Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**	
Title	**Downlink HARQ for transparent RS**	
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Re:	Call for Technical Proposals regarding IEEE Project P802.16j (IEEE 802.16j-07/007r2)
Abstract	This contribution proposes a procedure for handling retransmission of downlink HARQ for transparent RS.
Purpose	Add proposed spec changes in P802.16j Baseline Document
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Downlink HARQ for transparent RS

1. Introduction

This contribution introduces a downlink HARQ mechanism for transparent type of RS where the RS does not transmit a preamble, FCH and DL/ULMAP directly as shown Figure 1.

In order to reduce the resource for retransmission of HARQ bursts, the RS retransmits the HARQ burst instead of MR-BS, if the RS has the correct HARQ burst.

In this contribution, we propose the procedure for downlink HARQ transmission. We don't suggest the MAP allocation for HARQ burst and the ACK/NAK channel on relay-link.

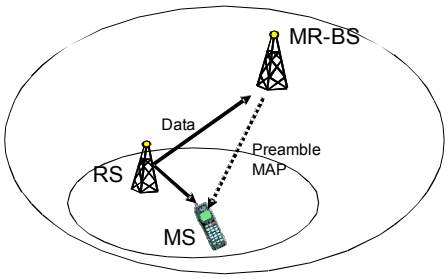

Figure 1 transparent RS

2. Downlink HARQ procedure

In this contribution, we propose the following HARQ relaying procedure.

- Hop-by-Hop relaying
- RS-assisted relaying

2.1. Hop-by-Hop relaying

In the case of hop-by-hop relaying, RS relays the HARQ burst, after the RS receives the HARQ burst correctly from MR-BS.

Figure 2 shows the DL HARQ procedure. When MR-BS transmits a HARQ burst to MS through RS, the MR-BS transmits the HARQ burst to RS firstly. If the RS fails to receive the HARQ burst, the RS replies NAK signal through ACK channel to MR-BS, then MR-BS retransmits the HARQ burst to the RS. If the RS receives the HARQ burst correctly, the RS replies ACK signal to MR-BS. Subsequently the MR-BS makes the RS relays the HARQ burst to MS. In the same time, the MR-BS also notifies MS to receive the HARQ burst by DL MAP. When the MS fails to receive the HARQ burst from RS, the MS replies NAK signal to the MR-BS through the RS, then the MR-BS makes RS retransmits the HARQ burst to the MS.

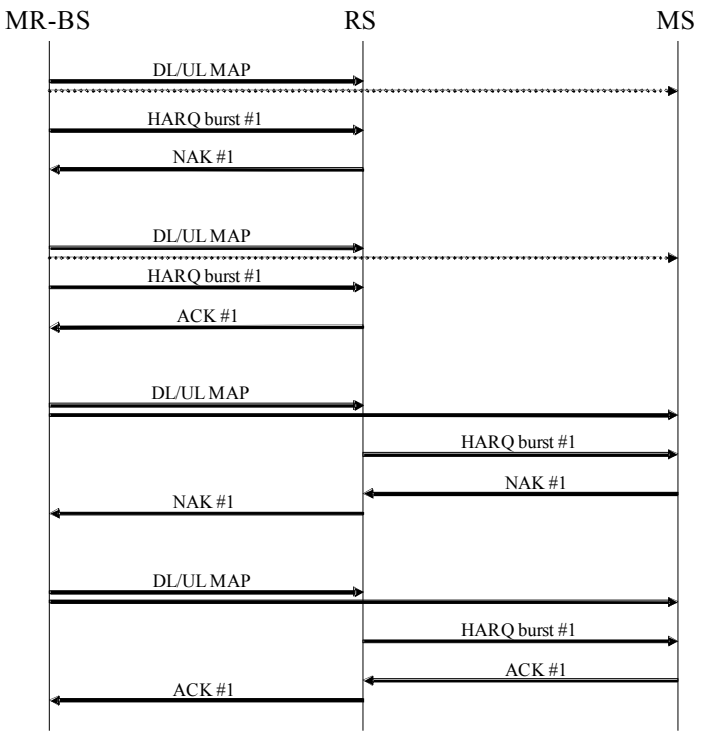

Figure 2 Hop-by-Hop relaying

2.2. RS-assisted relaying

In the case of RS-assisted relaying, RS monitors the HARQ burst transmitted by MR-BS to MS. If RS can decode the HARQ burst correctly and MS fails to receive the HARQ burst, the RS retransmits it to MS.

Figure 3 shows the example of RS-assisted relaying procedure. In this case, MR-BS receives ACK/NAK signal from RS and MS separately. If MR-BS receives NAK signal from both RS and MS, the MR-BS transmits the HARQ burst to RS and MS again. If MR-BS receives ACK signal from RS and NAK signal from MS, the MR-BS makes RS retransmits the HARQ burst to MS.

