	IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>
Title	**Request/Response Messages for providing Location Information in 802.16j**
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Re:	IEEE 802.16j Technical Contribution
Abstract	This contribution proposes the messages for requesting and providing location information in 802.16j
Purpose	Discussion and Adoption in IEEE 802.16j
Notice	

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Request/Response Messages for providing Location Information in 802.16j

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Introduction

This contribution is the result of an ongoing harmonization effort that brings together elements of the contributions C80216j-07_138.doc and C80216j-07_065.doc submitted to the January 2007 meeting.

The 802.16j amendment is aimed at extending the 802.16 specification in order to provide multi-hop relaying capabilities in the network. The usage scenarios developed in the context of 802.16j amendment envisages the use of relay stations that will be fixed, nomadic as well as mobile. Under a variety of situations, it may be quite helpful for the infrastructure stations to know the location of the other infrastructure stations. Two examples are provided below:

- One use of the location information is the transmission of a “relevant” set of neighbors in the MOB_NBR-ADV messages. The need for the selection of a relevant set of neighbors is foreseen because the length of the MOB_NBR-ADV message is likely to grow as more and more RSs are added to the network. As argued in contribution c80216j-07_139.doc titled ‘Reduced Neighbor Information Generation and Customized Delivery’, it is irrelevant for each MS in every RS cell to receive channel access parameters about each and every RS in the MR-network. Location information may be useful for infrastructure stations in selecting the relevant neighbors for any given RS for composing customized neighborhood information as suggested in the 802.16j baseline document 80216j-06_026r2.
- Another application in 802.16j where location information may be helpful is Interference Management. By using the location information, the MR-BS may be able to perform coarse resource allocation.

The current specification does not cater for a standardized method for requesting or providing location information. In this contribution, simple MAC messages for requesting and providing the location information are proposed.

Coordination Definition

WGS84 datum

The Global Positioning System (GPS) is based on the World Geodetic System of 1984 (WGS84) datum. WGS84 is a geocentric system, which provides an excellent mathematical representation in relation to the orbiting satellite constellation. Upon the introduction of satellite navigation, several national geodetic organizations immediately grasped the technology to update their datums with modernized geocentric ellipsoids and to reduce existing distortions.

A reference ellipsoid can be described by a series of parameters that define its shape and which include a semi-major axis (a), a semi-minor axis (b) and its first eccentricity (e) and its second eccentricity (e') as shown in Table 1. Depending on the formulation used, ellipsoid flattening (f) may be required. This ellipsoid has its origin coincident with the ECEF (Needs to be defined) origin. The X-axis pierces the Greenwich meridian (where longitude = 0 degrees) and the XY-plane make up the equatorial plane (latitude = 0 degrees). The Altitude is described as the perpendicular distance above the ellipsoid.

Table 1. WGS84 Parameters:

semi-major axis (a)	6378137
semi-minor axis (b)	$a(1-f)$ = 6356752.31424518
ellipsoid flattening (f)	1/298.257223563
first eccentricity (e)	$\sqrt{\frac{a^2-b^2}{a^2}}$
second eccentricity (e')	$\sqrt{\frac{a^2-b^2}{b^2}}$

LLA Coordinate System

The most commonly used coordinate system today is the latitude, longitude, and altitude (LLA) system. The origin of the system is at the mass center of the earth. The Prime Meridian and the Equator are the reference planes used to define latitude and longitude. The geodetic latitude (there are many other defined latitudes) of a point is the angle from the equatorial plane to the vertical direction of a line normal to the reference ellipsoid. The geodetic longitude of a point is the angle between a reference plane and a plane passing through the point, both planes being perpendicular to the equatorial plane. The geodetic altitude at a point is the distance from the reference ellipsoid to the point in a direction normal to the ellipsoid.

