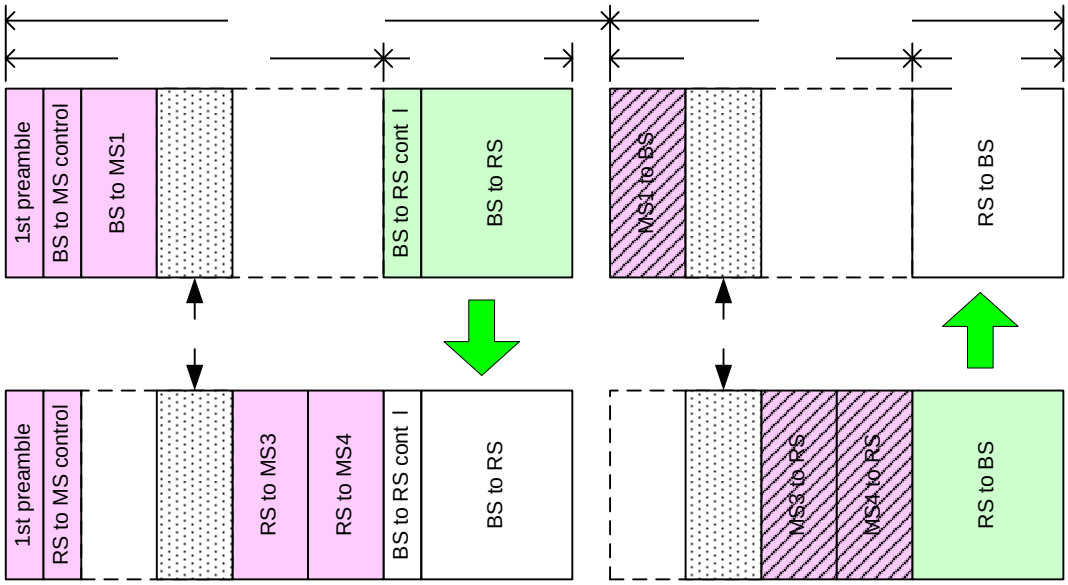

Figure 4 Expected frame structure

When MS2 is dropped, the radio resource that was used by MS2 is re-assigned to other MSs. The reassignment of the radio resource is performed based on following assumption.

$$\textit{Amount of Radio Resource}_{(BS\ to\ RS)} = \textit{Radio Resource}_{(RS\ to\ MS3)} + \textit{Radio Resource}_{(RS\ to\ MS4)}$$

2.3 PHY scheduling with zone boundary change

Figure 5 shows modified frame structure.

