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Title	**A frame structure for shared RS in IEEE 802.16j Multi-hop Relay Network**	
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Re:	IEEE 802.16j-07/007r2:"Call for Technical Comments and Contributions regarding IEEE Project 802.16j"	
Abstract	This contribution proposes a frame structure for share RS in IEEE 802.16j MR network.	
Purpose	For TG members to adopt the proposed messages and the supporting text into the IEEE 802.16j baseline document.	
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A frame structure for shared RS in IEEE 802.16j Multi-hop Relay Network

Introduction

In some scenarios, the multi-hop relay system comprises anchor BS and subordinate BS with a shared RS to enhance coverage, throughput and system capacity. However, the frame structures of MMR system with shared RSs have not been defined in the baseline IEEE802.16j-06/026r2. This contribution proposes a frame structure for shared RSs in IEEE 802.16j Multi-hop Network.

Details

The following assumptions are made:

1- The RS can relay messages in current frame for both anchor BS and subordinate BS.
2- The RS is positioned in the overlapping service area of BS1 and BS2.
3- Both BS1 and BS2 have MR capability (MR-BS1 and MR-BS2).
- Frame of both MR-BS1 and MR-BS2 are synchronized.

Shared RS system for MR

Fig. 1 MMR system with shared RSs

As shown in Fig.1, the shared RS system can be considered in 802.16j aware networks. The system provides load-balancing between the two adjacent cells, optimizes the RS bandwidth throughput and also improves the network reliability.

In the shared RS system, one RS could be connected to two or more MR-BS within the same frame. Each service flow from a mobile station is relayed to the related MR-BS by RS.

As shown in Fig.2, the frame structure with shared RS system can be considered in 802.16j network, the system provides load-balancing between two adjacent cells and improves spectral efficiency.

Fig.2 frame structure shared RS system for MMR.

The resource after A-DL and Optional R-DL/UL(CID#1) in DL subframe in anchor BS can be allocated idle or Optional DL/UL Access Zone. For convenience, it is called Optional DL/UL Reserved Zone.

The resource between A-DL /UL and Optional R-DL/UL(CID#2) in DL subframe in subordinate BS can be allocated idle or Optional DL/UL Access Zone. For convenience, it is called Optional DL/UL Reserved Zone.

The Optional DL/UL Reserved Zone shall be used by the following principle:

-If anchor BS Optional R-DL/UL were not selected, Optional DL/UL Reserved Zone in subordinate BS should not be selected too. They appear concurrently.

- If subordinate BS Optional R-DL/UL were not selected, Optional DL/UL Reserved Zone in anchor BS should not be selected too. They appear concurrently.

-If the load in anchor BS is not very heavy, the Optional DL/UL Reserved Zone should be allocated to idle state. On the contrary, the Optional DL/UL Reserved Zone should be allocated to Optional DL/UL Access Zone. In subordinate BS is the same.

Resource allocation method in shared RS system

In order to realize a shared RS mode of operation, the scheduler of the MR-BS is required to take into account the collision avoidance. The scheduling mechanism itself and its implementation in the RS are beyond the scope of the 802.16j standard. However the MR-BS and the RS that support a shared RS mode of operation are required to comply with the following rules.

- Each MR-BS needs to schedule a resource allocation avoiding allocating the same resource simultaneously to RS.
- Each MR-BS should use different interval exclusively in same frame for the same shared RS without any collision.

If BSs use frequency re-use pattern (1,3,3) and (1,3,1/3), there has no interference. The Reserved Zone allocated to DL/UL Access Zone adapts to all MSs. However, if BSs use frequency re-use pattern (1,3,1), there exists interference between shared RS communicating with one BS and some MSs communicating with the other BS. In this case, MSs need to be classified into two parts. DL/UL Access Zone can be allcocated to all MSs, Optional DL/UL Access Zone can only be allocated to part of MSs. The part of MSs communicating with the related MR-BS should not affect heavily shared RS communicating with other MR-BS if same frequency resource at the same time is used. The shared RS network entry and negotiation for the exclusive resource allocation is shown in Fig.2.

