Project	IEEE 802.16 Broadband Wireless Access Working Group <**http://ieee802.org/16**>
Title	A proposal for introducing a shared RS system in MR
Date Submitted	2007-01-08
Source(s)	Keiichi Nakatsugawa Fujitsu Laboratories Ltd. Kamikodanaka 4-1-1, Kawasaki, 211-8588, Japan Voice: +81-44-754-2811 Fax: +81-44-754-2786 nakatsugawa@jp.fujitsu.com Dorin Viorel Fujitsu Microelectronics Canada Inc. #300, 2710-17th Ave SE, Calgary, AB, T2A 0P6, Canada Voice: +1 403 207 6311 Fax: +1 403 248 1886 dviorel@fmci.fujitsu.com
Re:	IEEE802.16j-06/034~~xxx~~: “Call for Technical Proposals regarding IEEEP802.16j”
Abstract	This contribution proposes a shared RS system for 802.16j networks.
Purpose	Text proposal for 802.16j Baseline Document
Notice	
Release	
Patent Policy and Procedures	

A proposal for introducing a shared RS system in MR

Keiichi Nakatsugawa, Fujitsu Laboratories LTD.
Dorin Viorel, Fujitsu Microelectronics Canada Inc.

Introduction

This contribution proposes a shared RS system for 802.16j aware mobile WIMAX networks.

Details

The following assumptions are made:

- The RS is not required to relay message and data within the current frame. The message and data are delayed for one or more frames due to the related relay processing in RS.

- The RS is positioned in the overlapping service area of BS1 and BS2.

- Both BS1 and BS2 have MR capability (MR-BS1 and MR-BS2).

- Frame of both MR-BS1 and MR-BS2 are synchronized.

~~- The proposed system could also provide an enhanced coverage or an enhanced throughput for each one of the cells presented in Fig. 1~~

Shared RS system for MR

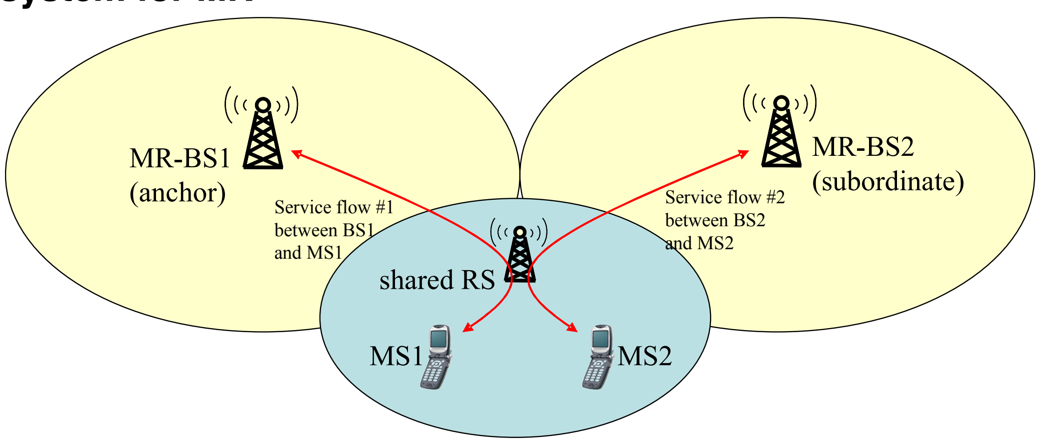

Fig. 1 Shared RS system for MR.

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.1, service flow #1 from MS1 is connected to MR-BS1 via RS. Also service flow #2 from MS2 is connected to MR-BS2 via the same RS.

In the shared RS system, the RS behaves like a MS performing a Fast BS Switching(FBSS)Macro Diversity Handover (MDHO) , as described by 802.16e[1]. In FBSSMDHO, MS creates diversity set for receives from and transmits to multiple BSs and communicates the anchor BS during handoverat the same time. The Base Stations need to be synchronized and to communicate each other for context transfer.ously allocate the same region of slot in a frame in order to provide a diversity effect. On the other hand, iIn a shared RS system, the RS also receives from and transmits to not only the anchor MR-BS but also the subordinate MR-BS.multiple BSs in the same way as the FBSS/MDHO. However, tThe anchor and subordinate MR-BSs need to synchronously allocate exclusive slots in order to avoid collisions at the RS side.

