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Title	**The Passive Multi-hop Relaying HARQ Mechanism**	
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Re:	Response to “Call for Technical Comments and Contributions regarding IEEE Project P802.16j” (IEEE 802.16j-07_007r2)	
Abstract	This document proposes a passive MR HARQ mechanism based on the multi-hop basis. This mechanism is preferable due to its simplicity. Furthermore, the cooperative relay can be implemented with it.	
Purpose	Add the proposed spec changes indicated in this document into the 802.16j Baseline Document (IEEE 802.16j-06/026r2)	
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The Passive Multi-hop Relaying HARQ Mechanism

I. Introduction

In relay based wireless communication systems, the efficiency of HARQ (Hybrid ARQ) mechanism is critical owing to its great impact on the transmission delay and the system capacity. The intention of this proposal is to develop an efficient HARQ retransmission mechanism adapted to relay based 802.16j systems and their certain functions by the collaboration between relay stations (RS) and base stations (BS).

As illustrated in Figure 1, a passive MR HARQ mechanism which is on a multi-hop basis is proposed. This mechanism benefits stable wireless channels greatly and furthermore the design of the RS is relatively simple.

This proposal focuses on mechanisms and procedures, instead of HARQ coding and combining techniques, and both soft combining and Incremental Redundancy (IR) combining are supported. These schemes apply to both uplink and downlink.

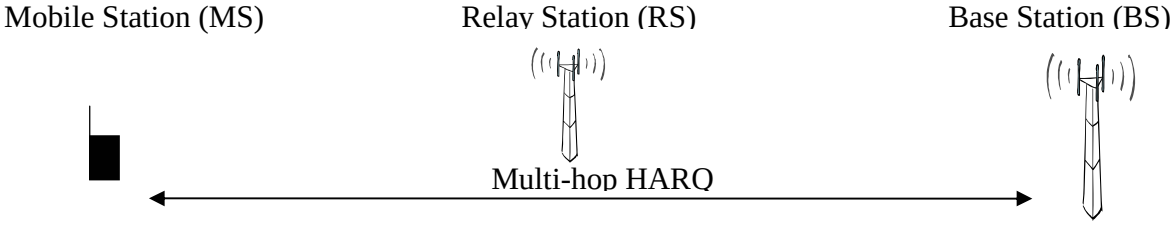

Fig. 1: The multi-hop HARQ in multi-hop relaying networks

II. System Description

In this mechanism, the number of hops to the destination for the multi-hop HARQ depends on whether the RS correctly receives the initial or combined packet to achieve the flexible and reliable transmission. If CRC is failed at the RS for the initial transmission, the multi-hop HARQ is performed between the source and the destination until the packet after combining at the RS is correct. Otherwise, the multi-hop HARQ is employed between the RS and destination to recover the original data. ACK/NACK message is only initiated by destination, and the RS is responsible to forward the ACK message or invert the NACK to ACK message in accordance with its CRC verification. No additional messages are required. A 2-hop example of the passive MR HARQ is illustrated in Figure 2.

For the initial transmission of HARQ, the RS forwards the received data to the next station (RS, BS or MS). As shown in Figure 2, when HARQ retransmission is received by the RS, it is then combined with the previous receptions. In the case of Chase combining, the combined packet is forwarded. In the case of IR combining the RS forwards the combined packet or the received retransmission from the source. This procedure continues until the final destination correctly receives the packet or the maximum allowed retransmission number is reached.

As a multi-hop HARQ mechanism, the BS keeps requesting the MS to perform HARQ retransmission until its correct reception. Therefore, some resources seem to be wasted if the correct packet is received in the RS but not received in the BS. However, no extra message is required in this mechanism to inform the BS of the statuses of all intermediate nodes and cooperative relaying can be supported in this mechanism. Furthermore, since CID can be unchanged in the RS, the passive MR HARQ mechanism is expected to be simple.

