Project	**IEEE 802.16 Broadband Wireless Access Working Group** <http://ieee802.org/16>
Title	**HARQ for RS Virtual Grouping**
Date Submitted	**2007-09-09**
Source(s)	Adrian Boariu, Shashikant Maheshwari, Haihong Zheng, Yousuf Saifullah, Peter Wang NSN adrian.boariu@nsn.com Aik Chindapol, Jimmy Chui Siemens Corporate Research aik.chindapol@siemens.com Kanchei (Ken) Loa, Yi-Hsueh Tsai, Yung-Ting Lee, Hua-Chiang Yin, Shiann-Tsong Sheu, Youn-Tai Lee Institute for Information Industry 8F, No. 218, Sec. 2, Dunhua S. Rd., Taipei City 106, Taiwan loa@iii.org.tw
Re:	This is in response for call for comments P802.16j/D1
Abstract	There is a need for HARQ specification under RS group operation.
Purpose	Review and adopt
Notice	
Release	
Patent Policy	

HARQ for RS Virtual Grouping

Adrian Boariu, et al.

NSN

Introduction

The baseline document defines the capability operating the RSs in as group. This contribution provides HARQ capability for the RS group in case of 2-hops only.

UL HARQ operation for RS group is case of more than two hops is not feasible. When MS sends UL HARQ burst in frame N, it expects DL ACK/NAK bitmap IE at-most in the frame N+ 3. In case of RS grouping, DL ACK/NAK bitmap IE for MSs has to be generated by MR-BS (status of UL HARQ burst reception at each RS in the group could be different and therefore RS can not generate and transmit DL ACK/NAK bitmap IE to MS). If 1 frame offset is assumed for ACK transmission and HARQ burst relaying then it is not possible to support UL HARQ for more than 2 hops.

Specification changes

[Insert new sub clause 6.3.17.7]

6.3.17.7. HARQ for RS group

[Insert new sub clause 6.3.17.7.1]

6.3.17.7.1 DL HARQ for non-transparent RS group

For the purpose of HARQ operation the superordinate station of the group provides the scheduling for the entire group of RSs by generating the MAPs for relay link (superordinate station to RSs in the group) and the access link (members of RS group to MSs).

If the data sub-burst transmitted by the superordinate station is received correctly by an RS in the group, it shall forward the data to the MS. If an RS in the group doesn't receive the data correctly, it shall not re-encode and transmit the erroneous data. The MS receives the superimposed bursts from the group of RSs, as shown in Figure AAA.
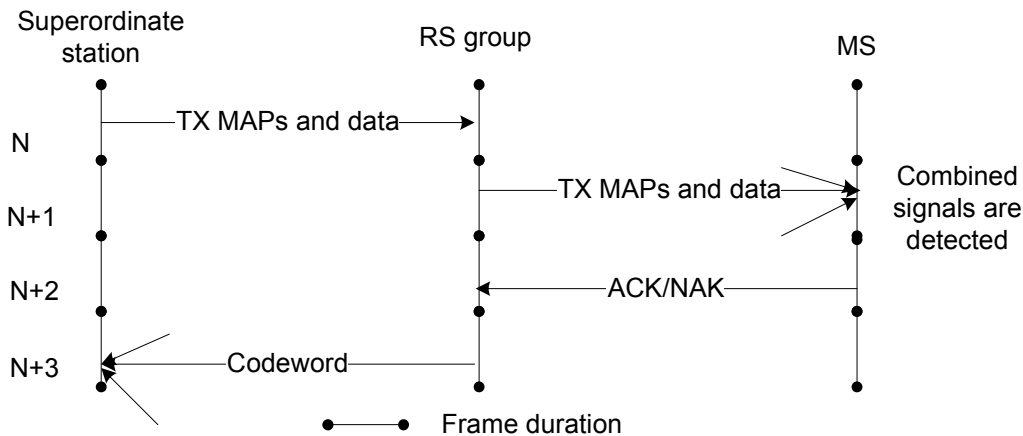
Figure AAA – HARQ operation for non-transparent RS group

