

Project	<b>IEEE 802.16 Broadband Wireless Access Working Group</b> < <a href="http://ieee802.org/16">http://ieee802.org/16</a> >
Title	ARQ Over HARQ in IEEE 802.16m
Date Submitted	2008-07-07
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Re:	Regarding IEEE 802.16m-08/024: Call for contributions Project 802.16m System Description Document (SDD) on upper MAC concepts and methods.
Abstract	Cross-layer design of ARQ and HARQ can result in performance improvements and overhead reduction. The HARQ ACK/NACK mechanism is used to provide internal ACK/NACK information to the ARQ layer
Purpose	For discussion and approval by TGm
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# ARQ over HARQ in IEEE 802.16m

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## Introduction

Cross-layer design of ARQ and HARQ can result in performance improvements and overhead reduction. We take advantage of the HARQ ACK/NACK mechanism and do not duplicate unnecessarily the same ACK/NACK information at the ARQ layer.

In addition, this ARQ over HARQ mechanism should be extended to MAC management flows.

## Discussion

The following sections describe the DL and UL operation of the ARQ over HARQ mechanism.

### ***DL Operation***

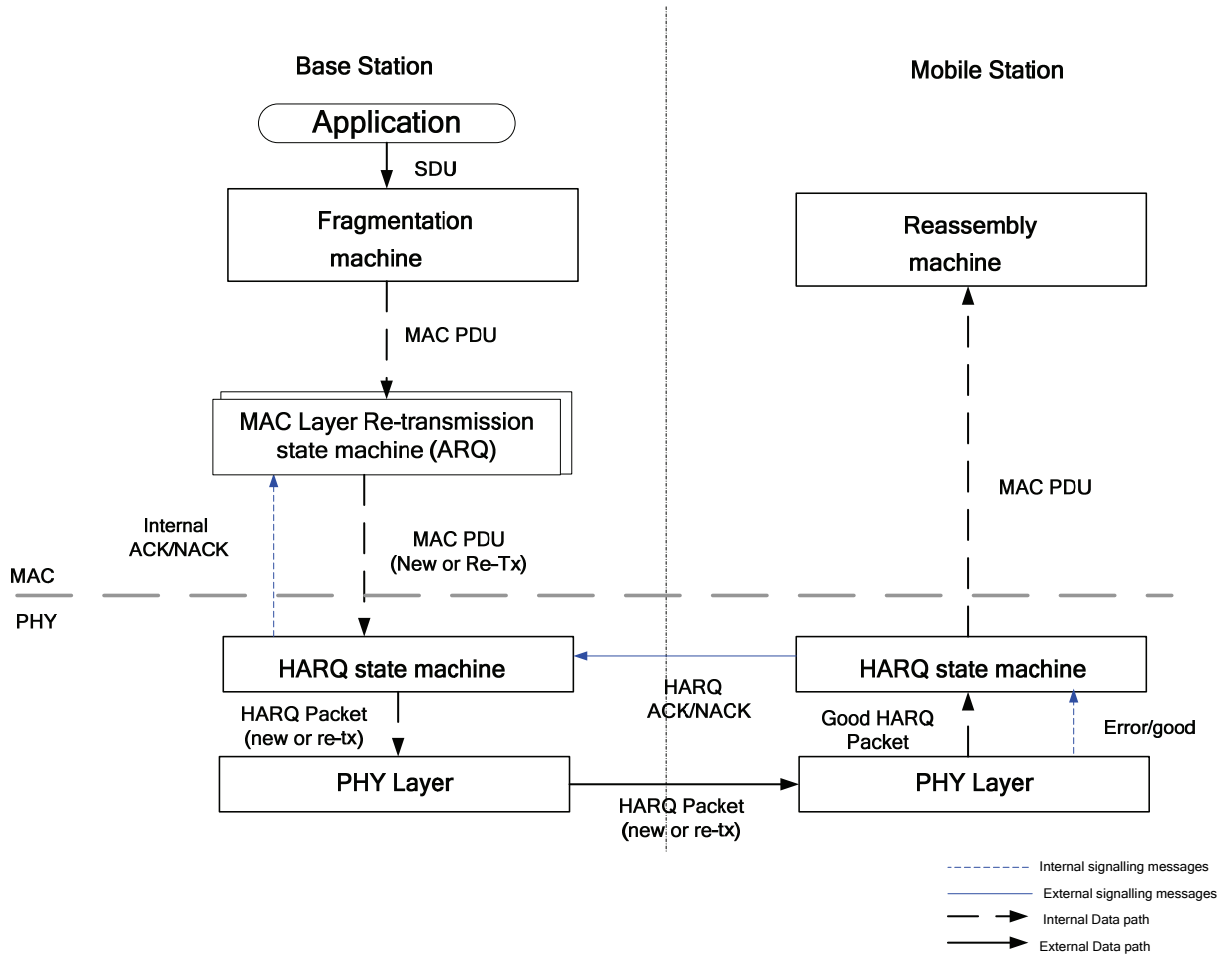
The BS relies on HARQ ACK/NACKs to drive MAC level retransmissions. The BS needs to keep track of MAC PDUs mapping to HARQ packets and if several MAC flows are multiplex onto the same HARQ packet. ARQ state machine is advanced based on HARQ ACK/NACK. This is analogous to the ARQ selective ACK, but without the overhead.

