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Title **Enhancement of Scanning and Association using SCAN-REQ/RSP**

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Re: This contribution is response to call for contribution about IEEE 802.16e-D3

Abstract This document proposes the scheme enhancing scanning and association operation with SCAN-REQ/RSP

Purpose Discuss and adapt proposed text and message format.

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Enhancement of Scanning and Association using SCAN-REQ/RSP

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1. Problem Statement

Currently, in many ways, MSS can get information about neighbor BS and measure SINR value of neighbor BS. MSS can get informed of neighbor BS with NBR-ADV message or by scanning another frequency directly. And MSS can measure SINR during scan interval or sleep interval without interruption of service with serving BS. According to the measured SINR values, it can decide whether it handover another BS or not. Further, MSS can get advantage expediting handover process using association with neighbor BS. Association is the process of pre-calibrating parameters required for ranging with neighbor BS. ~~When MSS decide to hand over, MSS can try association with neighbor BS before actual handoff. After association, MSS begin actual handoff process with transmitting MOB_MSSHQ-REQ. Therefore we can regard association process as the pre handoff procedure and fast association process shall effect fast handoff completion after deciding handoff.~~

In most cases, a MSS performs Neighbor BS scanning multiple times until the MSS make final decision to handoff so that the Serving BS and MSS already have knowledge of target BSs. When a MSS decides to try association before actual handoff, MSS may perform association with Target BS during scan interval assigned by Serving BS. However, the association procedure should be considered as urgent procedure that should be finished in a short time interval in order to minimize service inavailability time between BS and MSS. In addition to this consideration, initial access to Target BS in association should be tried with contention free access, because the association performed within a limited time, scan interval.

However, there is no detailed association procedure described in current draft 802.16e-D3 only except that association is performed during scan interval. It is expected to access to Target BS through contention-based access without any assistance from serving BS

~~However, at current draft 802.16e-D3, there is no specific procedure for association during Scan Interval. In addition, the MSS does not get assistance from serving BS and should access to target BS through random access during scan interval despite negotiation with serving BS for allocation of scan interval.~~

~~A MSS may try to make association with as many as candidate one Target BSs during within the short Scan Interval, it is crucial that the Target BS allows fast access to MSS in order to minimize delay time for association. the MSS to access based on contention-free method in order to minimize delay time for association.~~

~~Our proposed solution can enhance the association procedure process faster than previous algorithm using random access and we can get advantage that actual handoff time will be shortened after MSS's decision of handoff. And our solution can prevent MSS from trying association to inappropriate neighbor BS which cannot support continuous services as serving BS provides currently, by allowing a MSS to access Target BS based on contention-free method.~~

Since serving BS can negotiate with target BS for assigning fast_ranging_IE, we can get advantage using only redundant resource of target BS to make handoff procedure easy.

2. Proposed Remedy

2.1 Enhancement of Scanning

We propose to include Neighbor BS list in MOB_SCAN-REQ message to indicate the target BSs that Serving BS recommend MSS to scan. Since the MSS should perform Scanning operation within a limited time, MOB_SCAN-RSP message needs to include recommend neighbor BS list in order not to waste time for Scanning inappropriate neighbor BS.

2.2 Association Procedure during scanning interval

We propose fast access scheme for association operation in order to allow MSS to fast access to target BS during Scan Interval. Since a MSS in association procedure tries to access to target BS by initial ranging that takes unexpected time, it sometimes may fail to associate with target BS within a limited Scan Interval. Therefore, we need to allow MSS to use fast-ranging in order to finish association within a limited Scan Interval.

A modified MOB_SCAN-REQ and MOB_SCAN-RSP message are proposed to enhance MSS's operation of association for Scan Interval. ASC-Notification and ASC-Notification-RSP backbone messages are also proposed to inform target BSs of the information of MSS.

A MSS trying association can access to target BS through fast UL ranging IE provided by Target Neighbor BS. This case is

the same as handoff case with above proposed messages and scenario.

- MOB_SCN-REQ**
 This message includes Scan type field to indicate whether a MSS requests Scanning or Association. A serving BS may understand what operation the MSS requests ~~and inform the target BSs of that the MSS is going to try association based on Scan Type field value. Target BS list can be included if the MSS have preference list for association based on scanning performed lastly. It also includes Target BS lists to report which BSs the MSS tries to associate with.~~
- MOB_SCN-RSP**
 This message includes also Scan Type field ~~as MOB_SCN-REQ. This field may indicate which operation the Serving BS allows to the MSS. When a serving BS order a MSS to associate with target BSs, it is able to transmit unsolicited MOB_SCN RSP message to a MSS. In this case, the~~ The BS can indicate whether the BS orders scanning or association ~~referred to the scan type field in SCN-REQ. The BS can also transmit unsolicited MOB_SCN-RSP message to a MSS with scan type field. It also includes Target BS-ID that the Serving BS recommends a MSS for association. Target BS list can be included in SCN-RSP message to inform MSS of Target BSs that the Serving BS recommends to scan. If a Serving BS orders or allows association, SCN-RSP message include only one Target BS-ID in this message~~
- ASC-Notification**
 ASC_Notification is used to inform Target BS of MSSs, which try to make association with Target BS, so that Target BS may assign fast UL ranging IE.. The goal of ASC-Notification is the same as HO_pre-notification message.
- ASC-Notification-RSP**
 Target BS may response to ASC-Notification with reserved BW and QoS resources of BS. The purpose of this message is the same as HO_Pre-Notification-RSP