To perform the exclusive resource allocation, the shared RS chooses one of the available MR-BS as an anchor MR-BS for shared RS operation. The other MR-BS is treated as a subordinate MR-BS. The shared RS receives DL/UL-MAP alternately from the anchor MR-BS and the subordinate MR-BS, based on a negotiated resource allocation schedule.

RS Network entry and negotiation procedure in shared RS system

The shared RS network entry and negotiation for the exclusive resource allocation is shown in Fig.2.

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~~by default~~. These ~~Other~~ 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.

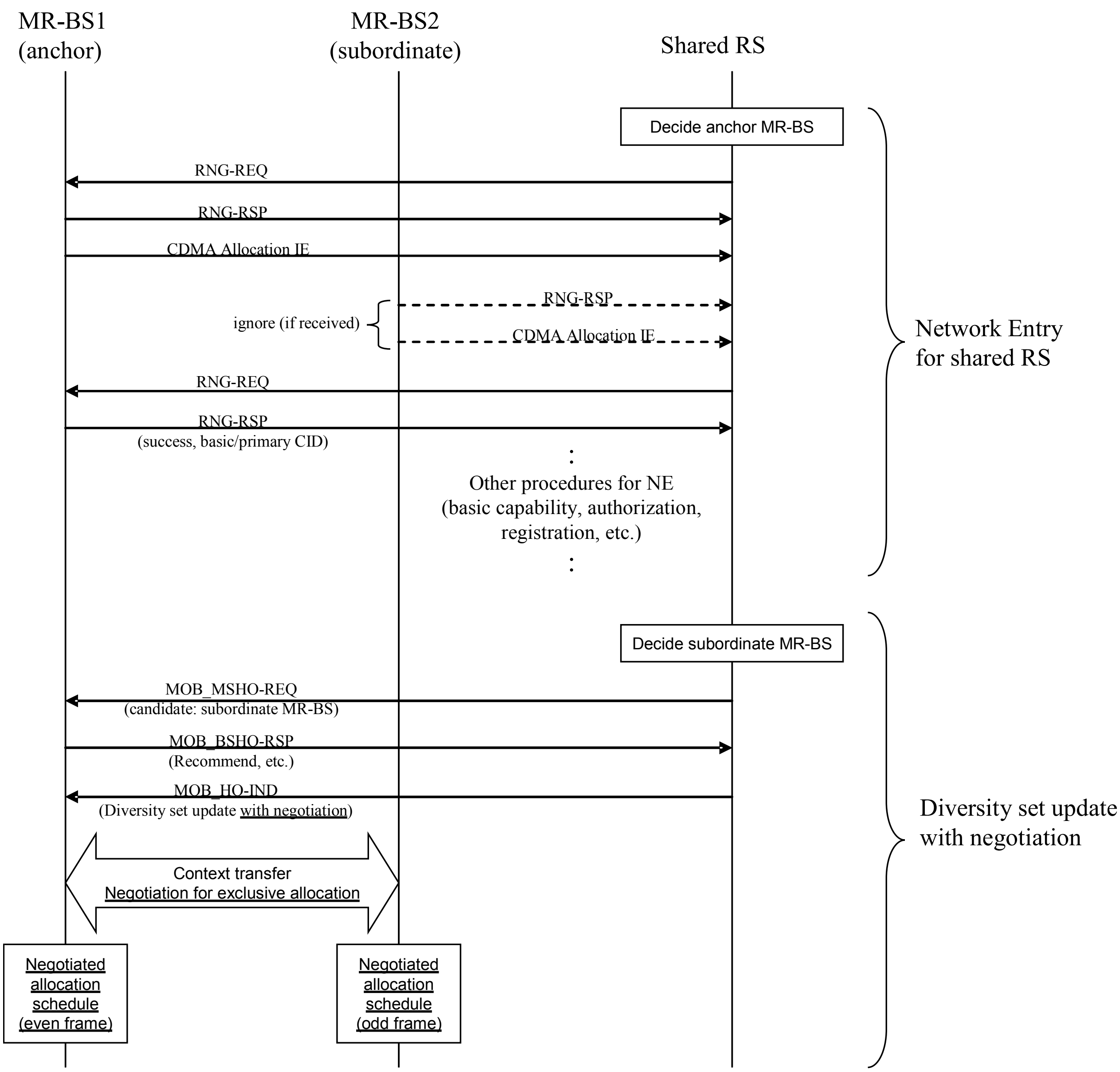

Fig. 2 An example procedure of the shared RS network entry and negotiation

MS network entry performed in shared RS systems

When the MS connects to the MR-BS via the shared RS, the shared RS performs MR-BS selection for the MS and relays the network entry procedures of the MS. The shared RS chooses one of the MR-BS which terminates the MS. For this choice, the shared RS may examine the number of MS, traffic load or channel quality of each MR-BS.

An example sequence of MS network entry is shown in Fig. 3. When the shared RS receives RNG-REQ from the MS1, the shared RS chooses the MR-BS1 for the MS1, and relay the RNG-REQ to the MR-BS1. After this, the shared RS relay messages for network entry of MS1 to the MR-BS1. In the same way, the shared RS chooses the MR-BS2 for the MS2 and relays messages between the MS2 and the MR-BS2.

For MS network entry, regular procedures will be reused for the shared RS system.

After completion of network entry, the service flow of the MS will be established to the MR-BS which is chosen for the MS at network entry phase. Bursts of the service flow are allocated by chosen MS-BS.