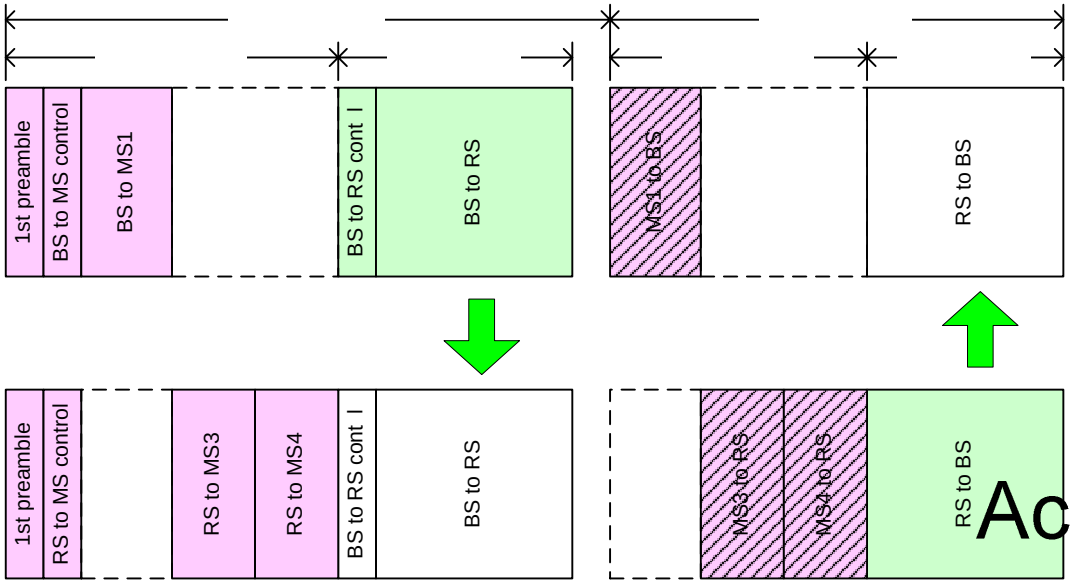

Figure 5 Modified frame structure (three MSs)

When fair scheduling that all MSs communicate with same throughput is considered, zone boundary between access zone and relay zone will be changed in response to traffic change.
Figure 6 shows comparison of the boundary for 4 MS case and 3 MS case.

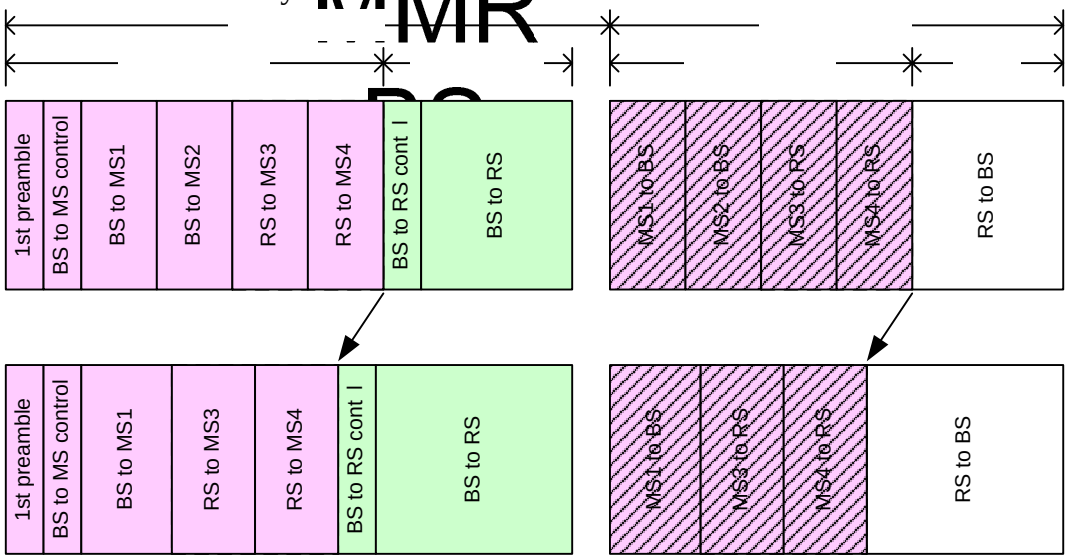

Figure 6 Comparison of zone boundary for 3 MS case and 4 MS case (superimposed)

2.4 PHY scheduling with zone sharing

As an alternative of the zone boundary change, zone sharing is discussed.
Figure 7 shows alternative of PHY scheduling with zone sharing for Figure 1 (4 MS case). Relay zone is shared with access link to MS2. This scheme allows BS to communicate with MS in relay zone.

