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Re:	Call for inputs for the Handoff Ad-hoc group	
Abstract	This contribution describes the reporting of scanning results for the HO and proposes a text changes for the proposed reporting of scanning result.	
Purpose	Handoff Ad Hoc draft proposal for the IEEE802.16e group.	
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# IEEE 802.16e Reporting of Scanning Results

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## 1. Introduction

Current draft document is mainly oriented to the HO procedures and a set of parameters requested by the MSS. According to the current HO AdHoc draft document[1], if the BS wants HO, the BS shall transmit the BSHO\_REQ message to MSS and receive HO\_RSP message from the MSS, which only includes the IDs of neighbor BS. Therefore, the serving BS cannot know the exact status of neighbor BS such as signal power for the MSS to be handoff.

Primarily, the serving BS must know the neighbor BS having the best received SINR in order to find a fitting neighbor BS in case of BS requesting HO. However, there are no elements indicating the received SINR of neighbor BS in HO\_RSP message transmitted by MSS and generic procedures for the BS initiated HO case. In order to make firm this kind of HO procedures, we propose the functionality, procedures and a set of parameters for scanning of reporting scheme based on the current HO ADHoc draft document.

## 2. Proposed Reporting of Scanning Results

For efficient HO and MSS operation we propose two kinds of reporting schemes for the BS initiated HO case as followings.

- Periodic Reporting
- Event Triggering Reporting
  - Event A reporting
  - Event B reporting

### 2.1 Periodic Reporting

In this reporting scheme, the MSS reports the received SINR of neighbor BS(s) to serving BS periodically. A MSS, upon detecting of a Scan\_IE addressed to it in the DL-MAP, scans SINR of neighbor BS(s) and periodically reports the scanning result to the serving BS based on the report period defined in the Scan\_report\_IE. Through this procedure, the serving BS always knows the status of neighbor BS(s) having the greatest received SINR so that it can indicate the suitable neighbor BS(s) to the MSS when the serving BS wants HO.

### 2.2 Event Triggering Report

In this reporting scheme, there can be two detail procedures as followings

#### 2.2.1 Event A scheme

The MSS reports the scanning result when the rank of received SINR of neighbor BS(s) is changed while in the serving BS still has the greatest received SINR. Therefore, the serving BS still has the greatest received SINR and the rank of received SINR of neighbor BS(s) in the active set that can be a one or more target BS(s) is only changed. Similar to periodic reporting scheme the serving BS always knows the BS

having the greatest received SINR and the ranking changes of received SINR of neighbor BS(s). Particularly, if MSS is slowly moving, the event triggering method of Event A is more effective than periodic reporting method requiring frequent transmission of reporting message.

### 2.2.2 Event B scheme

The MSS reports the scanning results when the serving BS having the greatest received SINR is changed and the highest rank is maintained during Timer 1 at least given by the message. Therefore, the serving BS would not be longer the BS having the greatest received SINR and one of neighbor BS(s) will have the greatest received SINR. In this operation, timer 1 will be used for avoiding the ping-pong situation under HO region and its value will be given by the message. Using Event B reporting method there is no need to report the scanning result to the serving BS independently because the operation of Event B is equal to the operation of MSS requesting HO. So the MSS shall transmit MSSHO\_REQ message including scanning result of neighbor BS(s) the same as MSS initiated HO case. Table 1 compares different between Event A and Event B scheme.

Table 1. Event triggering reporting scheme

Event	Situation	Action
Event A	The rank of received SINR of neighbor BS(s) is changed while in the serving BS still has the greatest received SINR.	<ul style="list-style-type: none"> <li>- Transmit initial reporting scanning result.</li> <li>- The MSS shall send SCAN_REPORT message including the scanning result.</li> </ul>
Event B	The serving BS having the greatest received SINR is changed and the highest rank is maintained during Timer 1 at least.	<ul style="list-style-type: none"> <li>- The MSS shall send MSSHO_REQ message including the scanning result.</li> </ul>

## 3. Proposed IE and MAC message

### 3.1 Scan-Report-IE

- Proposed IE for the DL\_MAP message
- This IE is sent through the DL\_MAP message
- Timer value for avoiding ping-pong effect
- Reporting mode indication
  - Periodic reporting
  - Event Triggering reporting (Event A or Event B)

### 3.2 SCAN-REPORT message

- Newly proposed
- The MSS sends this message to the serving BS in order to report the scanning results
  - Reporting mode indication
  - SINR of neighbor BS(s)

## 4. Text to be inserted to standard

### 6.2.17.2 MAC layer HO procedures

This section contains the procedures performed during HO on the air-interface.