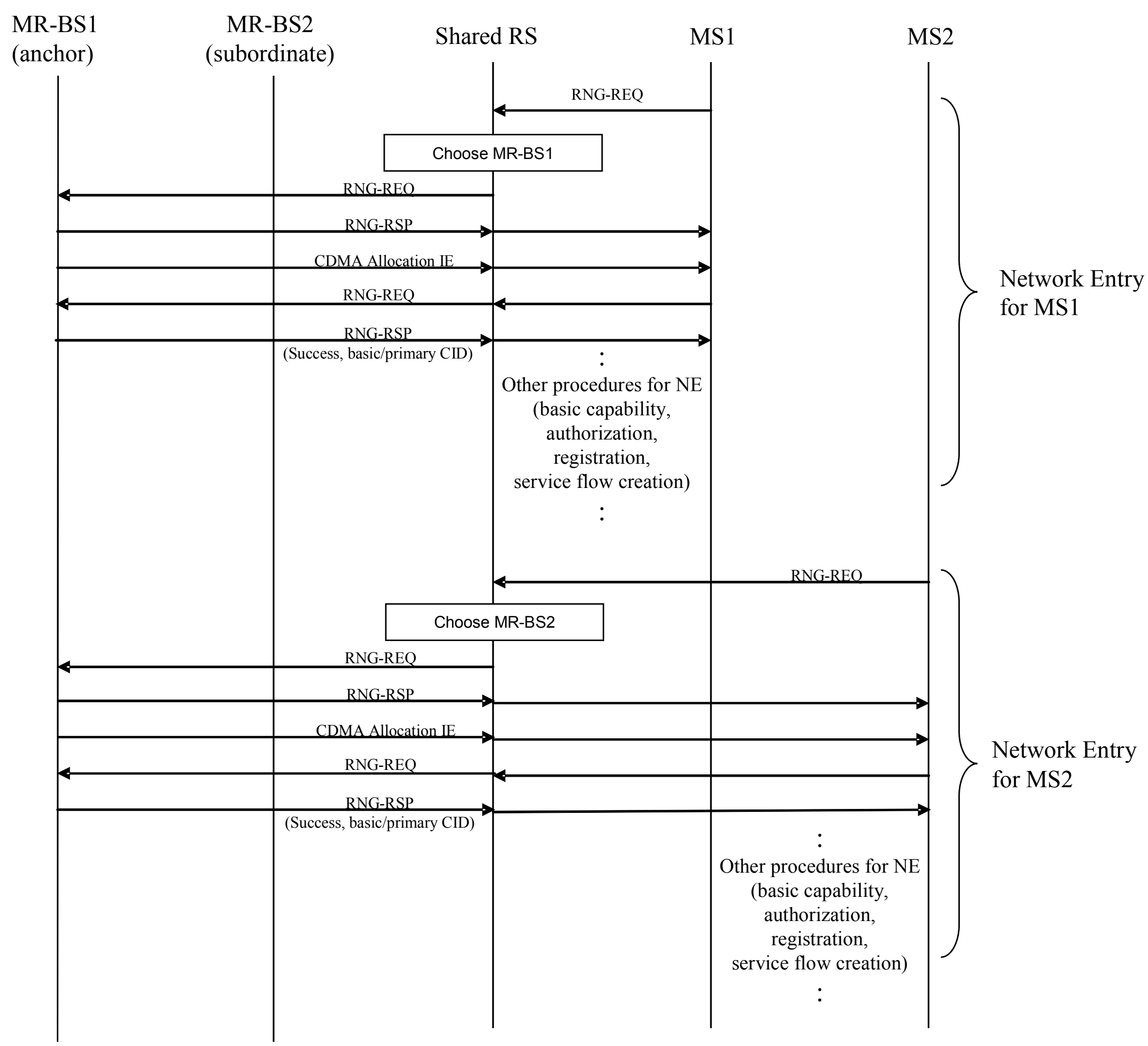

Fig. 3 An example procedure of MS network entry

Resource allocation method in shared RS system

In order to realize a RS shared 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 set of rules.

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

An example of resource allocation by exclusive frames in Fig.4, CID#1(for service flow #1) and CID#2(for service flow #2) are the same as shown in Fig.1. The blue box is an allocated burst for CID#1 transmitted between the MR-BS1 and the shared RS. And the red box is an allocated burst for CID#2 transmitted between the MR-BS2 and the shared RS. Both bursts are transmitted respectively over the relay link. In this example, the allocated bursts convey only CID#1 and CID#2 respectively. However, if multiple service flows are established to MR-BS1 and MR-BS2, allocated resource can be used for multiple CIDs.

In Fig. 4, for each DL and UL subframe, in Frame #n and #n+2, the MR-BS1 allocates a whole R-DL and R-UL to CID#1, but the MR-BS2 doesn't allocate any burst to CID#2. On the other hand, in Frame #n+1 and #n+3, the MR-BS2 allocates a whole R-DL and R-UL to CID#2, but the MR-BS1 doesn't allocate any burst to CID#1. This allocation schedule is negotiated at a diversity set update phase shown in Fig. 2.

For both the MR-BS1 and the MR-BS2, DL and UL burst which conveys CID#1 and CID#2 is defined by normal DL and UL MAP IE. The shared RS receives and sends bursts alternately between the MR-BS1 and the MR-BS2 according to the negotiated schedule.