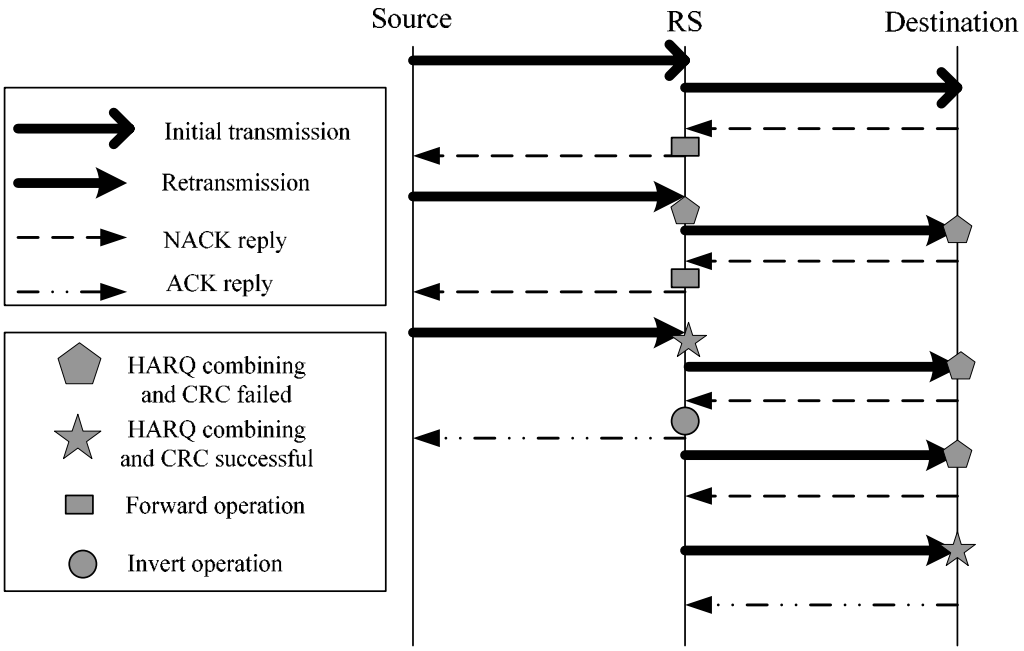

Fig.2: The passive MR HARQ mechanism in uplink & downlink

III. Summary

The passive MR HARQ is proposed for simplicity and can be used in the stable environments. In addition, cooperative relaying can be implemented with this mechanism. Either Chase combining or (IR) combining is supported.

IV. Proposed Text Changes

6.3.2.3 MAC Management messages

[Change the Table 14 as indicated:]

Type	Message name	Message description	connection
67	HQ_INFO	CRC verification result	basic
68-255		*reserved*	---

[Change 6.3.2.3.43.4 as indicated]

Two kinds of HARQ control IE are located in DL/UL MAP_IE. One is HARQ_Control_IE for MS and the other is MR_HARQ_Control_IE for RS. Both formats include encoding/decoding information for HARQ enabled DL/UL bursts, and are presented in the MAC frame.

In MR_HARQ_Control_IE, two HARQ mechanisms, active Multi-hop Relaying (MR) HARQ and passive MR HARQ, are alternative under the indication of Syntax “MHH”.

[Insert Table 94b as indicated (note that the original Table 94 is changed to be Table 94a)]

Table 94b MR_HARQ_Control_IE format

Syntax	Size	Notes
HARQ_Control_IE()	---	---
Prefix	1 bit	0 = Temporary disable MR HARQ 1 = enable MR HARQ
If (Prefix == 1) {	---	---
AI_SN	1 bit	HARQ ID Seq. No
SPID/Reserved	2 bits	Subpacket ID when IR is defined by the FEC mode, otherwise reserved (encoded 0b00)
ACID	4 bits	HARQ CH ID
MHH	1 bit	0 = active MR HARQ is enabled 1 = passive MR HARQ is enabled
Reserved	3 bits	Shall be set to zero
} else {	---	---
Reserved	3 bits	Shall be set to zero
}	---	---
}	---	---

MHH

Indicates which multi-hop HARQ is used, passive MR HARQ or active MR HARQ (which is an alternative multi-hop mechanism for high mobility environments)

[Insert new sub-clause 6.3.17.4 as follows]

Section 6.3.17.4 HARQ mechanism in multi-hop 802.16j networks

HARQ is performed over each hop based on a stop-and-wait protocol. Two complementary HARQ mechanisms, the active MR HARQ and the passive MR HARQ, are used on the distinct purposes, but they are compatible to each other in both transparent and non-transparent relays.