Reference

[1] “Giri Baleri, Sr.”, Datum Transformations of NAV420 Reference Frames, http://www.xbow.com/Support/Support_pdf_files/NAV420AppNote.pdf

Proposed Text Change

Insert new subclause 6.3.2.3.65:

6.3.2.3.65 Location information requesting and response messages

The location information defined in 6.3.2.3.65.3 is based on the World Geodetic System of 1984 (WGS84) datum.

6.3.2.3.65.1 MR_LOC-REQ message

The MR_LOC-REQ message may be transmitted by an MR-BS to an RS to request the location information of the RS. This message can also be transmitted by an RS to the MR-BS to request the location of other RSs. The MR_LOC-REQ message shall be generated in the format shown in Table X1.

The MR_LOC-REQ message can be set to any report type as specified in Table X1. When an RS sends the MR_LOC_REQ message, the report type field shall be set to '0b00' (meaning non-periodic).

Syntax	Size	Notes
MR_LOC-REQ_Message_Format() {	-	-
Type = xx	8 bits	-
Report Mode	2 bits	0b00: Once 0b01: Periodic report 0b10~11: reserved
Neighbor Location Req Flag	1 bit	0b0: Location request of the receiving RS only 0b1: Request message contains location request for neighboring access stations
If(Report Mode = 0b01) {	-	Available when the value of Report Mode is set to 0b01.
Report period	12 bits	Report period in units of frame, a value between 0 to 4095 corresponding to a range of 1 frame to 4096 frame.
}	-	-
If (Neighbor Location Req Flag != 0) {	-	If this message is transmitted by an RS to MR-BS
N_RS	8 bits	Number of neighboring stations for which the RS wants to know the location information.
For (j=0;j<N_RS; j++) {	-	-
RSID	48 bits	The 48 bit MAC address of the neighboring station (BS or RS) whose location is requested..
}	-	-
}	-	-
padding	variable	Padding bits to ensure byte aligned.
}	-	-

Table X1.MR_LOC-REQ message format

The following parameters shall be included in the MR_LOC_REQ message:

Report mode

Action code for an RS's report of location information:
0b0: The RS only sends a single response to the location request message.
0b1: The RS reports the location periodically

Neighbor Location Req Flag

Flag, when set, indicates that this message contains a request for the location of neighboring access stations.

The flag is set to 0 by the MR-BS when requesting the location of the receiving RS
The flag is set to 1 by the RS when requesting the location of the neighboring stations from the MR-BS.

Report period

This field represents the period with which an RS shall report the location information, if the Report mode option is set to periodic reporting.

N_RS

Number of neighboring stations (BSs as well as RSs) whose location is requested.

6.3.2.3.65.2 MR_LOC-RSP message

The MR_LOC-RSP message shall be transmitted in response to a MR_LOC-REQ message. The transmitter sends MR_LOC-RSP message based on the report mode indicated in the MR_LOC-REQ message. The transmitter of this message shall generate the MR_LOC-RSP message in accordance with the format shown in Table X2.

Syntax	Size	Notes
MR_LOC-RSP_Message_Format(){	-	-
Type = xx	8 bits	-
Report Mode	2 bits	0b00: Once 0b01: Periodic report 0b10~11: reserved
Neighbor Location Req Flag	1 bit	0b0: Location request of the receiving RS only 0b1: Request message contains location request for neighboring access stations
If (Neighbor Location Req Flag == 0)) {	-	If this message is transmitted by an RS to MR-BS
LLA_IE()	64 bits	Specifies the location of relay station in LLA format defined in section 6.3.2.3.62.3.
} else {	-	If this message is transmitted by an MR-BS to RS
N_RS	8 bits	Number of stations whose location information is included in the current MR_LOC-RSP message.
For (j=0;j<N_RS;j++) {	-	-
RSID	48 bits	The 48 bit MAC address of the neighboring station (BS or RS)
LLA_IE()	64 bits	Specifies the location of neighbor access station in LLA deviation format defined in section 6.3.2.3.62.3.
}	-	-
}	-	-
padding	variable	Padding bits to ensure byte aligned.
}	-	-

Table X2:MR_LOC-RSP message format.