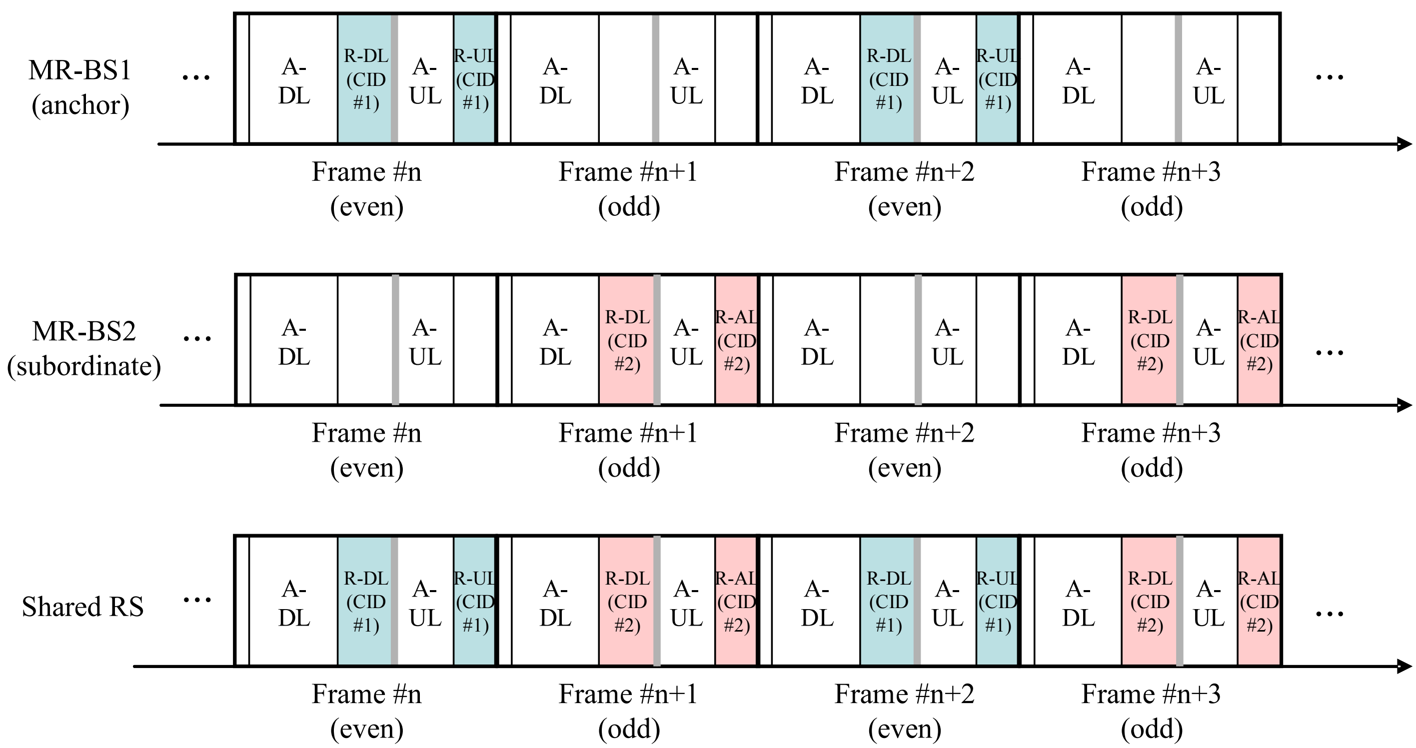

Fig. 4 Allocation by exclusive frame

According to these methods, the collision on the relay link on the shared RS can be avoided.

Conclusion

The method presented hereby could potentially increase the RS access link related throughput, avoids the related intra-cell interference and improves the network reliability.

It is expected that the related aspect of the relay extension will reflect this shared RS system accordingly.

Suggested Text Changes

Insert the new subclause in 6.1.1 Relaying extension:

6.1.1.x Shared RS system