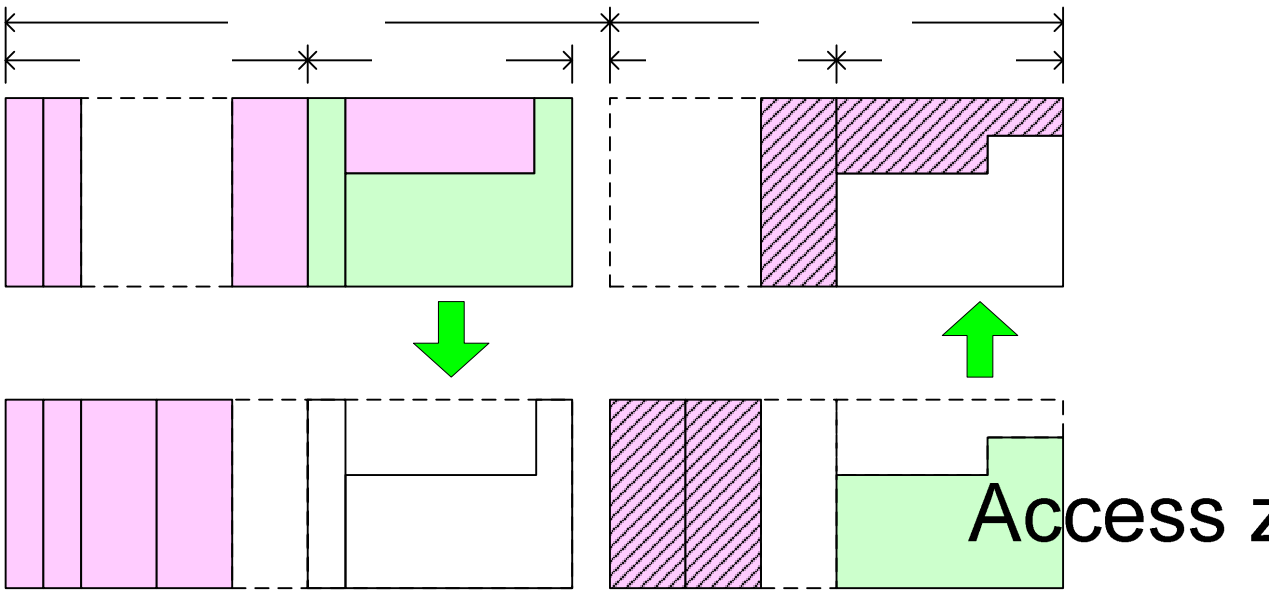

Figure 7 Alternative of PHY scheduling for Figure 1

Figure 8 shows PHY scheduling example for Figure 3 (3 MS case).

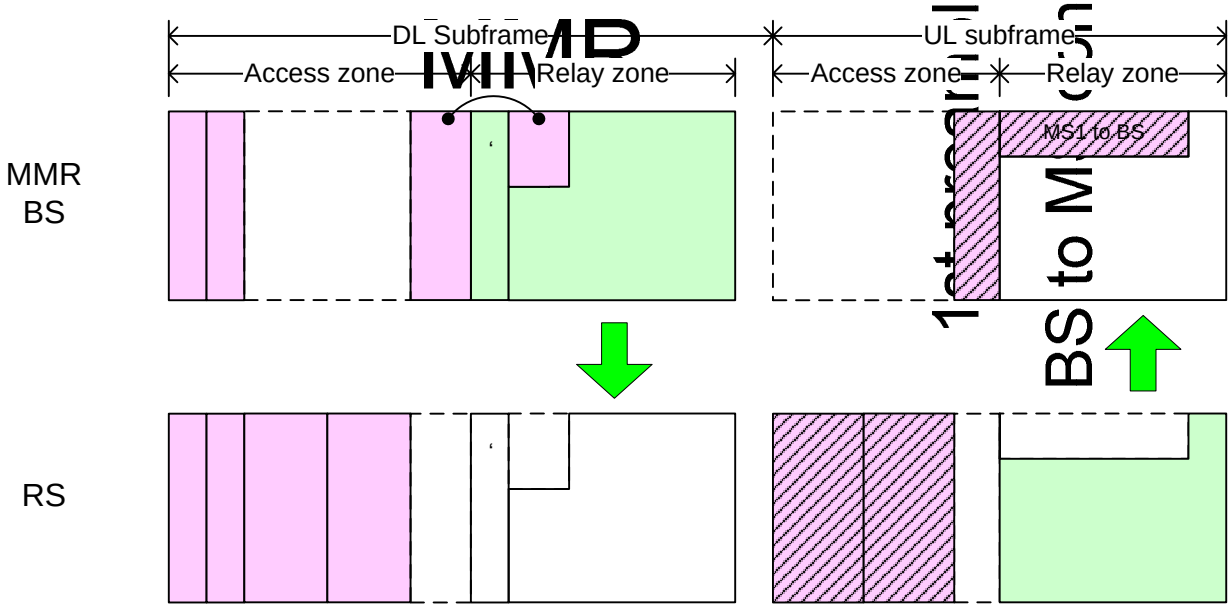

Figure 8. Frame implementation example for Figure 3.

