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Re:	IEEE802.16j-06/034: "Call for Technical Proposals regarding IEEEP802.16j"
Abstract	This contribution proposes a practical design for the synchronous multicast and broadcast service (MBS) transmission to achieve macro diversity in the MR networks.
Purpose	To propose design and text for MBS transmission synchronization in the MR networks.
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Synchronous MBS Transmission for Macro Diversity in MR Networks

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Introduction

This contribution proposes a practical design for the synchronous multicast and broadcast service (MBS) transmission to achieve macro diversity in the WiMAX MR networks.

All the related RS(s) defined in [1] are expected to be synchronized to achieve the macro diversity in the MBS transmission. Previous work in [2] reveals MBS transmission synchronization may be achieved by previously transmitting data on the relay link to all the RS(s) while informing the RS(s) how long they should wait. The waiting time is the maximum of the all the RSs' processing delays. However, since the waiting time does not include the network transmission delay, this design may not be practical to achieve macro diversity. Due to the variation of MBS data transmission delay from the network to the MR-BSs, the start time of pre-transmission of each MR-BS defined in [1] may be different. Accordingly, the synchronization between MR-BSs, as well as the related RS(s), in the MBS zone is not guaranteed. A practical design considering both the network transmission delay and processing delay to achieve synchronization is needed.

In our design, all the collected delay sum information will be reported by the MR-BS(s) to the network. When a MBS packet arrives, a packet serial number for synchronization (synchronization SN) is mapped according to the system time and all the delay sums collected at the network. Accordingly, the synchronization SN and the packet are transmitted to the enrolled MR-BS(s) as the start of the MBS.

For MBS, the MR-BS(s) will conclude their own transmission start time with system time and the synchronization SN. If there are RS(s) attached, MR-BS(s) relay the synchronization SN and the packet to the related RS(s) as a pre-transmission. If there is more than one hop in the relay link, the RS receives synchronization SN in the middle of the link shall relay the synchronization SN and the packet on the downlink to the attached RS(s). Consequently, all the related RS(s) conclude their own transmission start time with system time after the synchronization SN is received. Finally, once each MR-BS and RS has waited for its

specified waiting time, the MR-BS(s) and RS(s) shall synchronously transmit the MBS data over the access link. Accordingly, the effect of network transmission delay in the synchronization is eliminated.

Two examples of for the practical synchronization design in MR networks are shown in Figure 1 and Figure 2 as follows.