RS Network entry and negotiation procedure in shared RS system

Firstly, the shared RS detects both MR-BS1 and MR-BS2 by scanning, chooses one of the MR-BS as an anchor MR-BS, based on the quality of the received preambles from the two MR-BS (subject to PHY implementation). In this document, it is assumed that the MR-BS1 is the anchor. The shared RS performs network entry procedures (initial ranging, basic capability, authorization, registration, etc.) to the anchor MR-BS. These network entry procedures are same as a regular RS, reused and not modified for the shared RS operation. (The detailed RS network entry operation will be discussed in other contributions.)

Rarely during the initial ranging procedure, the CDMA ranging regions in UL subframe of both MR-BS could overlap. In this case, the shared RS may receive RNG-RSP and CDMA allocation IE from both MR-BS, as dotted arrows shown in Fig.2. In this case, the shared RS silently ignore the messages from the subordinate MR-BS.

After the network entry procedure with the anchor MR-BS was executed, the shared RS then performs the diversity set update procedure for the subordinate MR-BS.

This diversity set update procedure is almost same as the FBSS/MDHO one and it is extended for negotiation of resource allocation between the anchor and the subordinate MR-BS. For this negotiation, the shared RS indicates in MOB_HO-IND message that the shared RS offers the anchor MR-BS to negotiate schedules of exclusive resource allocation with the subordinate MR-BS. The new parameters value for the MOB_HO-IND will be defined.

The anchor MR-BS receives the MOB_HO-IND with negotiation indication, then may perform context transfer and exchange some messages in order to negotiate exclusive resource allocation with the subordinate MR-BS through backhaul connection.

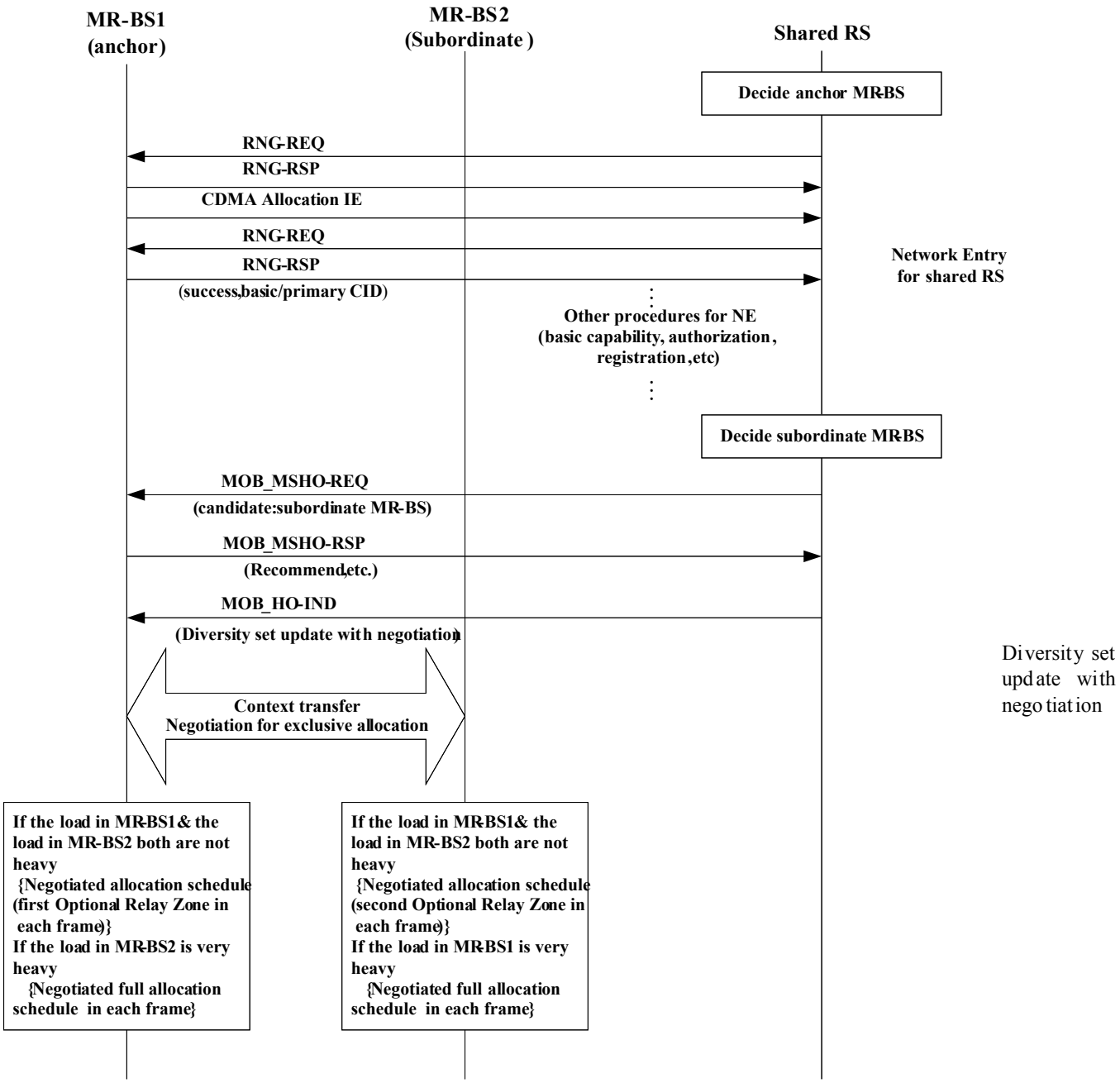
The anchor MR-BS may make out the exclusive resource allocation schedule for the subordinate MR-BS and itself. In the most basic way, the anchor and the subordinate MR-BS share the RS alternately frame by frame.