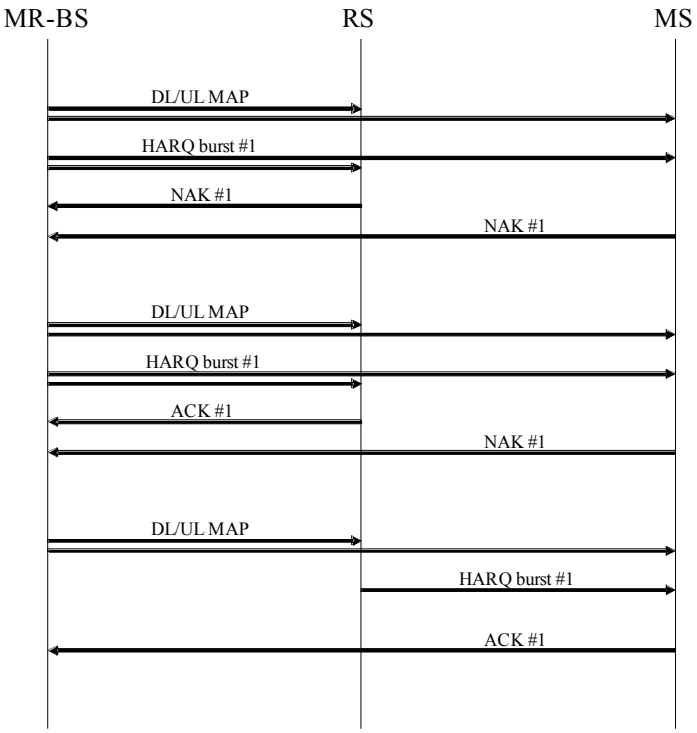

Figure 3 RS-assisted relaying

Figure 4 shows another ACK/NAK feedback method for RS-assisted relay. In this case, the encoded ACK/NAK is used on relay-link and RS replies the encoded ACK/NAK signal after receiving ACK/NAK signal from MS. If RS, which decoded the HARQ burst correctly, receives NAK from MS, RS replies the new encoded NAK (C_2) to MR-BS. Then MR-BS makes RS retransmits the HARQ burst to MS.

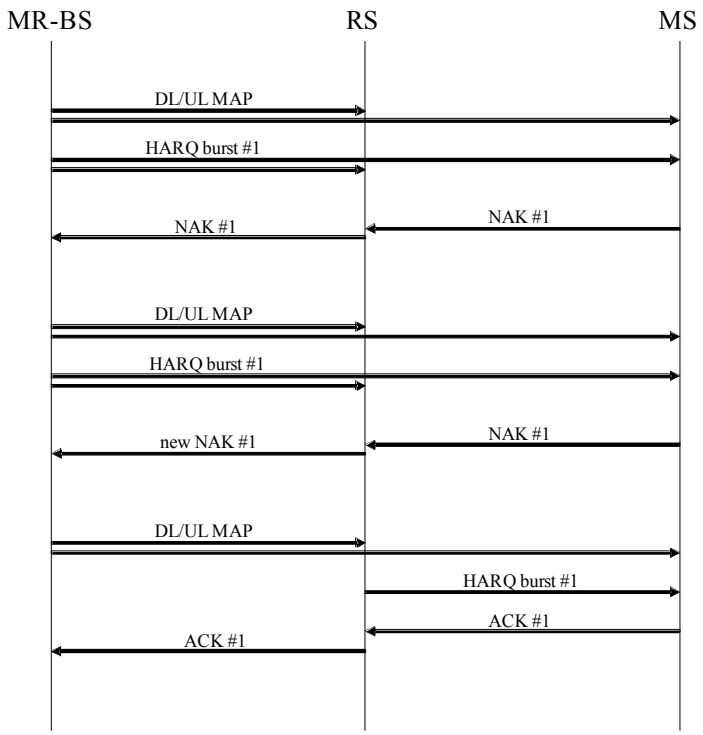

Figure 4 RS relaying the encoded ACK/NAK

3. Specific text changes

[Insert new sub-clause 6.3.17.5.1]

6.3.17.5.1 DL HARQ for Two Hop Transparent RS

In the two hop transparent case, MR-BS schedules a HARQ burst on both relay-link and access-link. When RS has the correct HARQ sub-burst for MS, MR-BS makes RS retransmit it to MS.

[Insert new sub-clause 6.3.17.5.1.1]

6.3.17.5.1.1 RS Hop-by-Hop Relay

When MR-BS sends a HARQ sub-burst to MS through RS, the RS shall receive the HARQ sub-burst from the MR-BS for relaying the burst to the MS. If the RS receives the HARQ sub-burst correctly, then the RS sends an ACK signal to the MR-BS and saves it for the event that there may be a retransmission to MS. Subsequently, the RS forwards the sub-burst to the MS. If the RS does not receive the HARQ sub-burst successfully, the RS shall send a NAK signal to the MR-BS. Upon receiving the NAK from the RS, the MR-BS shall retransmit the HARQ sub-burst to the RS. When HARQ sub-burst is successfully received at RS, MS-BS request RS to

transmit HARQ sub-burst. When the MR-BS receives a NAK from the MS, the MR-BS notifies the RS to retransmit the HARQ sub-burst to the MS, and the RS shall retransmit the stored HARQ sub-burst to the MS.