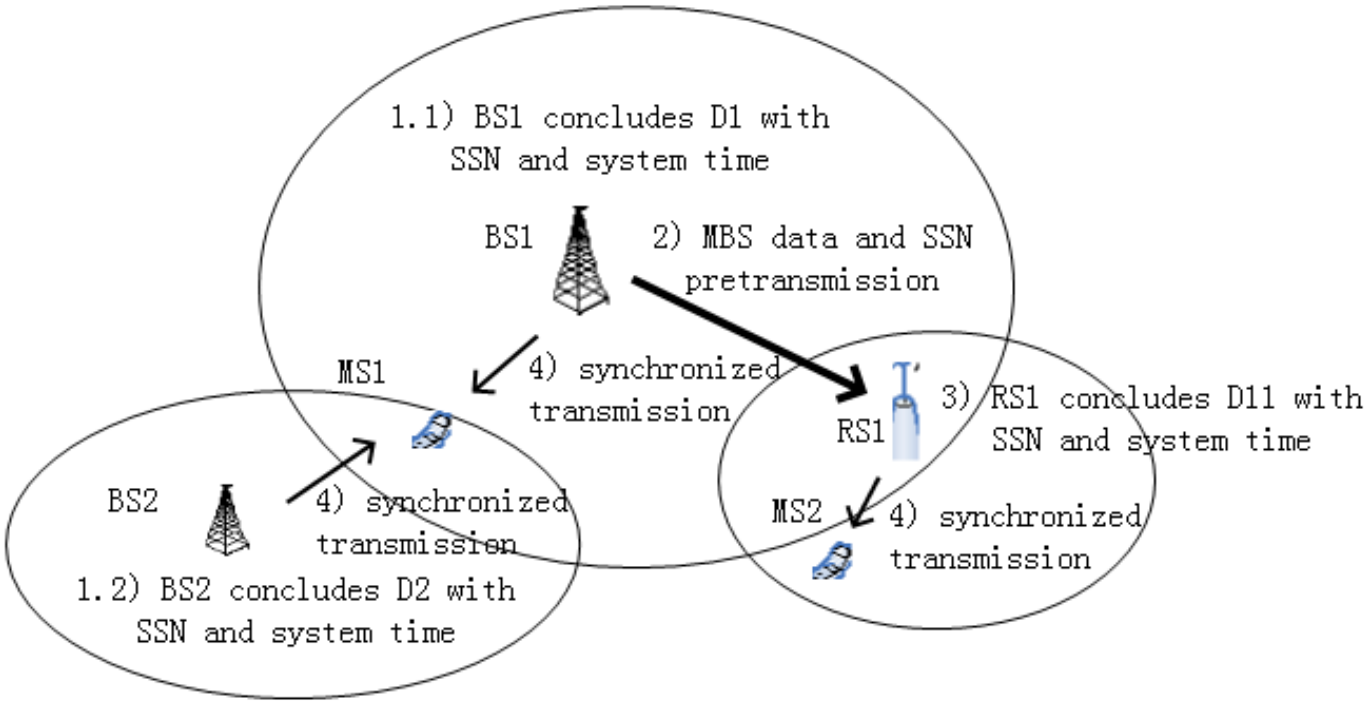

Fig.1 Synchronized MBS transmission to achieve macro diversity for single hop RS

As seen in Figure 1, four steps are found for the synchronized MBS transmission for single hop RS.

1) BS concludes its own transmission start time with synchronization SN received from the network and system time

1.1) for BS1, the concluded transmission start time is D1;

1.2) for BS2, the concluded transmission start time is D2;

2) The MBS data and the corresponding synchronization SN are transmitted previously to RS1 on the relay link;

3) RS1 concludes its own transmission start time D11 with synchronization SN received from BS1 and system

time;

4) Synchronized transmission on the access link of BS1, BS2, and RS1.

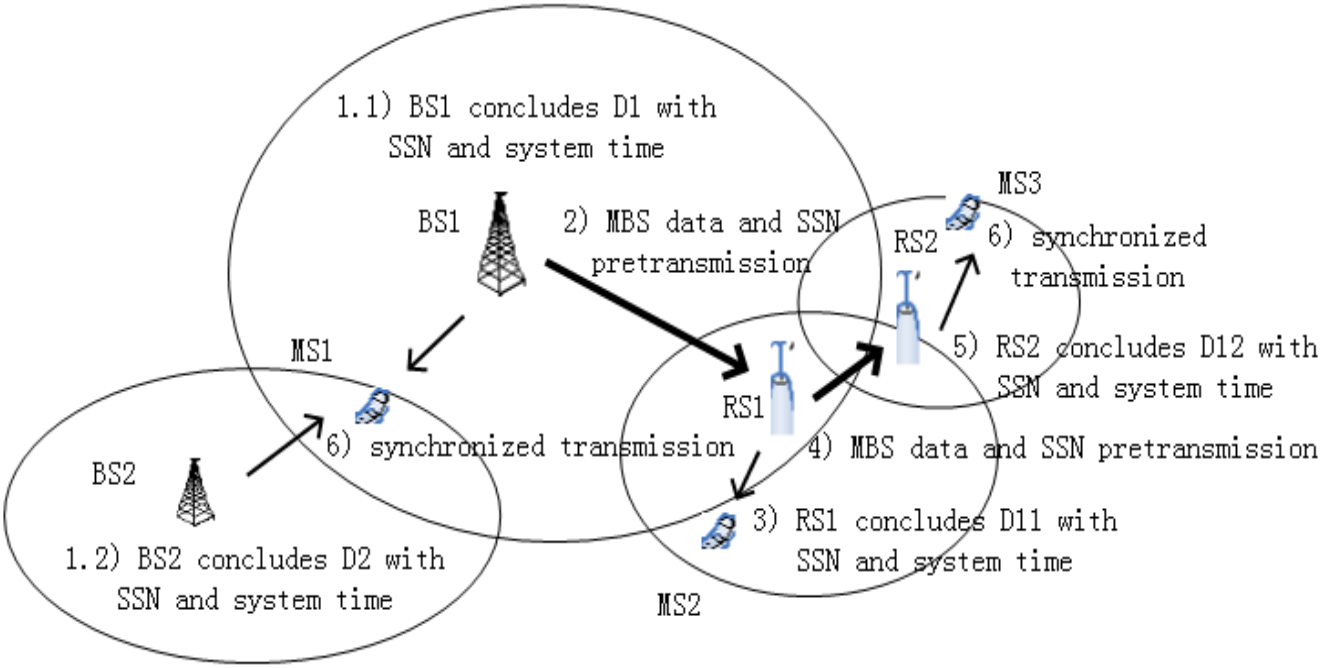

Fig.2 Synchronized MBS transmission to achieve macro diversity for two hop RS

As seen in Figure 2, six steps are found for the synchronized MBS transmission for two hop RS. However, the basic mechanism for the synchronization is the same.

