Project	**IEEE 802.16 Broadband Wireless Access Working Group** <http://ieee802.org/16>	
Title	**Persistent Allocation Error Recovery Procedures**	
Date Submitted	**January 14, 2008**	
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Re:	802.16 Working Group Letter Ballot #26a	
Abstract	The resource allocation scheme of 802.16e is extended to enable persistent allocations (also referred to as periodic allocations). This contribution outline the error recovery procedures associated with the persistent allocation method.	
Purpose	Accept the proposed specification changes on IEEE P802.16Rev2.	
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Persistent Allocation Error Recovery

Introduction

A related but separate contribution outlines the procedures for persistent resource allocation method. The persistent resource allocation method has the potential of greatly reducing MAP overhead and thereby increasing overall system capacity.

MAP decoding errors for MSs with a persistent resource allocation have the potential of seriously diminishing the benefits of persistent resource allocation. The error state resulting from failure to decode the MAP may also be persistent, especially for UL traffic. MSs that failed to decode the MAP on a designated frame must cease using the persistently allocated resources until the error state has been cleared. The longer it takes the base station to clear the error state the greater is the QoS degradation perceived by the MS. The persistent resource allocation method requires an expedient error reporting method.

Proposed Solution

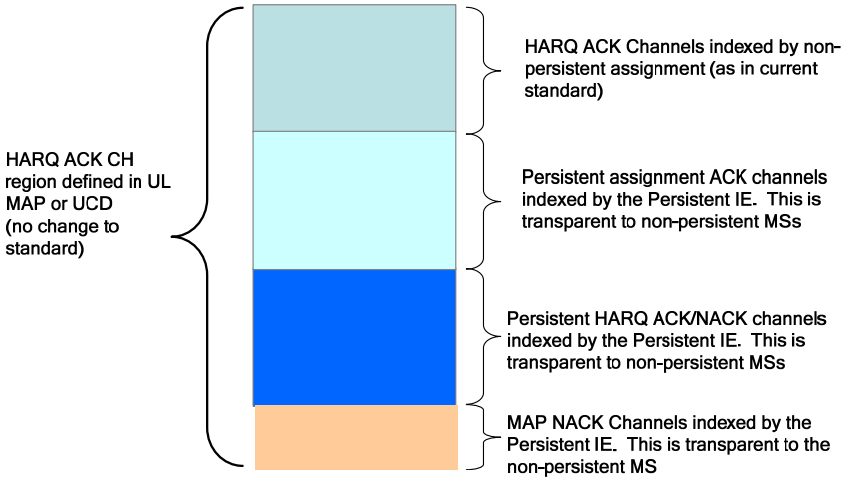
MSs with persistent resource allocations are also assigned a MAP NACK channel index. The MAP NACK Channel is defined within the HARQ ACK region and uses only one codeword to indicate a MAP decoding error event (NACK). The proposed NACK codeword is the same codeword used by the MS to indicate a HARQ NACK.

The base station can allocate more than one MAP NACK channel; each channel is identified by MAP NACK channel index. Several MSs can share the same MAP NACK channel. Several MSs can use the same MAP NACK channel at the same time.

From the base station's perspective it is immaterial who and how many MSs didn't get the MAP. The corrective action is the same: resend the persistent allocation information.

The base station may use implicit inference to further deduce which MSs did not send the NACK; e.g. if an MS sends data in the UL it probably didn't lose the MAP. If the base station determines that there was no change to any persistent resource allocations, the base station may send a 'no-change' indication or do nothing which can be used as an implicit indication of no change.

