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Source(s)	LIU Yang, QU Hongyun, CHEN Yuqin, XU Ling ZTE liu.yang8@zte.com.cn *<http://standards.ieee.org/faqs/affiliationFAQ.html>
Re:	IEEE802.16j-07/019:" Call for Technical Comments Regarding IEEE Project 802.16j"
Abstract	This contribution proposes an adaptive design for the downlink HARQ in the MR networks.
Purpose	The text proposal in this contribution is accepted by TG16j.
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Downlink Hop by Hop HARQ for Multihop Non-transparent RS

LIU Yang, QU Hongyun, CHEN Yuqin, and XU Ling

ZTE

Introduction

This contribution proposes the hop by hop HARQ for multihop HARQ (hybrid ARQ) for the WiMAX multihop networks. A typical MR-BS multihop network is shown in figure 1. RS1 and RS2 may receive control signal from MR-BS but the data burst shall be relayed by RS1 and RS2 separately.

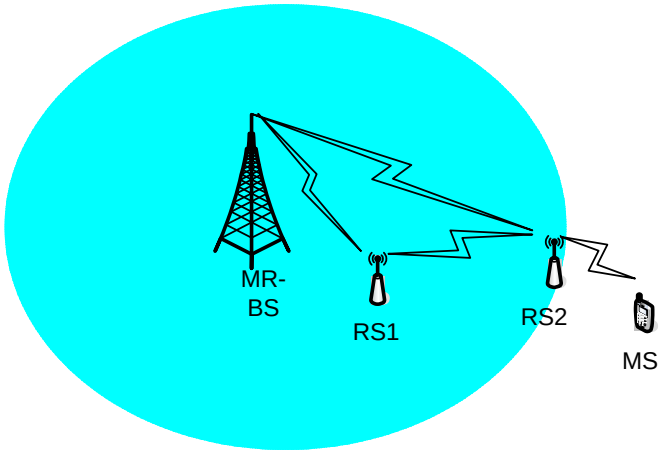

Fig. 1 A typical MR-BS multihop network

In previous contributions, two types of RS are defined as transparent RS and non-transparent RS. The non-transparent RS may transmit its own preamble and DL/UL MAP while transparent RS simply relay the preamble and DL/UL MAP from MR-BS. Furthermore, non-transparent RS has two types, centralized and distributed scheduling. The centralized scheduling RS does not create its own DL/UL MAP but may modify the MAP from MR-BS if necessary. As a contrast, the distributed scheduling RS generates its own DL/UL MAP.

Previous work in [1] proposes an end to end HARQ design for the non-transparent multihop RS networks. When RS receives one HARQ burst, the ACK will not be sent immediately. Instead, the RS relays the HARQ burst to the subordinate stations. The ACK from MS will be relayed to MR-BS when MS received the burst successfully. The MAP allocates the uplink ACK channel according to the successful transmission. However, the resource will be wasted if the burst relay fails.

The successful procedures of end to end HARQ for centralized and distributed scheduling RS in the typical multihop network (given by figure 1) are shown in figure 2 and figure 3. The only difference of the two figures lies in the DL MAP creation. In figure 2, DL MAP is created by MR-BS and relayed by RS1 and RS2. In figure 3, DL MAPs are created by MR-BS, RS1 and RS2 separately.