If the HARQ packet was ACK'ed by the MS, the BS sends an internal ACK to the ARQ state machine for the associated MAC PDU

If the base station gives up on a particular HARQ packet after max HARQ retransmission count, it sends an internal NACK indication for the associated PDUs. Note that HARQ packets can carry multiple flows. In this case the base station needs to send internal ACK/NACK indications to multiple state machines.

There are several advantages to this scheme:

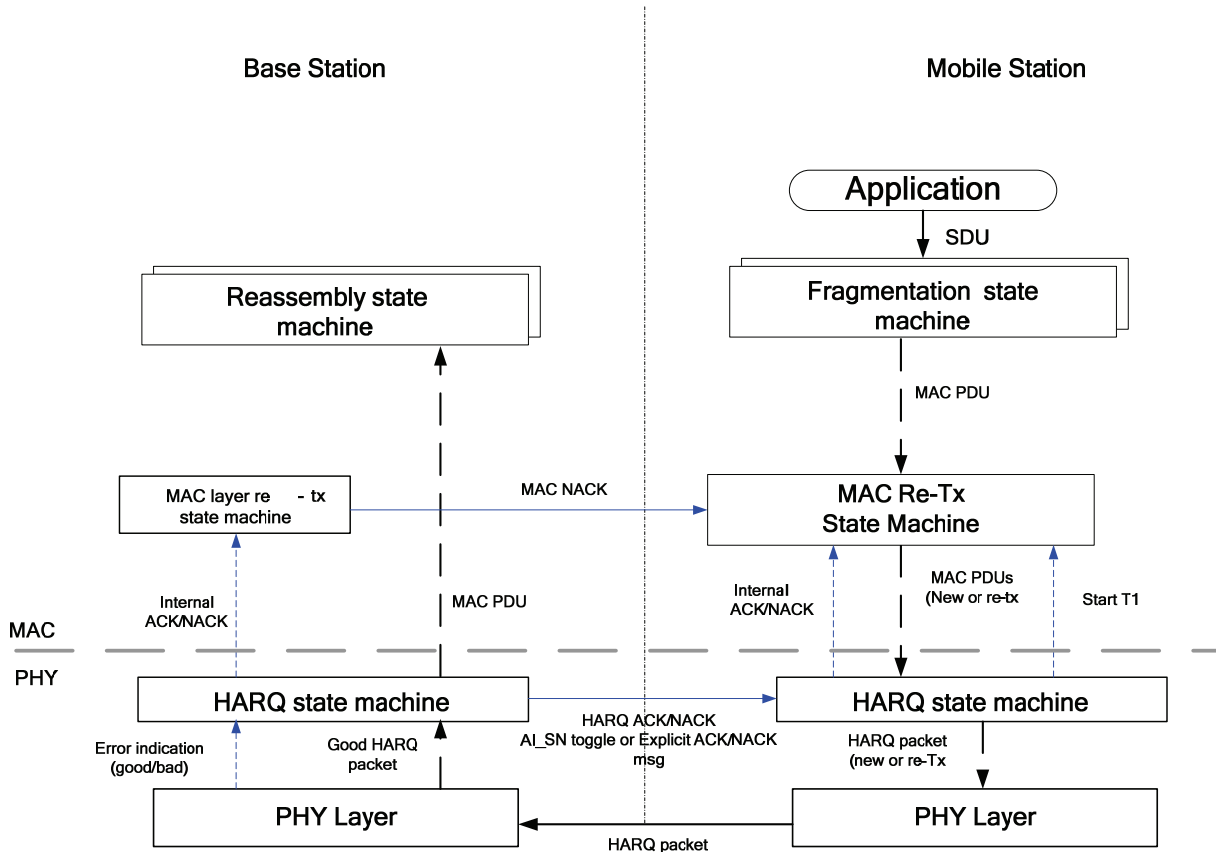
- Overhead savings – MS does not send UL ARQ ACK/NACK packets
- Faster retransmission since the combined MAC level retransmission and HARQ state machine use explicit indication instead of relying on timers to expire
- Remove the restriction of ARQ block size; note that ARQ blocks are used primarily as a way of reducing ARQ ACK/NACK overhead.
- Simpler design – no need to coordinate timers between two retransmission mechanisms to ensure that they do not overlap.



### UL Operation

For UL traffic, MS keeps track of MAC PDUs mapping to HARQ packets. Note the BS controls the HARQ retransmission operation. MS assumes that if the HARQ packet was ACKed implicitly via AI\_SN toggle, the packet was received correctly by the BS and sends an ACK for the associated PDUs after a predetermined time (T1). If the BS terminates the HARQ retransmission before its successful completion, it must send a NACK to the MS before the expiration of T1.