For example, the frame which has an even frame number is dedicated for the anchor MR-BS, and the off frames are dedicated for the subordinate MR-BS.

In this document, this “even/odd” frame number schedule for the exclusive resource allocation is pre-determined and assumed as an example. These types of frame allocations can’t be ruled out. Further detailed exclusive resource allocation types of schedules (e.g. exclusive zone / segment / burst) can be considered, but these are out of the scope of this document. It will required more detailed negotiation messages and intelligent scheduler implementation in the MR-BS.

After the negotiation, both the anchor and the subordinate MR-BS maintain the negotiated allocation schedules.

Proposed text changes

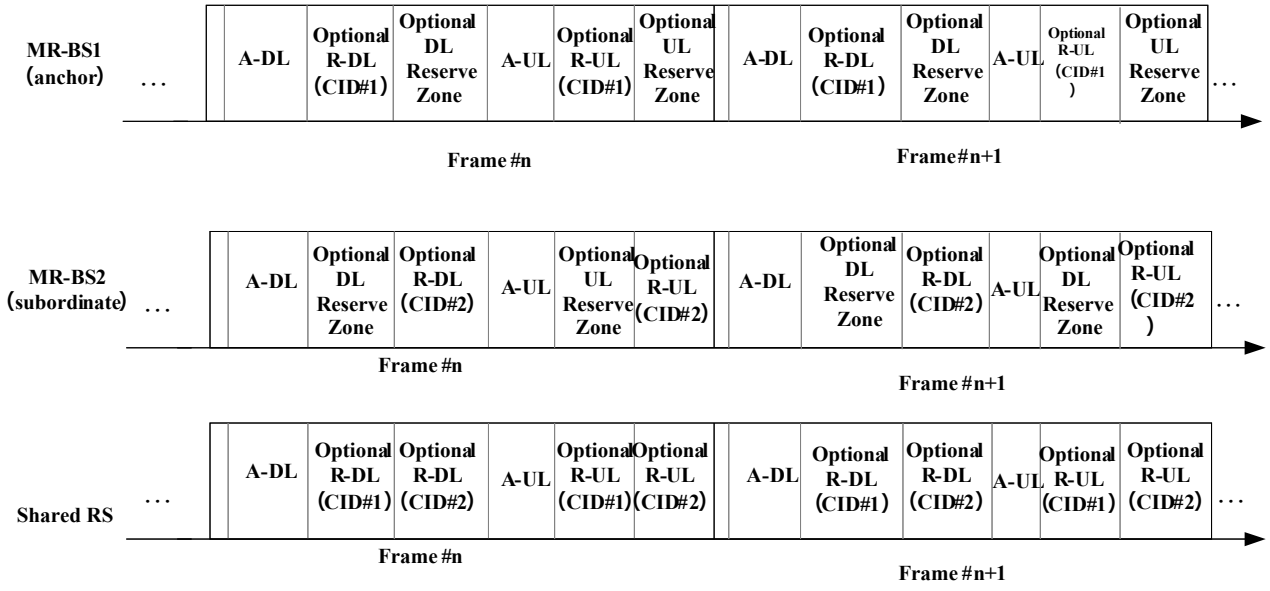


[Insert section 8.4.4.7.3 "Frame structure for shared RS mode" as indicated:]

8.4.4.7.3 Frame structure for shared RS mode

This section describes the minimal requirements for an in-band frame structure for anchor BS, subordinate BS and the shared RS.

Figure <xxx> Example of configuration for shared RS mode



8.4.4.7.3.1 Frame structure for anchor BS

For the TDD mode, an example of the anchor BS frame structure is shown in Figure <xxx>.

The frame structure consists of DL sub-frame period and UL sub-frame period. Each frame in the downlink starts with a preamble followed by FCH, DL MAP and possibly UL MAP. The DL sub-frame shall include at least one DL Access Zone and possibly one DL Relay Zone and possibly one DL Reserved Zone. The UL sub-frame shall include one UL Access Zone and may include one optional UL Relay Zone and one optional UL Reserved Zone. DL/UL Reserved Zone may be used in idle or Access Zone mode. In each frame, the TTG shall be inserted between the DL sub-frame and UL sub-frame. The RTG shall be inserted at the end of each frame.