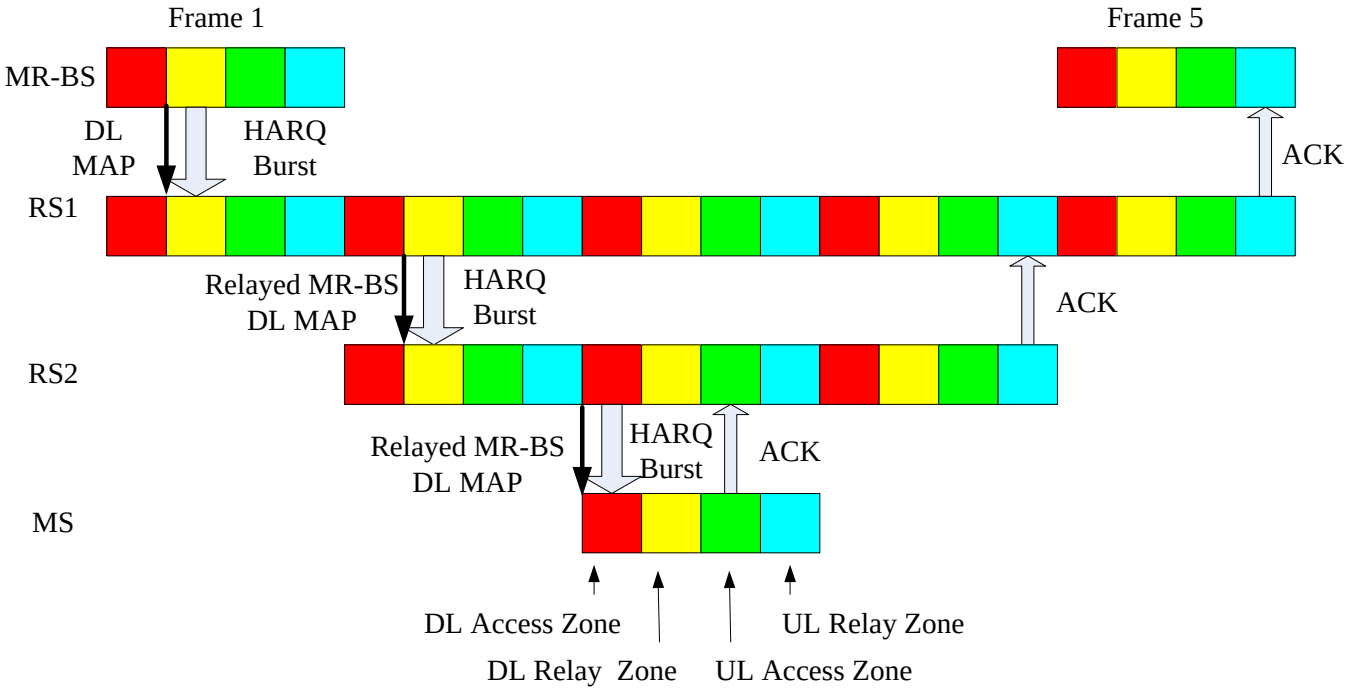

Fig. 2 End to end HARQ for non-transparent with centralized scheduling.

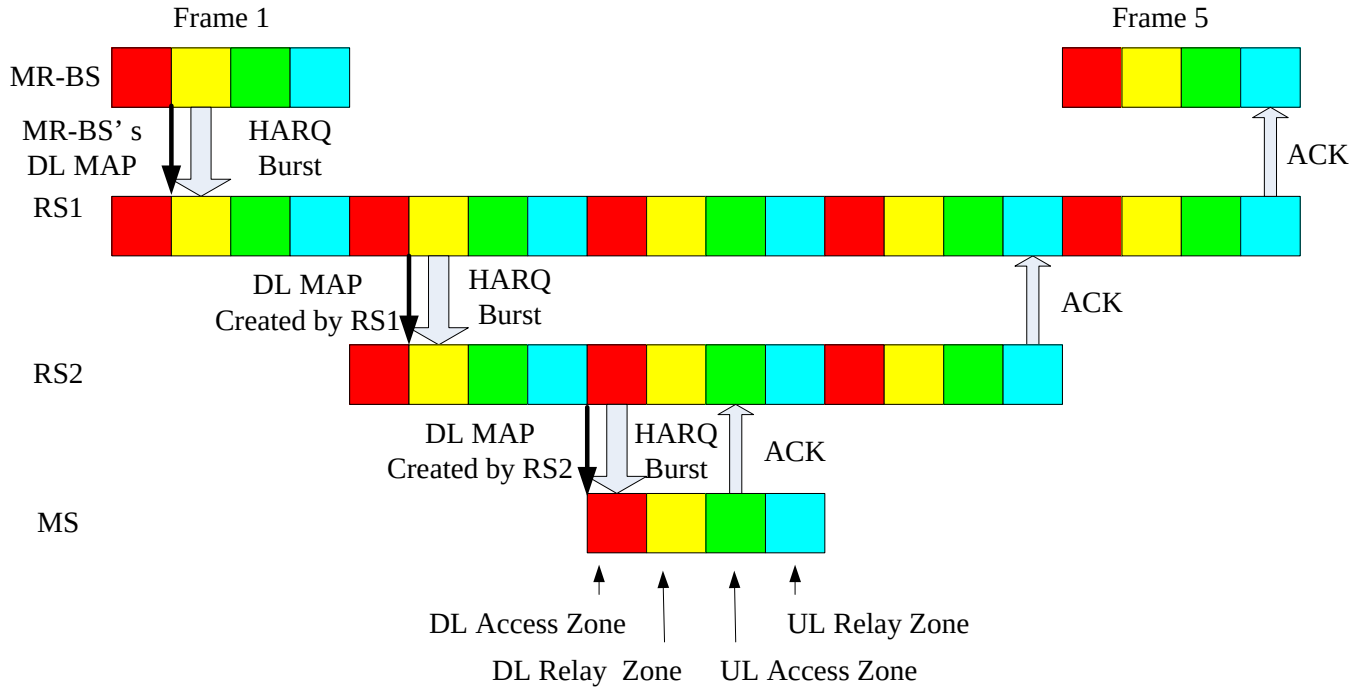

Fig. 3 End to end HARQ for non-transparent with distributed scheduling.

