Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**DL HARQ method for user-transparent relaying**
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Source(s)	Junichi Suga Voice: +81 44 754 2811 Fujitsu Laboratories Ltd. Fax: +81 44 754 2786 Kamikodanaka 4-1-1, suga.junichi@jp.fujitsu.com Kawasaki, 211-8588, Japan Michiharu Nakamura Voice: +81-46-839-5371 Fujitsu Laboratories LTD. Fax: +81-46-839-5560 5-5, Hikarinooka michi@labs.fujitsu.com Yokosuka, Japan. 239-0847
Re:	This contribution is response to call for technical proposal (IEEE 802.16j-06/027)
Abstract	This contribution proposes the method of DL HARQ processing for user-transparent relying.
Purpose	For discussion and approval of inclusion of the proposed text into the P802.16j baseline document.
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DL HARQ method for user-transparent relaying

Junichi Suga and Michiharu Nakamura
Fujitsu Laboratories Ltd.

Introduction

This contribution introduces Down Link HARQ processing for transparent type of RS, where the RS does not transmit a preamble, FCH or MAP, and BS receives signal of ACK channel from MS directly.
In order to reduce the resource for retransmission of HARQ data, RS retransmits HARQ data instead of MR-BS, if RS has correct HARQ data.

Whilst the Down Link HARQ processing introduced does require changes to the existing BS specification, it does not require any changes to the MS/SS as described in IEEE Std. 802.16.

Proposed method

Transparent relaying

In transparent relaying system, RS relays only user data. As shown figure 1, MS which is under RS receives a preamble, FCH or MAP from MR-BS directly, and receives user data via RS. On uplink, MR-BS receives signal of ACK channel from MS directly which is used for control HARQ retransmission.
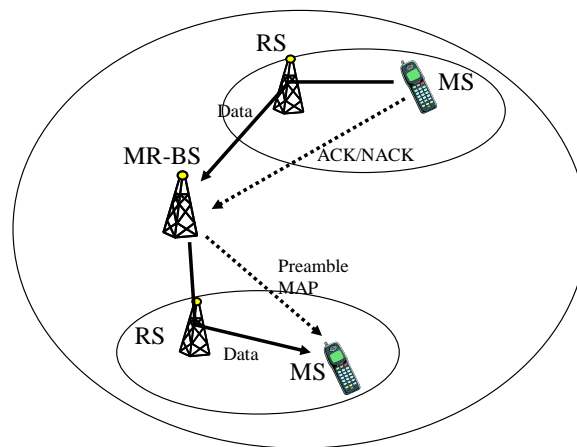

Figure 1 transparent relaying

Figure 2 shows the example of HARQ processing sequence. Since the delay of RS processing is assumed, RS does not relay HARQ data #1 in the same frame where RS receives it. And RS relays HARQ data #1 agreeing to DL MAP for MS sent by MR-BS. MR-BS receives ACK or NACK from MS directly through ACK channel.
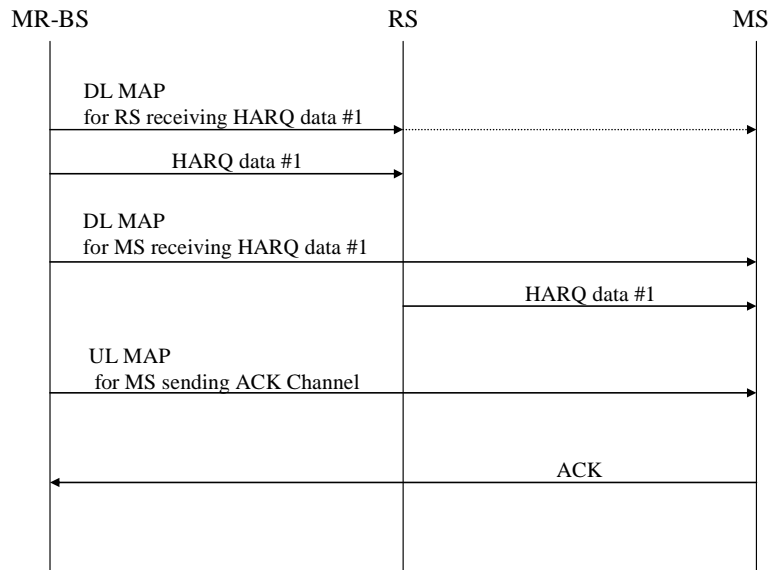
MR-BS   RS   MS

DL MAP
for RS receiving HARQ data #1

HARQ data #1

DL MAP
for MS receiving HARQ data #1

HARQ data #1

UL MAP
 for MS sending ACK Channel

ACK

Figure 2 DL HARQ processing

Retransmission HARQ data from RS

When MR-BS receives NACK from MS directly, the retransmission of the related HARQ data is needed. It is assumed that if RS has received HARQ data correctly, the retransmission from RS instead of MR-BS is efficient for radio resource. In this document, RS memorizes correct HARQ data when RS receives it from BS, and RS retransmits HARQ data to MS instead of BS, if needed.