8.4.4.7.3.2 Frame structure for subordinate BS

For the TDD mode, an example of the subordinate BS frame structure is shown in Figure <xxx>.

The frame structure consists of DL sub-frame period and UL sub-frame period. Each frame in the downlink starts with a preamble followed by FCH, DL MAP and possibly UL MAP. The DL sub-frame shall include at least one DL Access Zone and possibly one DL Relay Zone and possibly one DL Reserved Zone. The UL sub-frame shall include one UL Access Zone and may include one optional UL Reserved Zone and one optional UL Relay Zone. DL/UL Reserved Zone may be used in idle or Access Zone mode.

In each frame, the TTG shall be inserted between the DL sub-frame and UL sub-frame. The RTG shall be inserted at the end of each frame.

8.4.4.7.3.3 Frame structure for shared RS

For the TDD mode, an example of the shared RS frame structure is shown in Figure <xxx>.

The frame structure consists of DL sub-frame period and UL sub-frame period. Each frame in the downlink starts with a preamble followed by an FCH, DL MAP and possibly UL MAP. The DL sub-frame shall include at least one DL Access Zone and two optional UL Relay Zones. The UL sub-frame shall include one UL Access Zone and may include two optional UL Relay Zones.

In each frame, the TTG shall be inserted between the DL sub-frame and UL sub-frame. The RTG shall be inserted at the end of each frame. The R-TTG or R-RTG shall be inserted between transmission and reception mode in DL sub-frame and UL sub-frame.

I. References

[1] IEEE802.16e-2005
[2] C802.16j-07/026r2, Baseline Document for Draft Standard for 16j
[3] C802.16j-07/006r1,A proposal for introducing a shared RS system in MR