Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Channel Quality Information (CQI) Report for Mobility Support**
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Re:	This is a response to a Call for Comments IEEE 802.16e-03/58 on IEEE 802.16e-03/07r5
Abstract	This document contains proposal to report the Channel Quality Information (CQI) for mobility support.
Purpose	The document is submitted for review by 802.16e Working Group members.

CQI Report for Mobility Support

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1. Background

In IEEE P802.16-REVd/D2-2003 OFDMA-PHY, Channel Measurement report or Channel Quality Information (CQI) report mechanism is supported by using REP-REQ and REP-RSP messaging. But the current REP-REQ/RSP messaging mechanism cannot provide any means to transmit the REP-REQ message on the uplink within a certain delay margin. Since the channel is not changed frequently in a fixed environment, it may no need to guarantee the resources to transmit the REP-RSP message in a limited delay. But in a mobile environment, the channel changes more frequently, so it must require some means to transmit the REP-RSP message within some number of frames with little overheads.

If we allocate the uplink resources to transmit the REP-RSP message for the SS, it requires additional overheads in the DL-MAP message and the REP-REQ messaging because the REP-REQ message can be transmitted on the basic connection. And if the uplink resources for the REP-RSP message cannot be provided, the SS received the REP-REQ should use the contention mechanism to transmit the REP-RSP message. But it has the serious problem of delay, because it cannot be guaranteed to transmit in the appropriate frames. The REP-RSP message transferred in excessive delay may be no use for the proper adaptation for the modulation and coding of the SS's channel condition.

Due to the current REP-REQ/RSP procedures, a BS transmit the REP-REQ message to a specific SS on the basic connection of that SS which is needed to report the channel measurement information, then the SS should respond with REP-RSP message with average and standard deviation for CINR or RSSI. But, when the BS should request to several SSs in the certain frame, the signaling overhead may increase by transmitting the same kind of message to a different SSs. And the REP-REQ message cannot provide any information or assignment of resources to the SSs to transmit the REP-RSP message. Therefore, in general, the SSs should try random access to request the bandwidth to transmit the REP-RSP. That causes some unwanted delay and the channel measurement information may be of no use to reflect the channel situation to adapt the appropriate AMC (adaptive modulation and coding) to the SS in a mobile environment. If we assign the uplink resources by using the UL-MAP-IE( ) to the SSs which are requested by the REP-REQ, then the UL-MAP signaling overhead will be significant due to the resource allocation to the SSs individually.

To resolve these problems, we propose to change the usage of the REP-REQ/RSP message and its procedures as follows: (1) Add the REP-REQ/RSP message transmitting connections to a basic or broadcast connection, (2) Define the dedicated channel to report the channel measurements sharing with the ARQ_ACK channel. (3) Change the REP-REQ message format to include the basic CID fields to the requested SSs and uplink subchannel offset information to designate the uplink resource to report a channel measurement report from the SS.

As we described in the Figure 1 and Figure 2, the original concept of the REP-REQ/RSp procedure cannot guarantee the on time report of the REP-RSP, but the proposed concept can provide the channel measurement report in the frame.

In the Figure 3, we describe the above concept: By using the UL-MAP_IE( ), allocate the dedicated uplink resources to a ARQ ACK and CQI channel. REP-REQ message contains the basic CIDs of the SSs which are required to report the channel measurement, and slot offset information which will be the allocated resource

for the first SS in the basic CIDs list. Since the uplink resources to transmit the REP-RSP message information are fixed, the next SS in the CIDs list should transmit the next uplink resources, and so on. Then the UL-MAP signaling overhead can be saved and the on time report of the channel measurements for applying AMC can be achieved.

To acquire more efficiency of using this REP-REQ/RSP procedures, we propose to define and use of the Compressed_REP-RSP message in the CQI report channel which is the response of the broadcasted REP-REQ. Compressed_REP-RSP message is consist of only the average and standard deviation value with CRC. Since the channel is dedicated to a specific SS, the header is not required to transmit.

In this contribution, we propose to define an uplink CQI report channel, which will be used by the SSs to send CQI report information. The CQI report channel is allocated using a single uplink MAP entry, and uses a most robust modulation level of QPSK-1/2 like as ARQ_ACK channel. We propose to change the REP-REQ MAC messages using broadcast connection to allocate resources for each SS for transmitting CQI report information . A unit resource for CQI report channel can be allocated to different SSs using a changed REP-REQ MAC messages. The SS indicated by an REP-REQ MAC message should transmit the CQI report on the appropriate channel.