[Insert new sub-clause 6.3.17.5.1.2]

6.3.17.5.1.2 RS assisted Relay

In a case where the MR-BS sends a HARQ sub-burst to the MS directly, the MR-BS informs the RS that it needs to monitor that particular transmission by Compact DL-MAP MONITOR IE and also allocate HARQ ACK region allocation IE on the relay link for sending ACK/NAK from RS. The RS, having information on the downlink resource allocations sent in the DL-MAP for the MS and Compact DL-MAP MONITOR IE, monitors the HARQ sub-burst transmission sent to MS by MR-BS directly and attempts to decode it. When the RS receives the HARQ sub-burst correctly, the RS saves it for a possible retransmission.

When MR-BS receives ACK/NAK from MS directly, MR-BS informs RS to reply ACK/NAK signal after RS receives the HARQ sub-burst. In this case, MR-BS receives ACK/NAK from RS and MS separately. When MR-BS receives NAK from both RS and MS, MR-BS retransmits the HARQ sub-burst. If MR-BS receives ACK from RS and NAK from MS, MS-BS makes the RS retransmits the HARQ sub-burst.

MR-BS may also configure RS to listen the ACK/NAK from the MS using Compact DL-MAP MONITOR IE. After the RS receives ACK/NAK from the MS, the RS replies using an encoded ACK/NAK defined in Table xxx through ACK channel prepared by MR-BS. RS shall clear the HARQ sub-burst depending upon the ACK/NAK information received from MS. If the RS received the HARQ sub-burst correctly and receives a NAK from MS, the RS replies the C_2 to MR-BS. In this case, the MR-BS requests the RS to retransmit the HARQ sub-burst saved at the RS. When the RS fails to receive the HARQ sub-burst and receives a NAK from the MS, the RS sends a NAK to the MR-BS. Then the MR-BS retransmits the burst by itself. When the RS receives an ACK from MS then irrespective of whether RS receives the HARQ sub-burst correctly or not, the RS replies ACK to the MR-BS. RS will send the encoded ACK/NAK in the UL ACKCH according to the order of CID in the compact DL-MAP MONITOR IE.

6.3.2.3.43.4 HARQ control IE

[Insert new field in table 94 (HARQ control IE format) as indicated:]

Syntax	Size	Notes
RSH	1 bit	0 = RS-assisted HARQ is enabled 1 = RS-assisted HARQ is disabled

[Insert new subclause 6.3.2.3.43.6.10 and add table:]

6.3.2.3.43.6.10 Compact DL-MAP MONITOR IE

In RS-assisted relay case, MR-BS sends the Compact DL-MAP MONITOR IE to RS. The Compact DL-MAP MONITOR IE provides the list of CIDs of the MS whose transmissions need to be monitored in the DL part of the current frame and relayed in the next frame to the MS.

Syntax	Size	Notes
Compact DL-MAP_IE() {		
DL-MAP Type = 7	3 bits	
DL-MAP subtype	5 bits	
N_CID_direct	4 bits	Number of CIDs for which RS uses the direct feedback
N_CID_encoded	4 bits	Number of CIDs for which RS uses the encoded ACK/NAK
For(i=0; i<N_CID_encoded + N_CID_direct; i++) {		
RCID_IE(i)	16 bits	The CIDs of the connections that RS shall monitor in the current frame
}		
}		

N_CID_encoded

This field specifies the number of CIDs to use the encoded ACK/NAK among CIDs list in this IE. The CIDs from the beginning of the list to the value of this filed use the encoded ACK/NAK.

N_CID_direct

This field specifies the number of CIDs to use the direct ACK/NAK among CIDs list in this IE. The CIDs from the N_CID_encoded to the end of the list use the direct ACK/NAK.

8.4.5.4.13 UL ACK channel

[Insert the following text and add table:]

When MR-BS receives the ACK/NAK signal from MS through RS in the RS-assisted relay case, the new sequences based on Table 301a is used. RS notifies the status of HARQ sub-burst at both RS and MS with the encoded ACK/NAK signal defined in the table xxx. When RS receive ACK signal from MS then irrespective of whether RS receives the HARQ sub-burst correctly or not, the RS replies ACK to the MR-BS.

Table xxx: ACK / NAK Encoding

Link Distance/Depth	ACK/NAK 1-bit symbol	Vector Indices per Tile Tile(0), Tile(1), Tile(2)	Code #
Any Distance	0 (ACK)	0, 0, 0	C_0
1	1 (NAK)	4, 7, 2	C_1
2	1 (NAK)	3, 5, 1	C_2

4. References

[1] C802.16j-06_132, “Relaying methods proposal for 802.16j”

[2] C802.16j-06_266r1, “Relay-Assisted Hybrid ARQ”

[3] C802.16j-06_197r1, “HARQ with Relays”

[4] C802.16j-07_002r1, “DL HARQ with Relays”

[5] C802.16j-07_029, “UL HARQ with Relays”