A shared RS system is defined based on the network topology example presented in Fig. n

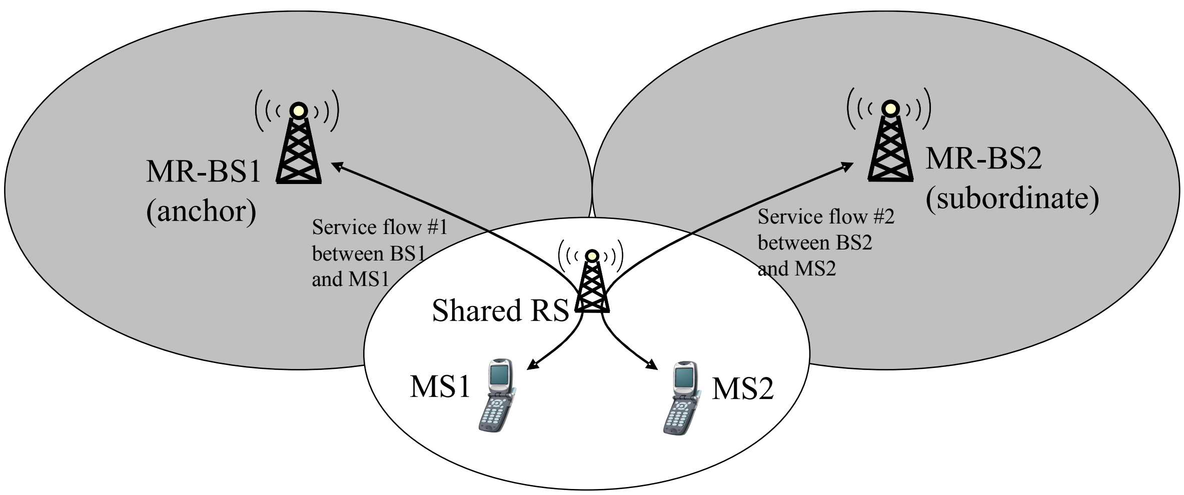

Fig. n. Example of shared RS system

In the shared RS system, one RS could be connected to two or more MR-BS. Each service flow from a MS is relayed to the related MR-BS by the related RS. As shown in Fig. n, service flow #1 from MS1 is connected to MR-BS1 via RS. Also service flow #2 from MS2 is connected to MR-BS2 via the same RS. The shared RS performs network entry procedures for the anchor MR-BS and adds the subordinate MR-BS to the diversity set.