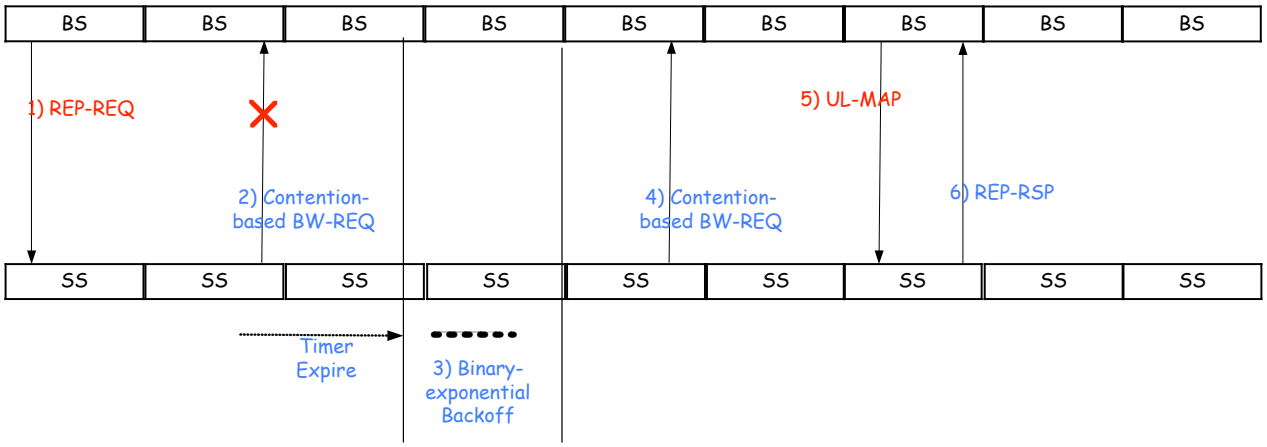

Figure 1. Example of Current REP-REQ/RSP Procedure

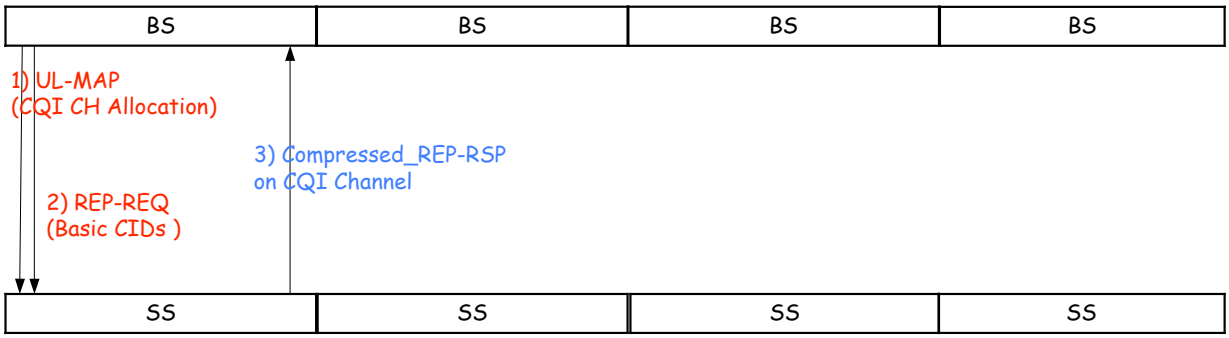

Figure 2. Example of Proposed REP-REQ/RSP Procedure in Mobile Environment

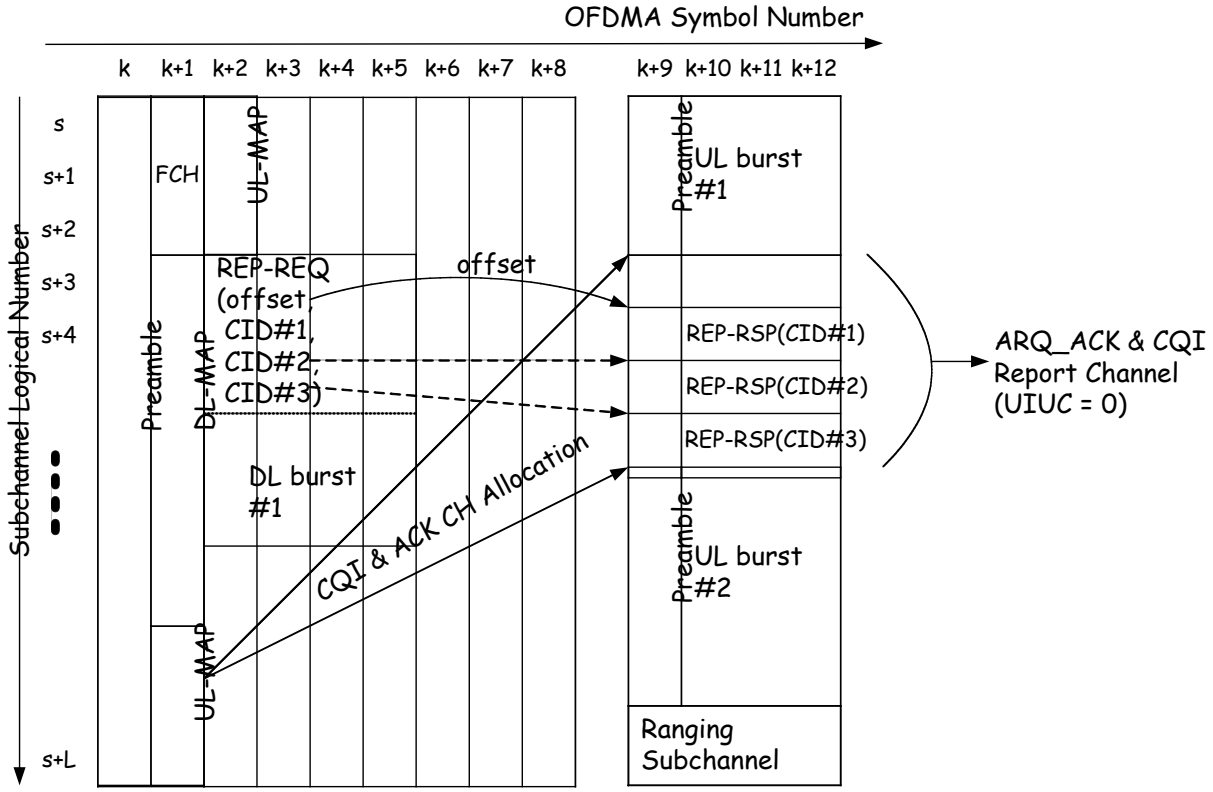

Figure 3. Example of Proposed CQI Channel Allocation and REP-REQ/RSP Procedure in OFDMA-PHY

2. Proposed changes on IEEE 802.16e-03/07r5:

[Changes on the P802.16-REVd/D2-2003 by the following text and adds these text in IEEE 802.16e-03/07r5.]

6.4.2.3 MAC Management Messages

[Replace the content of the Table 14 (REP-REQ):]

from:

Table 14 MAC Management messages

Type	Message name	Message description	Connection
36	REP-REQ	Channel measurement Report Request	Basic

to:

Table 14 MAC Management messages

Type	Message name	Message description	Connection
36	REP-REQ	Channel measurement Report Request	Basic, Broadcast

6.4.2.3.33 Channel measurement Report Request/Response (REP-REQ/RSP)

The channel measurements Report Request message shall be used by a BS, operating in bands below 11 GHz, to request received signal strength indicator (RSSI) and carrier-to-interference-and-noise ratio (CINR) channel measurement reports. In license exempt bands, it shall additionally be used to request the results of the DFS measurements the BS has previously scheduled. The SS may send the REP-RSP asynchronously to notify the BS of the status in the downlink channel.

[Replace the content of the Table 62 to the following:]

Table 62 Channel measurements Report Request (REP-REQ) message format

Syntax	Size	Notes
Report_Request_Message_Format( ) {		
Management Message Type = 36		
if (CID in the generic MAC header == broadcast CID) {		
Number of basic CIDs *N*	8 bits	
Offset	8 bits	PHY-dependent offset value of the unit resources for allocation; such as time slot offset or subchannel offset.
for (i = 0; i < *N*; i++) {		
Basic CID	16 bits	
}		
}		
Report Request TLVs	variable	
}		