MR-BS   RS   MS

DL MAP
for RS receiving HARQ data #1

HARQ data #1

DL MAP
for MS receiving HARQ data #1

UL MAP
for RS sending ACK Channel

HARQ data #1

ACK

UL MAP
for MS sending ACK Channel

NACK

DL MAP
for RS receiving HARQ data #1

DL MAP
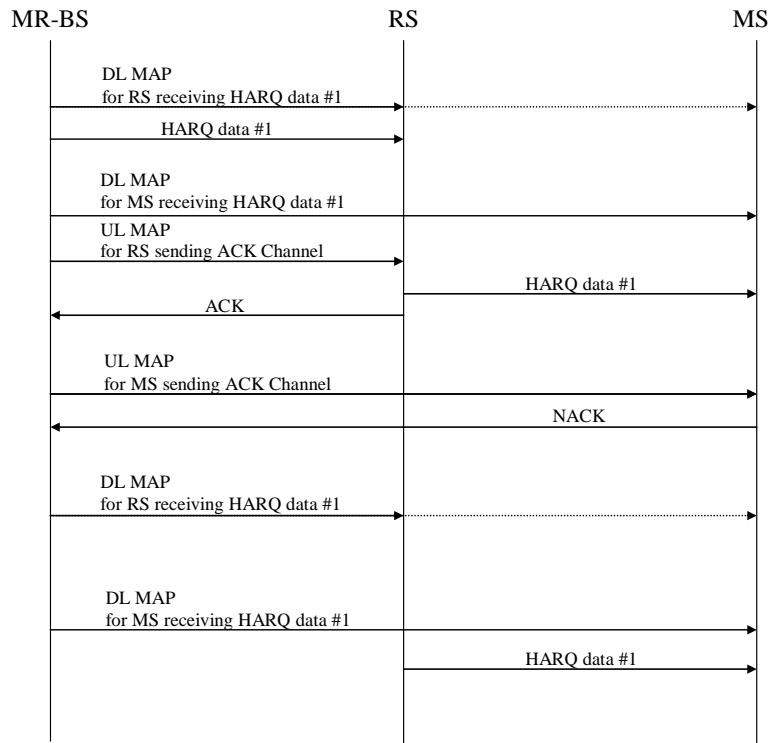 for MS receiving HARQ data #1

HARQ data #1

Figure 3 Proposed DL HARQ processing

Figure 3 shows the example of retransmission HARQ data from RS. In this proposal, ACK channel for RS is prepared by BS, and when RS receives HARQ data from BS, RS decodes it and replies ACK or NACK through prepared ACK channel to BS. When RS receives correct HARQ data from BS, RS memorizes it for retransmission.

In this example, since error is occurred on the link between RS and MS, RS replies ACK to BS, and MS replies NACK to BS. Since RS replies ACK to BS, BS recognizes that RS can retransmit HARQ data, then BS requests for RS by using DL MAP to retransmit HARQ data to MS instead of BS.

While, RS has received error HARQ data from BS may not transmit it to MS to avoid interference to other cell, and replies NACK to BS.

Specific text changes

Insert the following text at the end of the subclause
6.3.17.2 DL ACK/NAK signaling

For retransmission from MR-BS to RS, a dedicated PHY layer ACK channel is allocated in the R-UL.

Insert a new subclause 6.3.17.4
6.3.17.4 DL HARQ for centralized MR system

RS receives HARQ sub-burst from MR-BS for relaying to MS and replies ACK/NAK signal through ACK channel in the R-UL. When the RS receives the HARQ sub-burst correctly, the RS forwards the sub-burst to the MS and memorizes it for preparing to retransmit it. When the RS does not successfully receive the HARQ sub-burst, the RS shall not forward the sub-burst
MR-BS decides whether the MR-BS or RS retransmits the HARQ sub-burst based on the received ACK/NAK information from the RS and MS, . When MR-BS receives ACK signal from RS and NAK signal from MS, MR-BS notifies RS to retransmit HARQ sub-burst by using HARQ_DL MAP_IE.

Insert the following text at the end of the subclause
8.4.5.4.21 HARQ DL MAP IE

When the MR-BS decides to make the RS retransmit HARQ data packet to MS, the MR-BS shall transmit this IE without transmission of the HARQ sub-burst to the RS. Since RS has correct HARQ sub-burst, the information about length of sub-burst in this IE (e.g. duration) is to be zero. RS receives this IE which relates to correct sub-burst memorized by RS and retransmits the sub-burst to MS instead of MR-BS. The MR-BS also transmits the HARQ_DL_MAP_IE to the MS with the correct information about the length and location of HARQ sub-burst that is transmitted by the RS.

Insert the following text at the end of the subclause
8.4.5.4.13 UL ACK Channel

 This channel shall be supported by RS. RS transmits ACK or NAK feedback for HARQ sub-bursts on the R-DL.

Insert the following text at the end of the subclause
8.4.5.4.25 HARQ ACK region allocation IE

 This IE may be used by MR-BS to define an ACK channel region on the R-UL to include one or more ACK channel(s) for RS.

 RS receives HARQ DL sub-burst for relaying to MS at frame *i* shall transmit the ACK/NAK signal through the ACK Channel in the ACKCH region at frame (*i+j*). The frame offset *j* is defined by the "HARQ ACK Delay for DL Burst" field in the UCD message.

References

[1] C802.16j-06/132, "Relaying methods proposal for 802.16j", IEEE 802.16 meeting #46, November 2006.