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Title	<b>REP_RSP and REP_REQ MAC message modifications for Co-Channel Interference Detection and Resolution in Synchronized WirelessMAN-CX Same Profile Systems</b>	
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Re:	IEEE 802.16h-06/015r1 – working group review.	
Abstract	This document modifies two MAC messages and deletes two previous MAC messages to the draft IEEE802.16h working document. The sections and paragraphs given below refer to those of the subject working draft document IEEE802.16h-06/015r1.	
Purpose	This document is provided to modifications of channel measurement MAC messages used in signaling coexistence and co-channel interference information between WirelessMAN-CX systems	
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## **REP\_RSP and REP\_REQ MAC messages Modifications for Co-Channel Interference in Synchronized WirelessMAN -CX Same Profile Systems**

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### **Introduction**

RF channel measurement report messages REP\_RSP and REP\_REQ are used in same-profile IEEE 802.16h WirelessMAN-CX systems that are synchronized to a universal timing standard such as GPS. These messages are used to identify and resolve co-channel interference in systems that share common spectrum resources (such as LE systems).

The REP\_RSP message is sent in an unsolicited fashion by an interfered-with Subscriber Station under conditions where a new interfering base station is detected by the SS which is not registered in the SS's Interference Table (Section 15.2.2.4 Table H4).

This message contains the identity of the SS being affected by the interference and the identity (proxy IP address and CMI) and emission characteristics (EIRP, BS RF antenna sector ID, and mean of the interference RSSI) of the newly detected interference. This information is taken (or measured as RSSI) from the BSD that is demodulated during the interferer's CMI.

The purpose of the REP\_RSP is to indicate to the home BS the level of co-channel interference intensity experienced by the SS. During each CMI foreign base stations of a coexistence community are given the unique opportunity to broadcast their presence (via the BSD) and thus be detected by all other proximate, co-channel subscriber stations. Those subscriber stations receiving the BSD will be by default, interfered with by that base station. If the BSD is newly detected (for example, from a formerly hidden base station), the SS generates the REP\_RSP message and sends it to its home BS for resolution. When the interference is resolved, for example, by changing the scheduling downlink traffic, the home BS sends its response to the interfered-with SS. Once this is done the SS Interference Table is updated at the SS and REP\_RSP messages will cease being sent. Resolved interference means that downlink data destined for the SS will be sent during interference free intervals negotiated by the CP. It does not necessarily mean that the interference will physically disappear. This being the case the SS will continue to register interference during the CMI specific to the interfering BS and the number of interference instances over a given number of CMI cycles will be recorded. In this manner the subscriber station continually tracks the level of interference it receives from each base station of the Coexistence Community. Such information is useful to higher-level network management systems, such as Cognitive Radio, that optimize spectrum usage amongst many co-channel users. Figure 1 shows the above process.