A BS shall generate REP_REQ messages in the form shown in Table 62, including the following parameters:

CID *(in the generic MAC header)*
SS's Basic CID or Broadcast CID. If the Broadcast CID is used in the generic MAC header, the payload must contains as a list of each SS's basic CIDs.

The REP-REQ message shall contain the following TLV encoded parameters:

Report Request

The channel measurements Report Response message shall be used by the SS to respond to the channel measurements listed in the received Report Requests. In license exempt bands, the SS shall also send a REP-RSP in an unsolicited fashion upon detecting a Primary User on the channel it is operating in.

Table 63 Channel measurements Report Response (REP-RSP) message format

Syntax	Size	Notes
Report_Response_Message_Format( ) {		
Management Message Type = 37		
Report Response TLVs	variable	
}		

The REP-RSP message shall contain the following TLV encoded parameters:

Report
Compound TLV that shall contain the measurement Report in accordance with the Report Request (see 11.1.6).

If the SS has requested by the REP-REQ with broadcast CID and designated the uplink CQI report channel to transmit the channel measurement report, then the SS should use the compressed REP-RSP:

Table 63a Compressed REP-RSP (REP-RSP) message format

Syntax	Size	Notes
Compressed_Report_Response_Message_Format( ) {		
Mean	8 bits	
Standard Deviation	8 bits	
}		

The Compressed REP-RSP message shall contain the following parameters:

Mean
Mean value of CINR or RSSI.

Standard Deviation
Standard Deviation of CINR or RSSI.

[Change the following section to:]

8.5.5.3.1 UIUC Allocation

Table 238 defines the UIUC encoding that should be used in the UL-MAP_IE( ).

Table 238 OFDMA UIUC values

UIUC	Usage
0	ARQ_ACK Channel, CQI Report Channel
1-9	Different burst profiles
10	Null IE
11	CDMA Bandwidth Request, CDMA periodic ranging
12	Initial ranging
13	PAPR Reduction Allocation
14	CDMA Allocation IE
15	Extended UIUC