In both figure 2 and figure 3, RS1 receives the HARQ burst at frame 1, and relays the burst to RS2 at the next frame. The ACK of the burst will be relayed by RS1 to MR-BS at frame 5 which is already scheduled in the MR-BS's DL MAP given in frame 1. However, if the HARQ burst fails at the first hop, that is, RS1 does not receive the HARQ burst correctly, the NAK message will still be sent also at frame 5 since the uplink channel is prescheduled. Accordingly, the wasted frame number in this failure is four and the number of frame elapsed is ten if only one retransmission happens. Therefore, end to end HARQ may be unpractical when the channel condition is poor.

To tackle the challenge, hop by hop HARQ is proposed for the non-transparent MR-BS network. When MR-BS or RS sends a HARQ burst to MS to the aid of one RS, the RS shall receive the HARQ burst from the superordinate station. If the HARQ burst is received correctly, the RS will send an ACK to the superordinate station. After saving it for future retransmission, RS will forward this HARQ burst to the subordinate station. As a contrast, if the HARQ burst is not received correctly, the RS shall a NACK signal to the superordinate station. Subsequently, the superordinate station will retransmit the burst after it receives the NACK signal.

The successful procedures of hop by hop HARQ for centralized and distributed scheduling RS in the typical multihop network (given by figure 1) are shown in figure 4 and figure 5. Again, the only difference of the two

figures lies in the DL MAP creation. In figure 4, DL MAP is created by MR-BS and relayed by RS1 and RS2. In figure 5, DL MAPs are created by MR-BS, RS1 and RS2 separately.

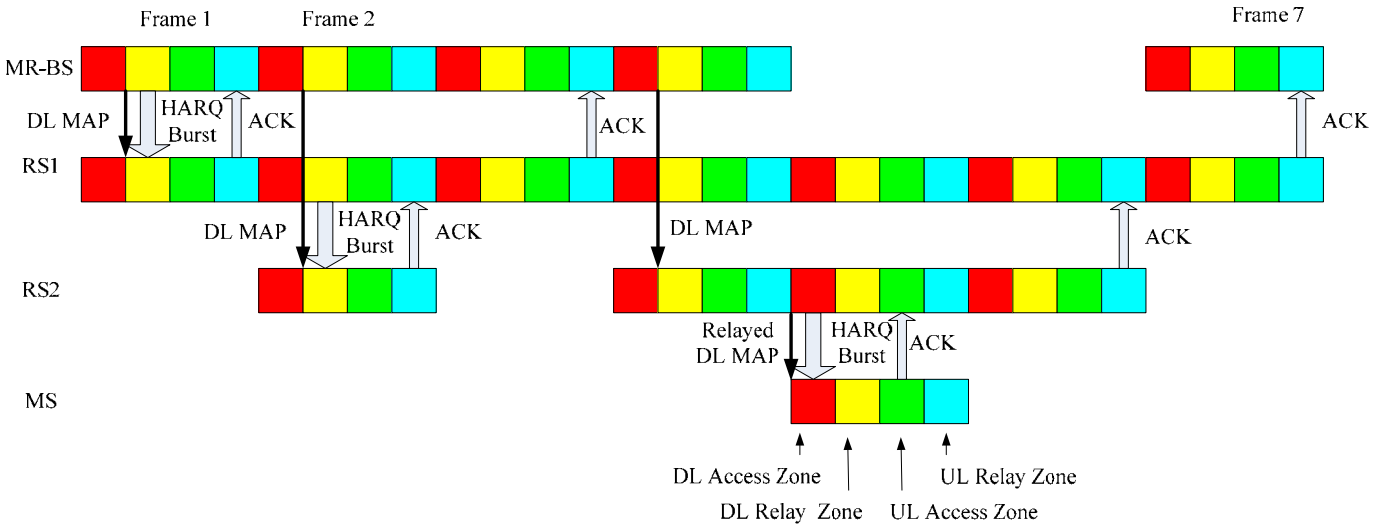

Fig. 4 Hop by hop HARQ for non-transparent with centralized scheduling.