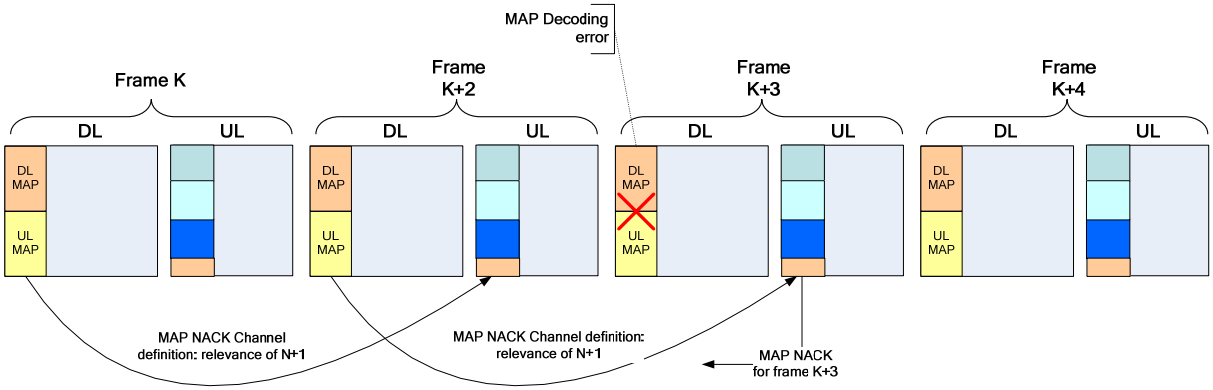
The figure below illustrates a HARQ ACK region with MAP NACK channel(s).



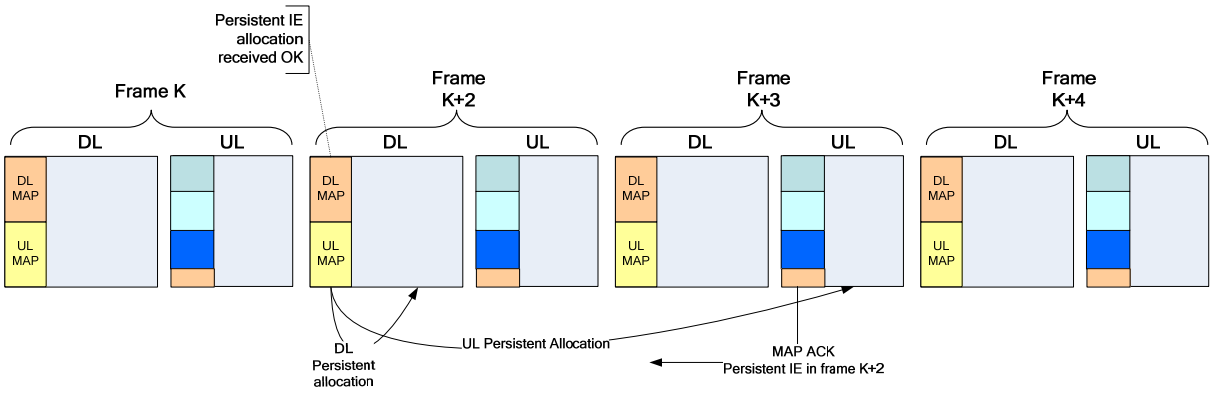
Note that persistent HARQ resource allocations must also a have persistent HARQ ACK/NACK channel assignment within the HARQ ACK region. The example also shows persistent assignment ACK channels for those MS that require acknowledging receipt of the persistent IE.

Frame Relevance of the MAP NACK and MAP ACK Indications

It is important to note the frame relevance of the MAP NACK and MAP ACK indications. The MAP NACK channel is defined in the UL MAP. The UL MAP has a frame relevance if N+1. The MS uses the MAP NACK channel of frame K to report MAP decoding error in frame K, hence the relevance of the MAP NACK and indication is said to have frame relevance on N. This is illustrated in the figure below.



MAP ACK relevance is proposed to be N+1 to allow MS sufficient time to prepare the MAP ACK and to be consistent with HARQ ACK/NACK time. (The HARQ ACK/NACK time is determined by the HARQ ACK delay parameter.) This is illustrated in the figure below.



Proposed Text

[Add to section 6]

6.3.27 persistent allocation
[Text in this section is provided in a separate but related contribution]

6.3.27.2 Error Handling Procedures

This section describes the MAC error handling procedures associated with the Persistent Allocation method.