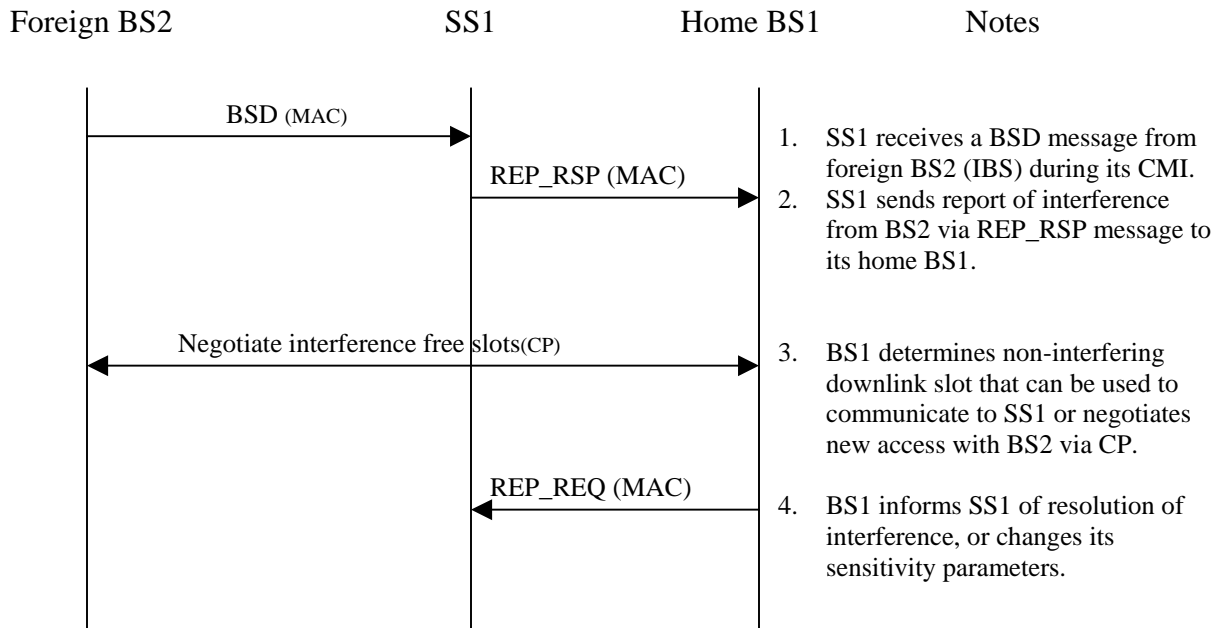


Figure 1. An Example of REP\_RSP and REP\_REQ usage

The REP\_RSP message is also used for Dynamic Frequency Selection (DFS) processes, which identify higher priority co-channel users such as military and weather radars, or satellite systems. Subscriber stations may be equipped with radar detectors. Such SS, on detection of higher priority signals, will forward DFS information to the base station and its network management systems via this message. Additionally the REP\_RSP is used to signal the presence of non-WirelessMAN-CX users, which are detected when their power is found present during special control channel interference and noise measurement intervals. Since the radars can be detected below their regulatory DFS threshold, there is a capability with the REP\_RSP message to indicate the power the radar or interference is detected at. Additionally, bit field space is left in the message to allow further categorization of the radar or the attributes of the non-WirelessMAN-CX system so detected.

There may be instances of sporadic and highly transient interference. To deal with such events the SS may be set with a threshold, below which it will not respond with a REP\_RSP message. This threshold may be adjusted by the BS (via the REP\_RSP message, see below). The threshold may be both the number of and power of the interference events detected per CMI cycles. In every cycle, all BS in a geographical locale (and not only in a Coexistence Community) will have one instance of broadcasting their BSD. To undertake this the INT\_BSD\_Frq bit field is used in the REP\_RSP message.

## REP\_REQ Message

The REP\_REQ is a message is sent by the home base station its subscriber station in response to the REP\_RSP. It contains parameters needed by the SS to either resolve co-channel interference, change its interference response threshold ( as they relate to the DFS\_LE\_PWR\_FRQ field of the REP\_REQ), or indicate to the SS that interference has been successfully resolved.

### 6.3.2.3.67. REP\_RSP message

*[this text replaces section 6.3.2.3.67 in draft IEEE 802.16h-06/015r1]*

The subscriber station co-channel interference indication (REP\_RSP) message contains co-channel interference information detected at a subscriber station. The source of co-channel interference can be foreign sources such as radars or non-WirelessMAN-CX compliant devices, as well as other WirelessMAN-CX base stations that may or may not be members of the coexistence community.

This is a MAC management message sent by a SS to its home base station when unresolved co-channel interference is detected at a SS. Unresolved co-channel interference typically is interference which is new to the SS and which is not recorded in the SS Interference Table as having been resolved using the Coexistence Protocol by the home base station of the SS. Resolved interference implies that messages destined to the SS will not be corrupted by interference emanating from a foreign WirelessMAN-CX base station. This message is sent either every time ( or after a set number of detection instances) the foreign BSD interference is detected and until the interference is resolved.

The message is sent also when non-WirelessMAN-CX systems are detected, such RLAN signals or radars which have higher regulatory priority to the bandwidth.

This REP\_RSP MAC management message shall contain the following minimum information to help determine the source and victim of co-channel interference:

#### **BS\_ID**

The foreign BS identity taken from the foreign BSD message.

#### **IP\_BS Proxy\_Address\_IE**

The proxy IP address associated with a foreign base station, derived from the BSD.

#### **BS\_RF\_Sector\_ID**

The RF antenna sector ID is used to identify the RF antenna in a base station if multiple RF antenna are used for RF reuse purpose; it is taken from the BSD.

**BS EIRP**

The EIRP of the interfering Base Station, taken from the BSD.