The following parameters shall be included in the MR_LOC_RSP message:

Report Mode

Action code for an RS's report of location information:
The RS only sends a single response to the location request message.
The RS reports the location periodically

Neighbor Location Req Flag

Flag, when set, indicates that this message contains a response for the location of neighboring access stations.
The flag is set to 0 by the RS when responding to the location request from the MR-BS.

The flag is set to 1 by the MR-BS when responding to the location request from the RS about the neighboring stations.

N_RS

Number of neighboring stations (BSs as well as RSs) whose location the receiver responses.

6.3.2.3.65.3 LLA IE() format and sequence charts

Table ttt-a LLA_IE()

Syntax	Size	Notes
LLA_IE(){		
Latitude	24 bits	Specifies the latitude of a position in units of 0.0625 seconds, a value between -5184000 to 5184000 corresponding to a range of -90° to +90°.
Longitude	24 bits	Specifies the longitude of a position in units of 0.125 seconds, a value between -5184000 to 5184000 corresponding to a range of -180° to +180°.
Altitude	16 bits	Specifies the altitude of a position in units of m, a value between -32768 and 32767 corresponding to a range of -32768m to 32767m.
}		

Latitude

Specifies the latitude of a position in units of 0.0625 seconds, a value between -5184000 to 5184000 corresponding to a range of -90° to +90°...

Longitude

Specifies the longitude of a position in units of 0.125 seconds, a value between -5184000 to 5184000 corresponding to a range of -180° to +180°.

Altitude

Specifies the altitude of a position in units of m, a value between -32768 and 32767 corresponding to a range of -32768 to 32767m.

Table xxx: Relay location report (part 1)

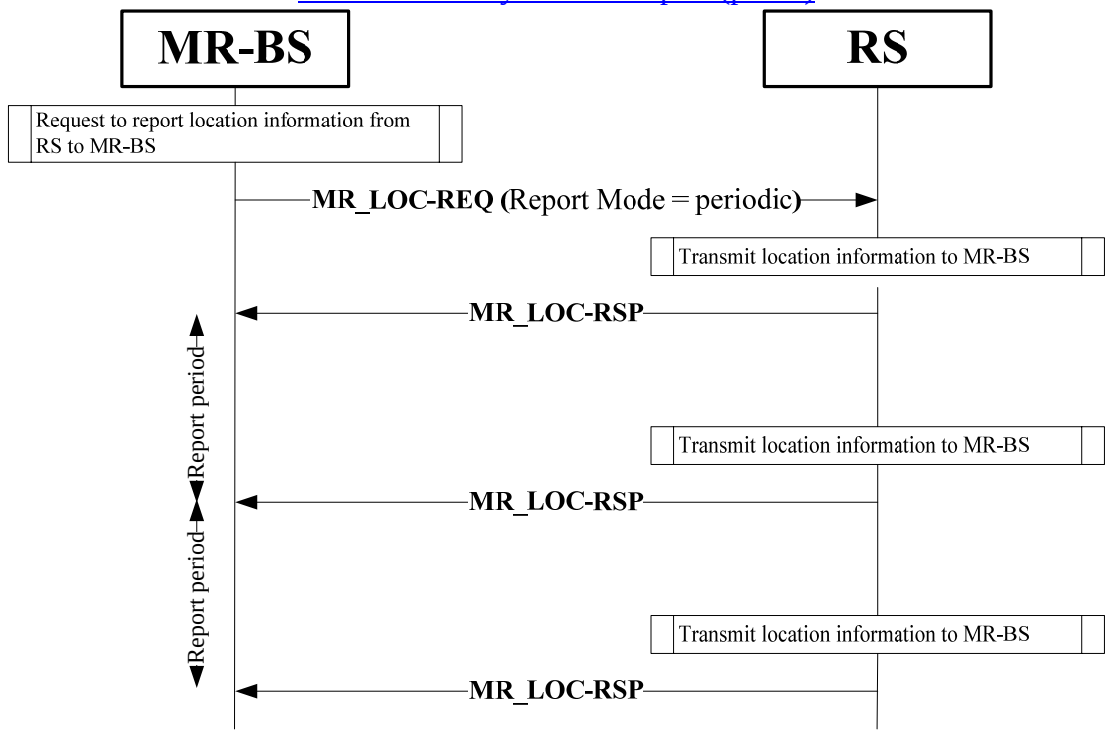


Table xxx: Relay location report (part 2)