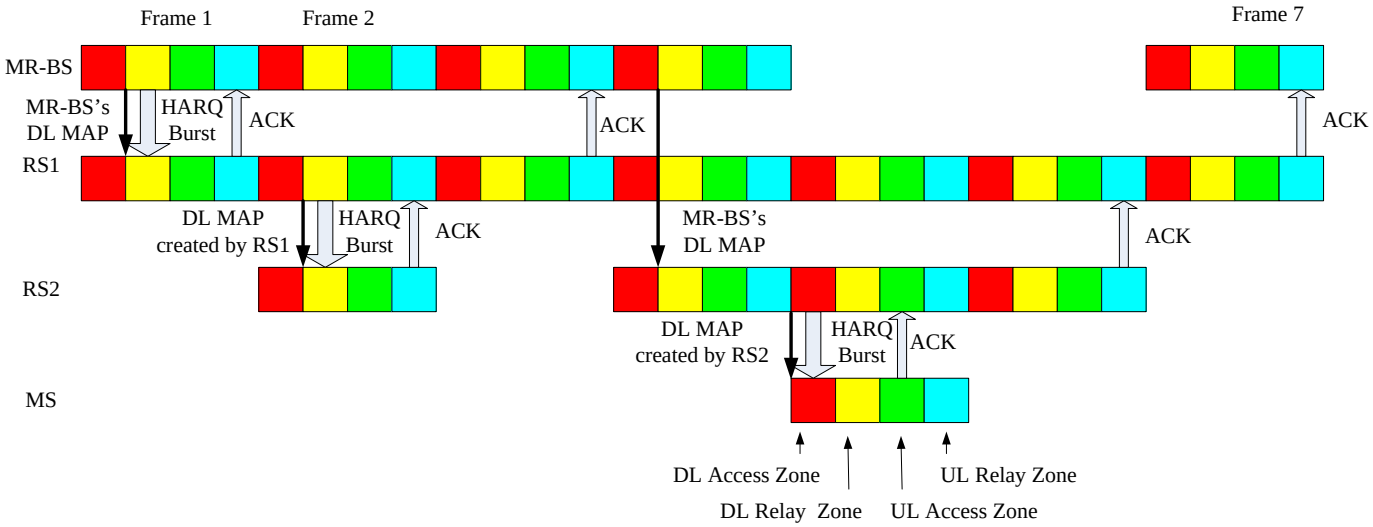

Fig. 5 Hop by hop HARQ for non-transparent with centralized scheduling.

In both figure 4 and figure 5, MR-BS transmits the HARQ burst and receives the ACK from RS1 in frame 1. After that, the HARQ burst is relayed by RS1 to RS2 in frame 2. In this manner, if one transmission fails in the design, the wasted frame number will be zero. However, the cost in the retransmission increases when the failed hop gets closer to the receiver. For instance, in both figures, if the first hop fails, the retransmission frame number is one; while if the third hop fails, the retransmission frame number will be four.

Accordingly, the frames number elapsed and wasted in the end to end and hop by hop HARQ mechanisms are listed in table 1 and table 2. For the illustration simplicity, in all the scenarios only one retransmission is assumed. The failed hop is 0 means no failure happens in the transmission. Since the centralized scheduling scenario the same number of frame elapsed as the distributed case does, both of them will not be specified in the following illustrations. Instead, only end to end HARQ and hop by hop cases are compared.

Table 1. Frames elapsed in various HARQ.

Type\Failed Hop	0	1st	2nd	3rd
End to end	5	10	9	8
Hop by hop	7	8	9	11

Table 2. Frames wasted in the HARQ.

Type\Failed Hop	0	1st	2nd	3rd
End to end	0	4	1	0
Hop by hop	0	0	0	0

As analyzed above, it can be observed hop by hop HARQ wastes none of the frames to the cost of larger frame elapsed. Therefore, it is a practical solution for both centralized and distributed scenarios when the channel condition is poor.

Specified Text Changes

[Insert new sub-clause 6.3.17.4.1.2]

6.3.17.4.1.2 DL Hop by Hop HARQ for Multihop Non-transparent RS

When the channel condition is poor, the hop by hop HARQ shall be used for both centralized and distributed scheduling RS scenarios.

When MR-BS or RS sends a HARQ burst to MS to the aid of one RS, the RS shall receive the HARQ burst from the superordinate station. If the HARQ burst is received correctly, the RS will send an ACK to the superordinate station. After saving it for future retransmission, RS will forward this HARQ burst to the subordinate station. As a contrast, if the HARQ burst is not received correctly, the RS shall a NACK signal to

the superordinate station. Subsequently, the superordinate station will retransmit the burst after it receives the NACK signal.

Reference:

[1] IEEE C802.16j-07/203r7, “Downlink HARQ with Relay”