Upon decoding the sub-burst, the MS shall transmit ACK/NAK in the corresponding allocated UL HARQ ACK channel of the access zone for the group of RSs. The RSs in the group shall monitor this UL HARQ ACK channel. For the relay link the superordinate station allocates a shared HARQ ACK channel in a frame after the group RSs receive the ACK/NAK report MS. An RS in the group sends a combined report for relay link and access link using the shared ACK channel. The combined report is generated using the appropriate codeword sequence according to Table 463a

If an RS receives ACK signal from MS, then RS transmits C_0 to superordinate station irrespective of the status of the relay link.
If an RS receives NAK signal from the MS, and the HARQ has been successful for relay link, the RS transmits C_2 to the superordinate station. This allows the option for the superordinate station to schedule the HARQ retransmission only on the access link. If the MR-BS receives neither C_0 nor C_2 codeword, then the MR-BS retransmits the burst by itself.
In all other cases an RS shall transmit nothing.

[Insert new sub clause 6.3.17.7.2]

6.3.17.7.2 DL HARQ for transparent RS group in assisted mode

For end-to-end operation, the MR-BS sends a HARQ data sub-burst to the MS directly the superordinate station uses MR_DL-MAP MONITOR IE to point to the data sub-burst to be received by the members of RS group, and also allocates a shared ACK/NAK channel on the relay link for sending encoded ACK/NAK reports by the RSs. The RSs, having information on the downlink resource allocations sent in the DL MAP for the MS and MR_DL-MAP MONITOR IE, monitor the HARQ data sub-burst transmission sent to MS by superordinate station directly and attempt to decode it. When an RS receives the HARQ sub-burst correctly, the RS saves it for a possible retransmission. An RS that did not receive the data sub-burst correctly shall not re-encode an erroneous packet for transmission.

For hop-by-hop operation, HARQ data sub-burst is scheduled from the MR-BS and forwarded to the MS by the RSs, if an RS receives the HARQ sub-burst from the MR-BS correctly, then the RS stores HARQ sub-burst and reports ACK to MR-BS through a shared ACK channel. If an RS fails to decode the sub-burst correctly, it shall transmit nothing in the ACK channel. If MR-BS receives the ACK from RS group, it schedules RS(s) to

forward HARQ sub-burst to MS. For RSs who report the ACK to MR-BS, it shall forward stored HARQ sub-burst to MS. For RS who does not report the ACK to MR-BS, it shall not re-encode and transmit the erroneous packet to the MS.

When MR-BS receives ACK/NAK from MS directly, MR-BS informs RSs to reply with ACK signal, after RSs received the HARQ data sub-burst. The RSs that did not receive the data sub-burst correctly shall transmit nothing to superordinate station. Thus, MR-BS receives ACK/NAK reports from RS and MS separately. MR-BS retransmits the HARQ data sub-burst if it did not receive an ACK from either the MS or a member of RS group. If MR-BS receives ACK from RSs and NAK from MS, MS-BS instructs the RSs to retransmit the HARQ data sub-burst. An RS sends the ACK/NAK in the UL ACKCH according to the order of CIDs in the MR_DL-MAP MONITOR IE.

MR-BS may also configure RSs to listen the ACK/NAK reports from the MS using MR_DL-MAP MONITOR IE. After the RSs receives ACK/NACK from the MS, the RSs reply using an encoded ACK/NAK defined in Table 463a through a shared ACK channel prepared by MR-BS. RS shall clear the HARQ sub-burst depending upon the ACK/NACK information received from MS. If a member of RS group received the HARQ sub-burst correctly and receives an NAK from MS, then it sends the codeword C_2 to MR-BS on the shared ACK channel. If a member of RS group fails to receive the HARQ data sub-burst and receives an NAK signal from the MS, then the RS sends nothing to the MR-BS. If a member of the RS group receives an ACK from MS then irrespective of whether the RS received the HARQ data sub-burst correctly or not, it sends C_0 codeword to MR-BS. If MR-BS received a C_2 codeword it has the option to request the RSs to retransmit the HARQ sub-burst saved at the RS, or it can retransmit itself. If the MR-BS receives neither C_0 nor C_2 codeword, then the MR-BS retransmits the burst by itself. An RS sends the encoded ACK/NACK in the UL ACKCH according to the order of CIDs in the MR_DL-MAP MONITOR IE.