6.3.27.2.1 MAP NACK Channel Initial Assignment

The base station needs to know that the MAP with the persistent allocation IE has been received correctly by the MS when assigning the MS MAP NACK Channel index. The base station may allocate a MAP ACK channel for MSs addressed by the Persistent Allocation IE. The MAP ACK Channel is used by the MS to acknowledge the receipt of the persistent allocation IE which contains the MAP NACK Channel index. The MAP NACK indication shall have the same codeword as the HARQ NACK indication (as per 8.4.5.4.13). The MAP ACK indication shall have the same codeword as the HARQ ACK indication (as per 8.4.5.4.13).

The persistent IE defines MAP ACK channel index for acknowledging the receipt of the persistent allocation IE and MAP NACK channel index for NACKing subsequent MAPs errors. The lack of acknowledgement on the MAP ACK channel is interpreted by the base station as NACK, meaning the MS did not receive the persistent allocation IE. Error recovery procedures from MAP loss indicated by the MAP ACK Channel are left to vendors' implementation.

Once the MS has successfully received the persistent allocation IE, it indicates subsequent MAP losses using the MAP NACK channel assigned using the persistent allocation IE.

6.3.27.2.2 Error Detection and Recovery Procedures

If the MS failed to decode the MAP in a frame in which it has a persistent resource allocation (frame K), the MS shall discard the rest of the DL of frame K. The MS shall not transmit on any UL persistent resource allocations (including HARQ ACK/NACK channel) in frame K+1 (UL) and shall send a MAP NACK on the associated MAP NACK Channel.

The base station upon receiving a MAP NACK indication, shall determine if the persistent IE needs to be resent. The MS shall resume using the persistent resource allocation in frame K + Allocation Period (PA) if:

- The base station did not include a persistent IE update (implicit indication of no-change)
- The base station included an explicit no-change indication IE
- The base station included a persistent IE update, but the included persistent IE did not have any changes relevant to the MS

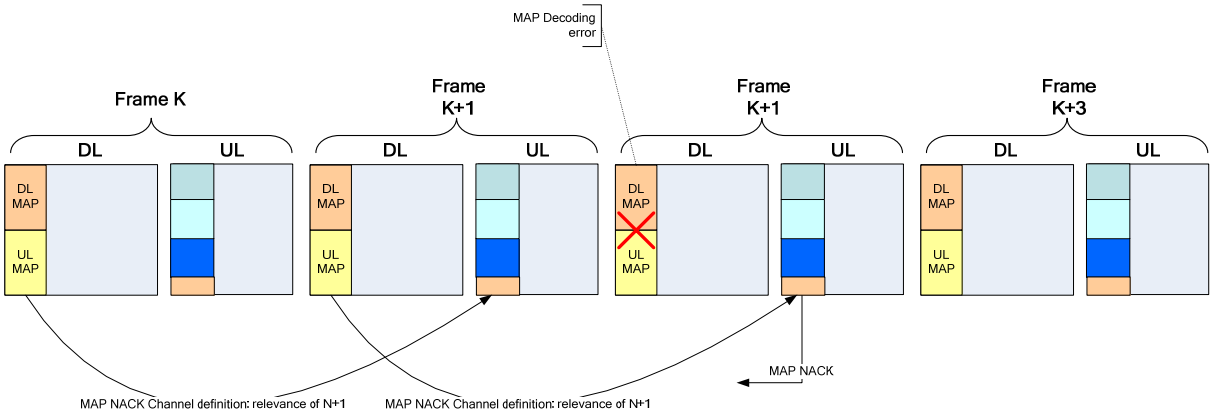
Otherwise, the MS shall utilize the persistent resource allocation as per the updated Persistent IE.

6.3.27.2.3 MAP NACK Channel Index Assignment

The MAP NACK channels are defined within the HARQ ACK Region. The MAP NACK channel index is defined using the Persistent Allocation IE.