[Insert new sub-clause 6.3.17.4.2 and add figures]

Section 6.3.17.4.2 Passive MR HARQ mechanism

The passive MR HARQ is a multi-hop mechanism in which the forward is performed at the RS no matter whether the correct packet is received or not in the intermediate RS. This mechanism is dedicated for data forwarding with/without CID change along the route. Both the transparent and non-transparent relay can be supported by this passive MR HARQ mechanism.

The principle and process of the passive MR HARQ is illustrated in Figure 130jc.

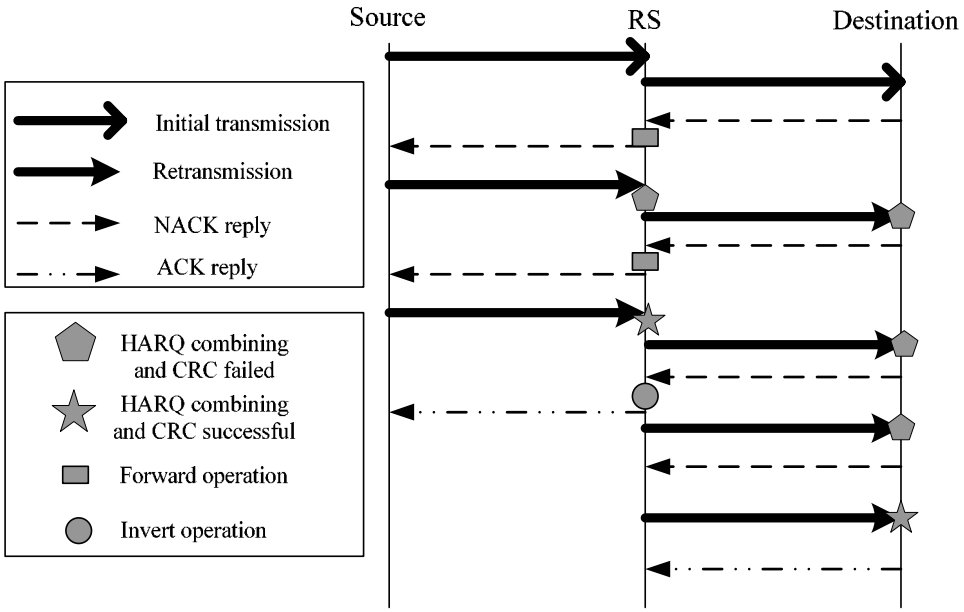

Figure 130jc: The passive MR HARQ mechanism

In both uplink and downlink, the source transmits its packets to the RS. The RS forwards the packet to the destination. ACK is sent back to the source via hops from the destination after a fixed delay defined by HARQ_ACK_Delay for UL or DL burst which is specified in DCD message, if the received packet succeeds in the CRC verification. Otherwise, NACK signal is transmitted. Those intermediate RSs simply forward ACK/NACK replies.

Only when a NACK is received for the previous HARQ attempt or an ACK is not received properly, the retransmission is conducted by the source. The intermediate RS performs HARQ combining and CRC verification. If the combined packet passes the CRC verification, the associated RS will play the role of the source in the following HARQ retransmission attempt to send the error-free packet, and also reply ACK signal to the source. Otherwise, the combined packet is forwarded to the next hop for Chase Combining, and the original received HARQ retransmission or the combined packet is forwarded to the next hop for Incremental Redundancy.

The use of the passive MR HARQ mechanism allows for the implementation of cooperative relay even within the intermediate hops.