#### 6.2.17.2.1 Network topology acquisition

##### 6.2.17.2.1.1 Network topology advertisement

A BS shall broadcast information about the network topology using the NBR-ADV MAC message. MSS may decode this message to find out information about the parameters of neighbor BS. Each MSS will thus be able to synchronize quickly with neighbor BS.

##### 6.2.17.2.1.2 MSS Scanning of neighbor BS

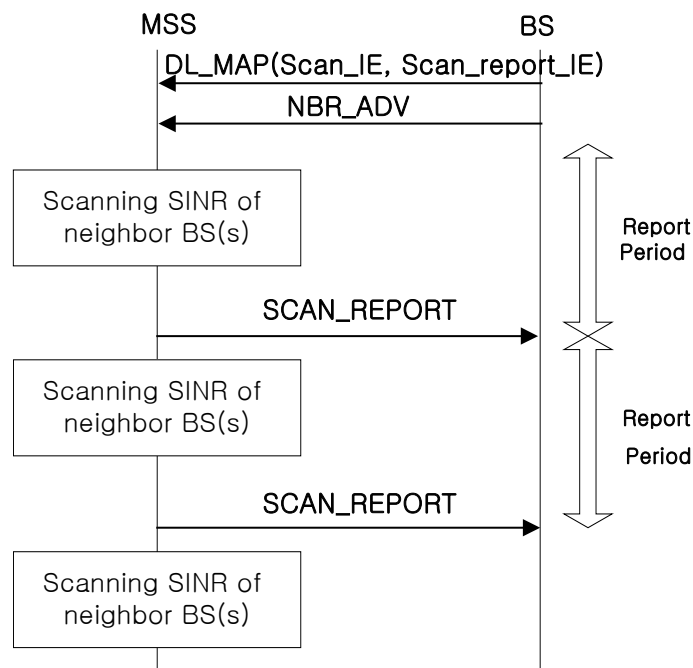
A BS may allocate time intervals to MSS for the purpose of seeking and monitoring neighbor BS suitability as targets for HO. Such a time interval will be referred to as a **scanning interval**.

A MSS may request an allocation of a scanning interval using the SCN-REQ MAC message. The MSS indicates in this message the duration of time it requires for the scan, based on its PHY capabilities. Upon reception of this message, the BS shall respond with placement of a Scanning\_IE in the DL-MAP. The Scanning\_IE shall either grant the requesting MSS a scanning interval that is at least as long as requested by that MSS, or deny the request. The BS may also place unsolicited Scanning\_IE. A MSS, upon detection of a Scanning\_IE addressed to it in the DL-MAP, shall use the allocated interval to seek for neighbor BS. When neighbor BS are identified, the MSS shall attempt to synchronize with their downlink transmissions, and estimate the quality of the PHY connection.