[Insert new sub clause 6.3.17.7.3]

6.3.17.7.3 UL HARQ for non-transparent RS group

When MR-BS schedules an HARQ attempt, it allocates bandwidth over all the links from the MS to the MR-BS. It also allocates bandwidth for a shared ACK channel on the relay link between members of RS group and MR-BS. The members of RS group attempt to decode the uplink HARQ data sub-burst from the MS. If an RS decodes it successfully, it stores the data sub-burst, forwards the HARQ data sub-burst to MR-BS and transmits an ACK signal on the shared ACK channel. If an RS fails to decode the data sub-burst it sends nothing to the MR-BS.

If the MR-BS receives the ACK signal and detects successfully the data sub-burst it transmits ACK on the DL HARQ ACK Bitmap IE for the MS. If the MR-BS receives ACK signal and the data sub-burst detection fails, it has the option to schedule the HARQ retransmission only for the relay link while sending the ACK on the DL HARQ ACK Bitmap IE for the MS.
If the MR-BS receives nothing on the shared ACK channel, it sends NAK on the DL HARQ ACK Bitmap IE and schedules HARQ retransmission from the MS.

[Move the sections 6.3.17.5.2.1, 6.3.17.5.2.1.1 and 6.3.17.5.2.1.2 in the newly inserted sub clause 6.3.17.7.4. as shown below.]

6.3.17.7.4 UL HARQ for transparent RS group in assisted mode

Multiple Members of a transparent RSs group can also be involved in the two-hop HARQ process. The schedule of source station transmitting a sub-burst to multiple members of a transparent RSs group may be signaled by using MR Compact UL-MAP MONITOR IE which points to the burst to be received by the RSs. RSs use shared ACK channel to report status to MR-BS. MR-BS replies an ACK to MS if it receives the ACK from RS; otherwisie, it replies NAK to MS. If the MR-BS does not receive the ACK from the RSs, the MR-BS shall arrange data retransmission for the access link. If the MR-BS receives the ACK from the RSs but fails to decode the sub-burst, the MR-BS shall arrange data retransmission for the relay link.

6.3.17.7.4.1 Hop-by-hop operation

In case ofFor hop-by-hop HARQ involving multiple members of a transparent RSs group, HARQ data sub-burst is scheduled from the MS and forwarded to the MR-BS by the RSs. when MR-BS receives from the RSs the ACK on shared ACK channel. If an RS receives the HARQ sub-burst from the MS correctly, then the RS stores HARQ sub-burst and reports ACK to MR-BS on a shared ACK channel. If an RS fails to decode the sub-burst correctly, it shall transmit nothing in the ACK channel. If MR-BS receives the ACK, it schedules RS(s) to forward HARQ sub-burst to MR-BS. For RSs who report the ACK to MR-BS, it shall forward stored HARQ sub-burst to MR-BS. For RS who does not report the ACK to MR-BS, it shall not transmit the erroneous packet to the MR-BS.

6.3.17.7.4.2 End-to-end operation

In case ofFor end-to-end HARQ involving multiplemembers of a transparent RSs group and the resources isare prescheduled for all links,. tThe MR-BS allocates UL transmission for the RSs to relay the received sub-burst from MS to the MR-BS and allocates one shared ACK channel for RSs to send an ACK signal to the MR-BS. If an RS receives the HARQ sub burst from the MS correctly, then the RS forwards HARQ sub-burst to the MR-BS and reports an ACK to MR-BS. If an RS fails to decode the sub-burst correctly, it shall not transmit the erroneous packet to the MR-BS, and it shall transmit nothing in the shared ACK channel.

If the MR-BS receives ACK report from RSs but fails to decode the data sub-burst correctly, it should perform retransmission only for the relay link. If it does not receive ACK from the RSs, it can schedule the retransmission across all hops. If MR-BS receives correctly the HARQ data sub-burst from the MS, then regardless of the ACK/NAK received from the RS, the MR-BS sends ACK on HARQ ACK Bitmap IE to the MS.