In this case, data of BS to MS1 and MS1 to BS is divided into two MAC PDUs over two bursts. It results in increase of overhead (MAC generic header). However, flexibility of radio resource allocation with fixed zone boundary can be achieved.

3 Proposed Text Change

We propose that the sentence "Optionally the relay zone may be shared with access link for flexible PHY scheduling." be added to the end of 8.4.4.7.2.1 and 8.4.4.7.2.2 in current baseline text (802.16j-06/026r2).

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8.4.4.7.2.1 MR-BS frame structure

For the TDD mode, an example of the MR-BS frame structure is shown in Figure <xxx>.
Each MR-BS frame begins with a preamble followed by an FCH and the DL MAP and possibly UL MAP.
The DL sub-frame shall include at least one DL Access_Zone and may include one or more DL Relay_Zones. The UL sub-frame may include one or more UL Access_Zones and it may include one or more UL Relay_Zones. A relay zone may be utilized for either transmission or reception but the MR-BS shall not be required to support both modes of operation within the same zone. In each frame, the TTG shall be inserted between the DL sub-frame and the UL sub-frame. The RTG shall be inserted at the end of each frame. In the DL Access_Zone, the subchannel allocation, the FCH transmission, and the FCH shall be defined as in Section 8.4.4.2.The DL Relay_Zone shall include a R-FCH and a 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.
The number, size, and location of the relay zones shall be configurable. Optionally the relay zone may be shared with access link for flexible PHY scheduling.

8.4.4.7.2.2 Relay frame structure

For the TDD mode, an example of an RS frame structure is shown in Figure <xxx>.
The Relay Station transmits its frame start preamble time aligned with its serving MR-BS frame start preamble.
The DL sub-frame shall include at least one DL Access_Zone and may include one or more Relay_Zones.
An R-TTG may be placed between a DL Access_Zone and a DL Relay_Zone and an R-TTG or R-RTG may be place between two adjacent DL Relay_Zones.
The UL sub-frame may include one or more UL Access_Zones and one or more Relay_Zones. An R-RTG may be placed between a UL Access_Zone and a UL Relay_Zone and an R-TTG or R-RTG may be inserted between two adjacent UL Relay_Zones.
A relay zone may be utilized for either transmission or reception but the RS shall not be required to support both modes of operation within the same zone.
If the relay station switches from transmission to reception mode, an R-TTG may be required. If the relay station switches from reception to transmission mode, an R-RTG may be required. There may be more than one R-TTG and more than one R-RTG inserted in the RS frame. In each frame, the TTG shall be inserted between the DL sub-frame and the UL sub-frame. The RTG shall be inserted at the end of each frame.
The contents of the FCH, DL-MAP and UL-MAP in the Relay Frame may be different from those in the MR-BS frame.
Each RS frame begins with a preamble followed by an FCH and the DL-MAP and possibly a UL-MAP. In the DL Access_Zone, the subchannel allocation, the FCH transmission, and the FCH shall be as defined in Section 8.4.4.2.
The number, size, and location of the relay zones and whether the RS is utilizing the relay zone for transmission or reception shall be configurable. Optionally the relay zone may be shared with access link for flexible PHY scheduling. The number of frames that make up a multi-frame shall be configurable.

4 Reference

[1] “P802.16j Baseline Document,” IEEE 802.16j-06/026r2, February 9, 2007 (http://ieee802.org/16/relay/docs/80216j-06_026r2.pdf)