##### 6.2.17.2.1.3 MSS Reporting of Scanning result

###### 6.2.17.2.1.3.1 Periodic reporting

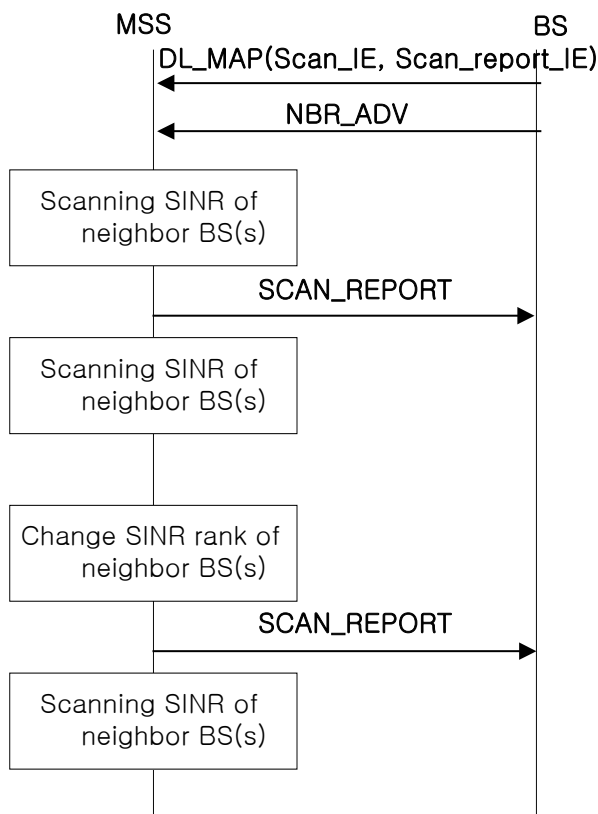
Using periodic report the MS shall report the received SINR of neighbor BS(s) to serving BS periodically. A MSS, upon detection of a Scan\_IE addressed to it in the DL-MAP, shall scan SINR of neighbor BS(s). If PERIODIC\_N\_REPORTMODE of Scan\_report\_IE in the DL\_MAP is not set to zero, the MSS shall report the scanning result to the serving BS through SCAN\_REPORT message periodically at Report Period defined in the Scan\_report\_IE. Figure XXX shows the example of scan report message using periodic reporting scheme.



**Figure XXX. Example of Scan report message flow using periodic reporting scheme**

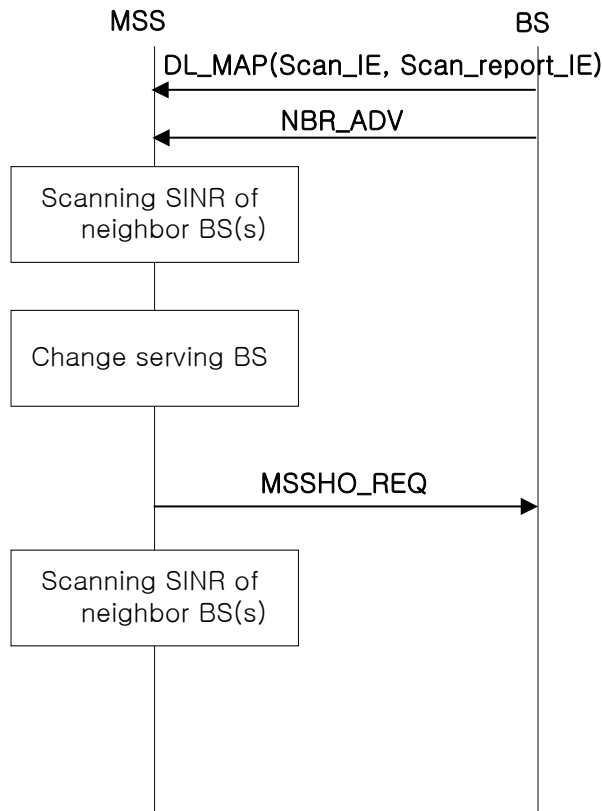
###### 6.2.17.2.1.3.2 Event triggering report

In this reporting scheme, there are two kinds of detail triggering report schemes such Event A and Event B. If the Event A mode parameter of Scan\_IE in the DL\_MAP is set to 1, the MSS shall report the scanning result with SCAN\_REPORT message when the received SINR of neighbor BS(s) is changed while in the serving BS still has the greatest received SINR. The MSS shall send the first scanning result to the serving BS with SCAN\_REPORT message after scanning neighbor BS at the first time. Similar to periodic reporting scheme the serving BS always knows the BS having the greatest received SINR and the rank of received SINR of neighbor BS(s). Figure YYY shows the example of scan report message using periodic reporting scheme.