**CMI\_ID\_XX**

The Coexistence Messaging Interval during which the interference was received. This is a claimed CMI value, it represents the CMI CX\_MAC\_NO in which an interference BSD was received. If this is a noise and interference CX\_CC measurement, it represents the specific CX\_MAC\_NO in which the non-wirelessMAN system was detected.

**SS\_ID**

The subscriber station identifier: a 48 bit long field identifying the subscriber station that generated this REP\_RSP management message. This subscriber station is a victim of co-channel interference reported in this message.

**INT\_BSD\_Frq**

The frequency of specified interference BSD events detected per CMI cycles (calculated as the number of BSD interference events per N full CMI coexistence channel cycles) . For this specific BSD, as relayed by this REP\_RSP message. This value can be set by the home base station to make the SS less responsive to interference detection (such as highly sporadic and transient events).

**DFS\_LE\_PWR\_FRQ**

This parameter is used to identify the mean RSSI of the radar signals or non-WirelessMAN-CX systems detected in during a noise and interference measurement on the coexistence channel. Radar signals may be detected at below DFS threshold values and the value given for their signature will be radar events (pulses) per minute. If non-WirelessMAN-CX systems their signature will be given as number of detected CMI\_ID\_54 events per N CMI cycles [ 1 minute=1 Cycle TBD]

**REP\_RSP management message encoding (addition to section 11.12 in IEEE 802.16-2004):**

Name	Type	Length	Value
BS_CCID_IND	3	25	BS_CCID_IND_IE information element

**Table 1. BS\_CCID\_IND Information Element Format:**

Syntax	Size	Notes
BS_CCID_IND_IE ( ) {		
SS_ID	48 bits	Subscriber station ID
DFS_LE_PWR_FRQ	32 bits	Bits 0-3: Device Type

		Bits 4-15: Device detection specific Bits 16-23: 8 bit mean RSSI Bits 24-31: TBD
INT_BSD_Frq	16 bits	The frequency of interference BSD (or non-WirelessMAN-CX) interference events at set detection power threshold
BS ID	48 bits	Foreign BS_ID
BS_RF_Sector_id	8 bits	1-255 for RF reuse BS 0 reserved for no RF reuse BS
BS EIRP	8 bits	Nominal EIRP of interfering BS
CMI_ID_XX	8 bits	Coexistence Messaging Interval ID (CMI_ID_54 for non-Wireless MAN-CX)
IP_BS Proxy_Address	32 bits	Proxy IPv4
}		

### 6.3.2.3.68. REP\_REQ message

[ this test replaces section 6.3.2.3.68 in draft IEEE 802.16h-06/015r1 ]

This message is sent to the SS initiating the REP\_RSP message. It is sent by the BS and it is used to indicate whether the interference events identified in the REP\_RSP have been resolved. For DFS and non-WirelessMAN-CX responses, other responses will also be issued by the network management systems, which can entail moving to other channels, reducing EIRP, etc, at the SS.

REP\_REQ shall contain the following parameters:

#### **BS\_ID**

The identity of the foreign BS noted in the REP\_REQ. This can be null if the message was originally due to DFS or non-WirelessMAN-CX sources.

#### **RSP\_FIELD**

The response field indicates:

- (1) Interference with foreign BS is/is not resolved
- (2) Sub DFS threshold and non-IEEE 802.16h users noted, no response at present
- (3) TBD threshold/response adjustment variables (TBD)

**REP\_REQ management message encoding (addition to section 11.12 in IEEE 802.16-2004):**

Name	Type	Length	Value
BS_CCID_RSP	2	8	BS_CCID_RSP_IE information element

**Table 2. BS\_CCID\_RSP Information Element Format**

Syntax	Size	Notes
BS_CCID_RSP_IE ( ) {		
BS_ID	48 bits	Interfering BS station ID for which this response is sent to SS; set to zero if non-WirelessMAN -CX
RSP_Field	16 bits	The response field indicates: Bit 0: Response to Radar=1 Response to Non-WirelessMAN CX =0 Bit 1-2: 0 – Resolved 1 – Pending Resolution 2 – Adjust threshold 3 – Inhibit Response Bit 3-9: Interference RSSI Power threshold Adjust (-95 to -55 dBm (TBD)) Bit 10-15: TBD Threshold for number of interference events per CMI Cycle)
}		