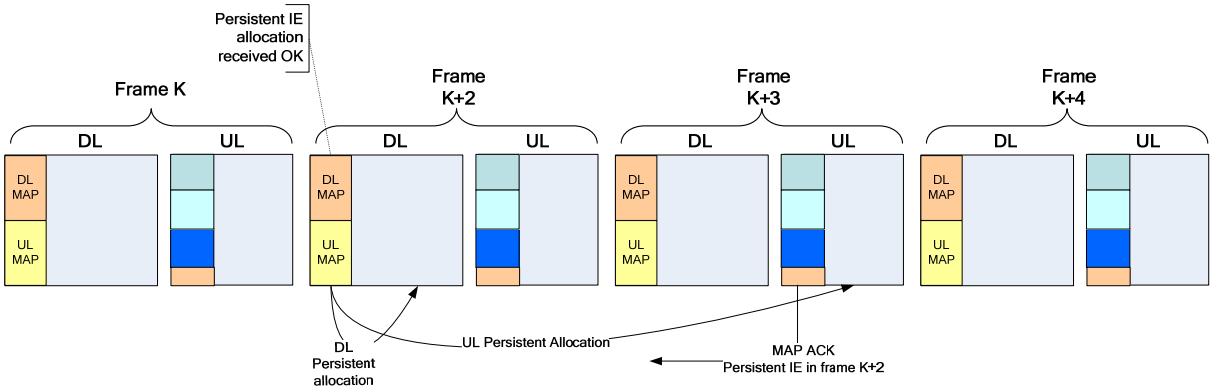
6.3.27.2.4 Relevance of MAP NACK Indication

The MS uses the designated MAP NACK channel of frame K to report a MAP decoding error in frame K, hence the relevance of the MAP NACK indication is said to have frame relevance on N. This is illustrated in the figure below.



6.3.27.2.5 Relevance of MAP ACK Indication

The MS uses the designated MAP ACK channel of frame K + HARQ_ACK_Delay for DL burst as per UCD message (see Table 610). to indicate successful receipt of a persistent Allocation IE in frame K. This is illustrated in the figure below with HARQ_ACK_Delay of 1.



[Add to section 8.4.5.3.21; Persistent Allocation IE table 355]

…		…
MAP NACK channel Index	8	Indicates the MAP NACK channel index within the HARQ ACK region. This MAP NACK index is to be used by MS for this persistent allocation MAP decoding error.
MAP_ACK_channel flag	1	1 = MAP ACK channel index is included in this IE 0= MAP ACK channel index is not included
If (MAP_ACK_channel_flag==1)		
MAP ACK channel index	8	Indicates the MAP ACK channel used by the MS to acknowledge correct reception of the persistent IE

…		….

MAP NACK channel index

If the MS was unable to decode the MAP in which it also has a persistent resource allocation, the MS shall use the associated MAP NACK channel for transmitting a MAP NACK indication. The MAP NACK indication shall have the same codeword as the HARQ NACK indication (as per 8.4.5.4.13). The MAP NACK channel relevance is the current frame.

MAP ACK channel index

The MS shall use the indicated MAP ACK channel for acknowledging the reception of the persistent IE. The MAP ACK channel relevance is HARQ ACK delay for the UL as indicated in the UCD.

[Add to section 8.4.5.2.21]

8.4.5.2.21.x Explicit No Change Indication

The base station may send a no change indication to explicitly indicate that there was no change to the persistent IE. There can be several persistent IE in a frame. The base station indicates no-change using the No_Change_Persistent_indication IE (new IE).

Syntax	Length (bits)	Comments
No_Change_Persistent_indication IE () {		
No-change indication	1	0 = no change 1 = change
Reserved	7	Shall be set to 0

References:

1. Draft Standard for Local and Metropolitan Area Networks; Part 16: Air Interface for Broadband Wireless Access Systems; **P802.16Rev2/D2 (December 2007)**
2. Contribution C80216maint-08_056.doc; Baseline Persistent Allocation IE for Chase Combine HARQ