The NACK needs to uniquely identify the HARQ packet so that the MS can trigger the MAC level retransmission for the associated PDUs. For example the NACK message may contain the HARQ process ID (ACID) and the frame number the HARQ packet was received.



## Conclusion

This contribution proposes a cross-layer approach from retransmission relaying first on HARQ and potentially completing the retransmission at the MAC level.

## Proposed Text

Add the following text to SDD: *new Text is shown in blue*

10 Medium Access Control

10.x. ARQ

10.x.y ARQ Over HARQ

ARQ over HARQ mechanism should be extended to MAC management flows.

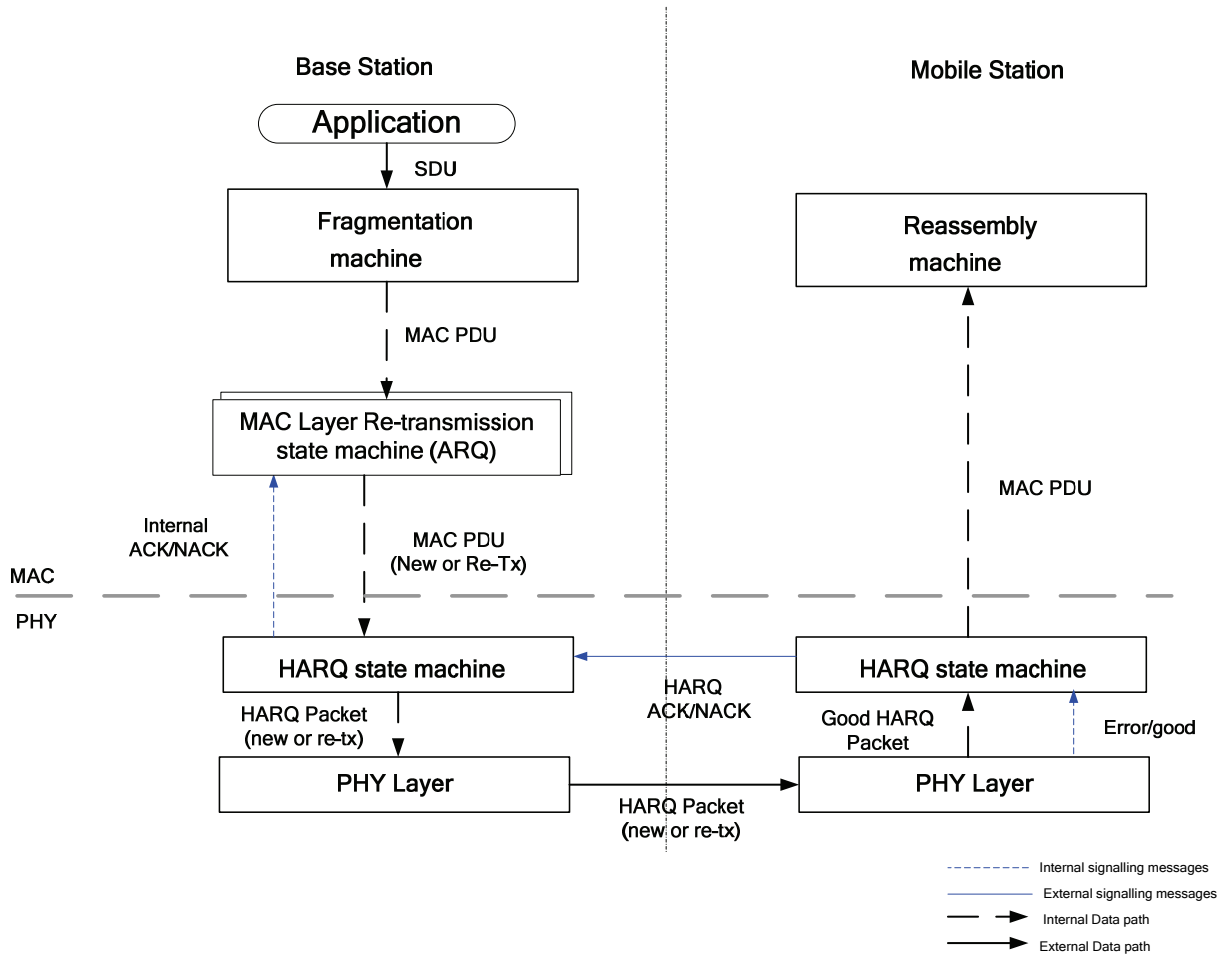
10.x.y.1 DL Operation

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### 10.x.y.2 UL Operation

For UL traffic, MS keeps track of MAC PDUs mapping to HARQ packets. Note that the BS controls the HARQ retransmission operation. MS assumes that if the HARQ packet was ACKed implicitly via AI\_SN toggle, the packet was received correctly by the BS and sends an ACK for the associated PDUs after a predetermined time (T1). If the BS terminates the HARQ retransmission before its successful completion, it must send a NACK to the MS before the expiration of T1.

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