Each MR-BS needs to schedule accordingly the related resource allocation without allocating the same resource simultaneously to the related RS. Each MR-BS should use different frames exclusively for the same shared RS without any collision. When the shared RS adds the subordinate MR-BS to the diversity set, it offers the anchor MR-BS to negotiate the exclusive resource allocation indicating in the MOB_HO-IND message.

When the network entry procedure is performed by MS, the shared RS chooses the MR-BS which is connected to and relays messages. After the network entry, the service flow of the MS will be established to the MR-BS which is chosen for the MS during network entry phase. Bursts of the service flow are allocated by chosen MR-BS. The shared RS receives and sends bursts exclusively~~alternately~~ between the anchor and the subordinate MR-BS according to the negotiated schedule. For example, the shared RS may use frames alternately between the anchor and the subordinate MR-BS. Such a scheduling pattern is out of the standard.

Insert the text for table109m in 6.3.2.3.53 MS HO Request (MOB_MSHO-REQ) message:

The MOB_HO-IND message may contain the following TLV:

Subordinate MR-BS for shared RS (See 11.15.2)

Insert the text for table109n in 6.3.2.3.54 BS HO Response (MOB_BSHO-RSP) message:

The MOB_HO-IND message may contain the following TLV:

Resource Retain Time (See 11.15.1.)
Subordinate MR-BS for shared RS (See 11.15.2)

Insert~~Change~~ the text for table109o ~~text~~ in 6.3.2.3.55 HO indication (MOB_HO-IND) message:

The MOB_HO-IND message may~~shall~~ contain~~include~~ the following ~~parameter encoded as~~ TLV ~~tuples~~:

~~HMAC/CMAC Tuple (See 11.1.2.)~~
Subordinate MR-BS for shared RS (See 11.15.2)

Insert the new subclause in 11.15 Handover management encodings:

11.15.2 Subordinate MR-BS for shared RS

For the shared RS system in MR, the shared RS may include the BSID of s~~S~~ubordinate ~~BSID~~ MR-BS in handover~~a MOB_HO-IND~~ messages in order to offer the negotiation for exclusive resource allocation between the anchor and the subordinate MR-BS.

Type	Length(bits)	Value	Scope
2	3	TEMP_BSID of the Subordinate MR-BS.	MOB_MSHO-REQ MOB_BSHO-RSP MOB_HO-IND

~~Table 109o – MOB_HO-IND message format~~

~~Syntax~~	~~Size~~	~~Notes~~

MOB_HO-IND_message_format() {		
: (omitted)		
If (Mode = 0b10){		
MDHOFBSS_IND_Type	2bits	0b00: Confirms Diversity Set update 0b01: Diversity Set update cancel 0b10: Diversity Set update reject 0b11: *Reserved*
if (MDHOFBSS_IND_Type=0b00){	-	-
Diversity Set Included Indicator	1bit	1: Final decision of Diversity Set members included in the message 0: Diversity Set members are as specified in MOB_BSHO_RSP message. No Diversity Set information included in this message.
if (Diversity Set Included Indicator ==1) {	-	-
Anchor BSID	3bits	TEMP_BSID of the Anchor BS.
N_BSs	3bits	Number of BS in the Diversity Set, excluding the Anchor BS.
For (j=0 ; j<N_BSs ; j++) {	-	-
Temp BSID	3bits	Diversity Set member ID assigned.
}		
Subordinate BS Included Indicator	1bit	1: Subordinate MR-BS for shared RS included. 0: Subordinate MR-BS for shared RS not included.
if (Subordinate BS Included Indicator ==1){	-	-
Subordinate BSID	3bits	TEMP_BSID of the Subordinate MR-BS.
}		
}		
Action time	8bits	Action time when the Anchor BS shall be updated.
}		
: (omitted)		

References

[1] IEEE 802.16e-2005