**Figure YYY. Example of Scan report message flow using event triggering report (Event a)**

In the Event B, the MSS shall report the scanning results when the serving BS having the greatest received SINR is changed and the highest rank is maintained during Timer 1 at least given by the Scan\_report\_IE. Therefore the serving BS would not be longer the BS having the greatest received SINR and one of neighbor BS(s) will have the greatest received SINR. To avoid the ping-pong situation under HO region, Timer1 parameter shall be defined Scan\_report\_IE. If the Event B mode parameter of Scan\_IE in the DL\_MAP is set to 1, the MSS shall report the scanning result with MSSHO\_REQ message. Figure YYY shows the example of scan report message using periodic reporting scheme. Figure ZZZ shows the example of scan report message using periodic reporting scheme.



**Figure ZZZ. Example of Scan report message flow using event triggering report (Event B)**

#### **6.2.2.3.49 Report Scanning result (Scan-Report-IE) IE**

BSS shall allocate Scan\_Report\_IE in the DL\_MAP message to support reporting the scanning result.

The Scan\_Report\_IE is sent from BS to the MSS on the MSS 's basic CID. The message includes several report mode parameters. One MSS may report the scanning result using periodic reporting method and using event triggering reporting method.

**Table 2. Scan Report IE**

Syntax	Size	Notes
Scan_Report_IE {		
__CID	16 bits	MSS basic CID
__PERIODIC_N_REPORTMODE	8 bits	Number of Periodic Report Mode
For (j=0 ;j<PERIODIC_N_ REPORTMODE; j+ + )		
{		
__Report Period	8 bits	Only if report mode is periodic.
}		
Event A mode	1 bit	0: Event A not used 1: Event A used

<u>Event B mode</u>	<u>1 bits</u>	<u>0: Event B not used</u> <u>1: Event B used</u>
<u>If(Event B mode == 1)</u>		
<u>Timer 1</u>	<u>8 bits</u>	<u>This field exists when the report mode is set to Event B.</u> <u>Timer 1 is the minimum time duration to maintain the situation that pilot SINR of certain neighbor BS is higher than pilot SINR of serving BS</u>
<u>}</u>		
<u>}</u>		

PERIODIC\_N\_REPORTMODE – Number of periodic report mode

Report Period – If the reporting method is periodic report, this parameter is the duration time to report periodically.

Event A mode – This parameter indicates whether the MSS reports scanning result or not when Event A is occurred

Event B mode – This parameter indicates whether the MSS reports scanning result or not when Event B is occurred

Timer 1– The minimum time duration to maintain the situation that pilot SINR of certain neighbor BS is higher than pilot SINR of serving BS.

### 6.2.2.3.50 Report scanning result (SCAN\_REPORT) message

The MSS uses the SCAN\_REPORT message to report the scanning result to serving BS. The message is sent from MSS to the BS. The message includes scanning result same as SINR of neighbor BS.

**Table 3. SCAN\_REPORT message format**

<u>Syntax</u>	<u>Size</u>	<u>Notes</u>
<u>SCAN_REPORT_Message_Format() {</u>		
<u>Management Message Type = ?</u>	<u>8 bits</u>	
<u>Report Mode</u>	<u>2bits</u>	<u>00:Periodic</u> <u>01: Event A</u> <u>10:Event B</u>
<u>N_NEIGHBORS</u>	<u>8 bits</u>	
<u>For (j=0 ; j&lt;N_NEIGHBORS ; j++) {</u>		
<u>Neighbor BS-ID</u>	<u>48 bits</u>	
<u>S(I+ N)</u>	<u>16 bits</u>	
<u>}</u>		
<u>}</u>		

Report Mode – This parameter indicates the report mode.

Neighbor BS-ID – Same as the Base Station ID parameter in the DL--MAP message of neighbor BS(s)

BS S/(N + I) – This parameter indicates the signal to noise and interference ratio measured by the MSS from the particular BS. The value shall be interpreted as an unsigned byte with units of 0.25dB.

#### Reference

[1] IEEE C802.16e-03/20r1 “IEEE 802.16e Handoff Draft”