1) BS concludes its own transmission start time with synchronization SN received from the network and system time

1.1) for BS1, the concluded transmission start time is D1;

1.2) for BS2, the concluded transmission start time is D2;

2) The MBS data and the corresponding synchronization SN are transmitted previously to RS1 on the relay link;

3) RS1 concludes its own transmission start time D11 with synchronization SN received from BS1 and system time;

4) The MBS data and the corresponding synchronization SN are transmitted previously to RS2 on the relay link;

5) RS2 concludes its own transmission start time D12 with synchronization SN received from RS1 and system time;
6) Synchronized transmission on the access link of BS1, BS2, RS1 and RS2.

The transmission of synchronization SN can be processed with a minor modification to the MBS_MAP_IE. The collection of the sum of delay can be done by two updated MAC management message: REP-REQ and REP-RSP. Accordingly, the delay should be reported either as a response to the request, or unsolicited.

Specified Text Changes

6.3.23.2.2 Performance enhancement with macro diversity

[Insert the following text at the end of 6.3.23.2.2:]

MBS transmission synchronization is required within an MBS zone for MR networks.

In the MBS zone, all the RS(s) shall report the sum of its processing delay and transmission delay, either as a response to the REP-REP message or unsolicited, in the uplink REP-RSP message. All the collected delay sum information will be reported by the MR-BS(s) to the network. When a MBS packet arrives, a packet serial number for synchronization (synchronization SN) is mapped according to the system time and all the delay sums collected at the network. Accordingly, the synchronization SN and the packet are transmitted to the enrolled MR-BS(s) as the start of the MBS.

For MBS, the MR-BS(s) will conclude their own transmission start time with system time and the synchronization SN. If there are RS(s) attached, MR-BS(s) relay the synchronization SN and the packet to the related RS(s) as a pre-transmission. If there is more than one hop in the relay link, the RS receives synchronization SN in the middle of the link shall relay the synchronization SN and the packet on the downlink to the attached RS(s). Consequently, all the related RS(s) conclude their own transmission start time with system time after the synchronization SN is received. The transmission of synchronization SN can be processed with a minor modification to the MBS_MAP_IE. Finally, once each MR-BS and RS has waited for its specified transmission start time, the MR-BS(s) and RS(s) shall synchronously transmit the MBS data over the access link.

8.4.5.3.12 Multicast and Broadcast Service MAP IE (MBS_MAP_IE)

[Change the end of Table 286a as indicated]

Table 286a—Multicast and Broadcast Service MAP IE

Syntax	Size	Notes
}	—	—
Synchronization SN	8bits	The synchronization SN is the packet serial number for synchronization, mapped according to the system time and all the delay sums collected at the network.
if !(byte boundary) {	—	—
Padding Nibble	*variable*	Padding to reach byte boundary
}	—	—
}	—	—

Next MBS_MAP_IE frame offset

The Next MBS_MAP_IE frame offset value is lower 8 bits of the frame number in which the BS shall transmit the next MBS_MAP_IE frame.

Synchronization SN

The synchronization SN is the packet serial number for synchronization, mapped according to the system time and all the delay sums collected at the network.

At the MBS region, MBS MAP message are located from the first subchannel and first OFDMA symbol of MBS region.

11.11 REP-REQ management message encodings

[Insert the following entries into the end of the second table of 11.11]

Name	Type	Length	Value
Delay Sum Request	1.9	1	Bit #0: 1 - include delay sum report Bit #1-7: *Reserved*, shall be set to zero

11.12 REP-RSP management message encodings

[Insert the following table after the last table of 11.12]

Delay Sum Request	Name	Type	Length	Value
Bit #0 = 1	Delay Sum Report	7	1	Sum of processing delay and transmission delay in unit of frame

Reference:

[1] IEEE 802.16e-2005.
[2] IEEE C802.16j-07/005, “A proposal for synchronous MBS transmission in MR”.