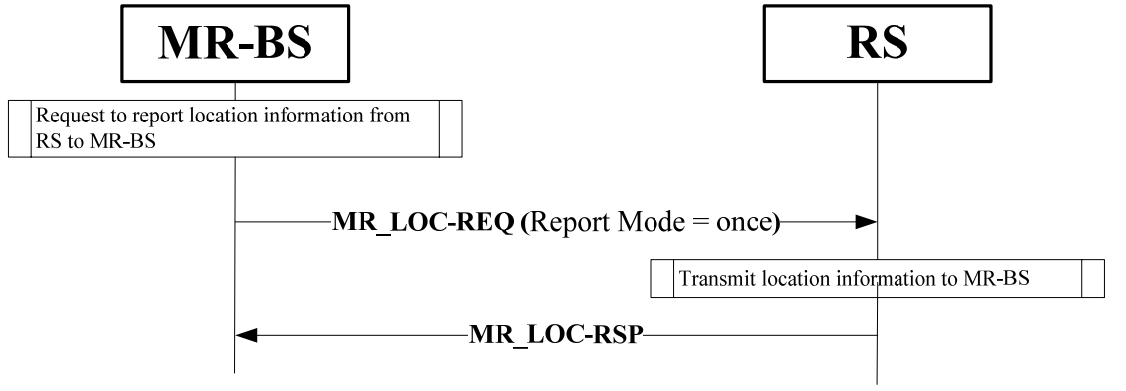
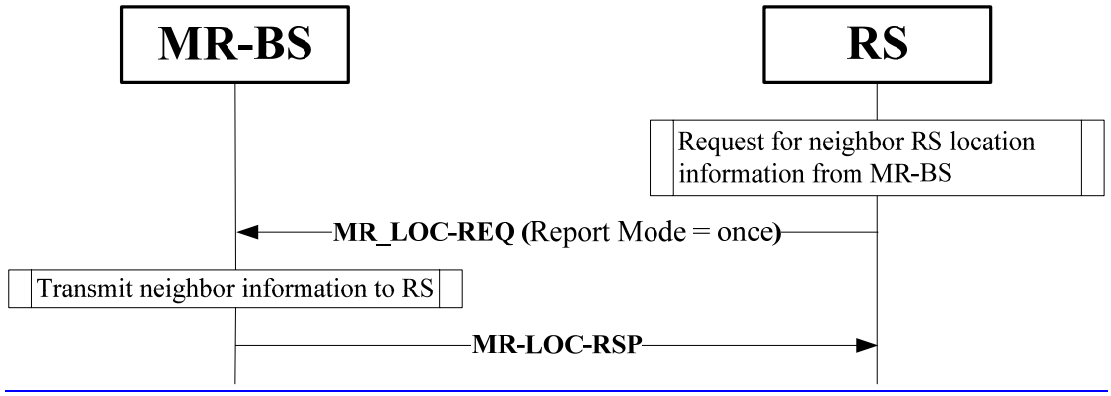


Table xxx: Relay location report (part 3)



Insert new sub clause 11.7.8.14: 11.7.8 SS capabilities encodings

11.7.8.14 Location Support

Name	Type	Length	Value	Scope
Location Support	19	1	0: no location support 1: location support	REG-REQ REG-RSP

(Note: If there will be “RS capabilities encodings” in 11.7.27 then the Location Support TLV will be inserted in the new subclause 11.7.27.)