3. Proposed Text Changes

6.3.2.3.51 Scanning Interval Allocation Request (MOB-SCN-REQ) message

[Modify Table 92e in Page 22, Line 1 – MOB-SCN-REQ Message format as follows]

A MOB-SCN-REQ message may be transmitted by an MSS to request a scanning interval for the purpose of seeking neighbor BS, and determining their suitability as targets for HO. [An MSS may request the scanning allocation to perform scanning with Scan_Type = 0, -or association with Scan_Type = 1.](#)

An MSS shall generate MOB-SCN-REQ messages in the format shown in Table 92e:

Table 92e --- MOB-SCN-REQ Message Format

Syntax	Size	Notes
MOB-SCN-REQ_Message_Format() {		
Management message type = 50		
Scan Duration	12 bits	Units are frame
Scan Type	1 bit	[0] Scanning [1] Association
Reserved	3 bits	
For(j=0; j<N_Recommended; j++) {		<u>N_Recommended can be derived from the known length of the MAC message</u>
Neighbor BS-ID	48 bits	Only included Target BS-ID for association
}		
HMAC Tuple	21 bytes	See 11.41.42
}		

The following parameters shall be included in the MOB-SCN-REQ message,
Scan Duration

Duration (in units of frames) of the requested scanning period.

Scan Type

Operation that a MSS intends to during Scanning Interval

HMAC Tuple (see 11.4.1.1-2 in IEEE Standard P802.16 REVd/D3 2004)

The HMAC Tuple Attribute contains a keyed Message digest (to authenticate the sender). HMAC Tuple shall be the last item in the message.

The following parameters may be included in the MOB-SCN-REQ message.

Neighbor BS-ID

Target BS list for Scanning if Scan_Type=0 or target BS list for association if Scan_Type=1. Neighbor BS-ID field may be included only if a MSS has a candidate target BS to associate. If the BS indicates Association (Scan_Type=1) in the message, only one recommended Target BS may be included in the message

6.3.2.3.51 Scanning Interval Allocation Response (MOB-SCN-RSP) message

[Modify Table 92e in Page 22, Line 1 – MOB-SCN-RSP Message format as follows]

A MOB-SCN-RSP message shall be transmitted by the BS in response to an MOB-SCN-REQ message sent by an MSS. In addition, BS may send an unsolicited MOB_SCN_RSP. If a BS transmits an unsolicited MOB_SCN_RSP, Scan_Type should be set to '0' for scanning and/or '1' for association to indicate which operation the BS intends to the MSS to perform. Neighbor BS Lists may be is also included in MOB_SCN-RSP message to indicate which Neighbor BS are recommended for MSS to scan. If the BS allow-indicates Association (Scan_Type=1), at most of the cases only one recommended Target BS may be is included in the message recommended in the neighbor BS list. The message shall be transmitted on the basic CID. The format of the MOB-SCN-RSP message is depicted in Table 92f[S1].

Table 92f --- MOB-SCN-RSP Message Format

Syntax	Size	Notes
MOB-SCN-REQ_Message_Format() {		
Management message type = 51	8 bits	
CID	16 bits	Basic CID of the MSS
Duration	12 bits	<u>Units are frame</u>
Start Frame	4 bits	
Scan_Type	<u>1 bit</u>	<u>[0] Scanning</u> <u>[1] Association</u>
Reserved	<u>7 bits</u>	
<u>For(j=0; j<N_Recommended; j++) {</u>		<u>N_Recommended can be derived from the length field in the MAC header of the message</u>
<u>Neighbor BS-ID</u>	<u>48 bits</u>	<u>Recommended BS-IDs for scanning and selected one target BS for association.</u>
<u>}</u>		
<u>}</u>		

The following parameters shall be included in the MOB-SCN-RSP message:

CID

Basic CID of the MSS that have sent MOB-SCN-REQ message.

Duration

Duration (in units of frames) where the MSS may scan for neighbor BS.

Start Frame

Measured from the frame in which this message was received. A value of zero means that it will start in the next frame.

Scan Type

0: The BS allows approval of requested/directed Scanning operation requested by MOB_SCN_REQ or lets an MSS perform scanning neighbor BS

1: The BS allows approval of requested/directed Association operation requested by MOB_SCN_REQ or lets an MSS perform association with Neighbor BS during Scanning Interval

Neighbor BS-ID

Recommended target BS list for Scanning if Scan_Type=0 and/or target BS-ID for association if Scan_Type=1. In case of association, only one selected target BS to associate can be included. Neighbor BS-ID may not be included if there is no recommendation from Serving-BS.

6.3.20.1.2 MSS Scanning of neighbor BS*[Proposed text change in Section 6.3.20.1.2]*

An MSS may request an allocation of a scanning interval using the MOB-SCN-REQ MAC Management message with Scan_Type field value '0'. The MSS indicates in this message the estimated duration of time it requires for the scan.

Upon reception of this message, the BS shall respond with a MOB-SCN-RSP MAC Management message with recommended neighbor BS list if the BS has recommendation. The MOB-SCN-RSP MAC Management message shall either grant the requesting MSS a scanning interval that is at least as long as requested by that MSS, or deny the request. A value of zero for Duration in MOB-SCN-RSP shall indicate the request for an allocation of scanning interval is denied.

Following reception of a MOB-SCN-RSP MAC Management message, an MSS shall scan for a neighbor BS during the time interval allocated in that message. The MSS may scan neighbor BS that is recommended by neighbor BS list if the list is found in received MOB-SCN-RSP message. When neighbor BS are identified, the MSS shall attempt to synchronize with their downlink transmissions, and estimate the quality of the PHY channel.

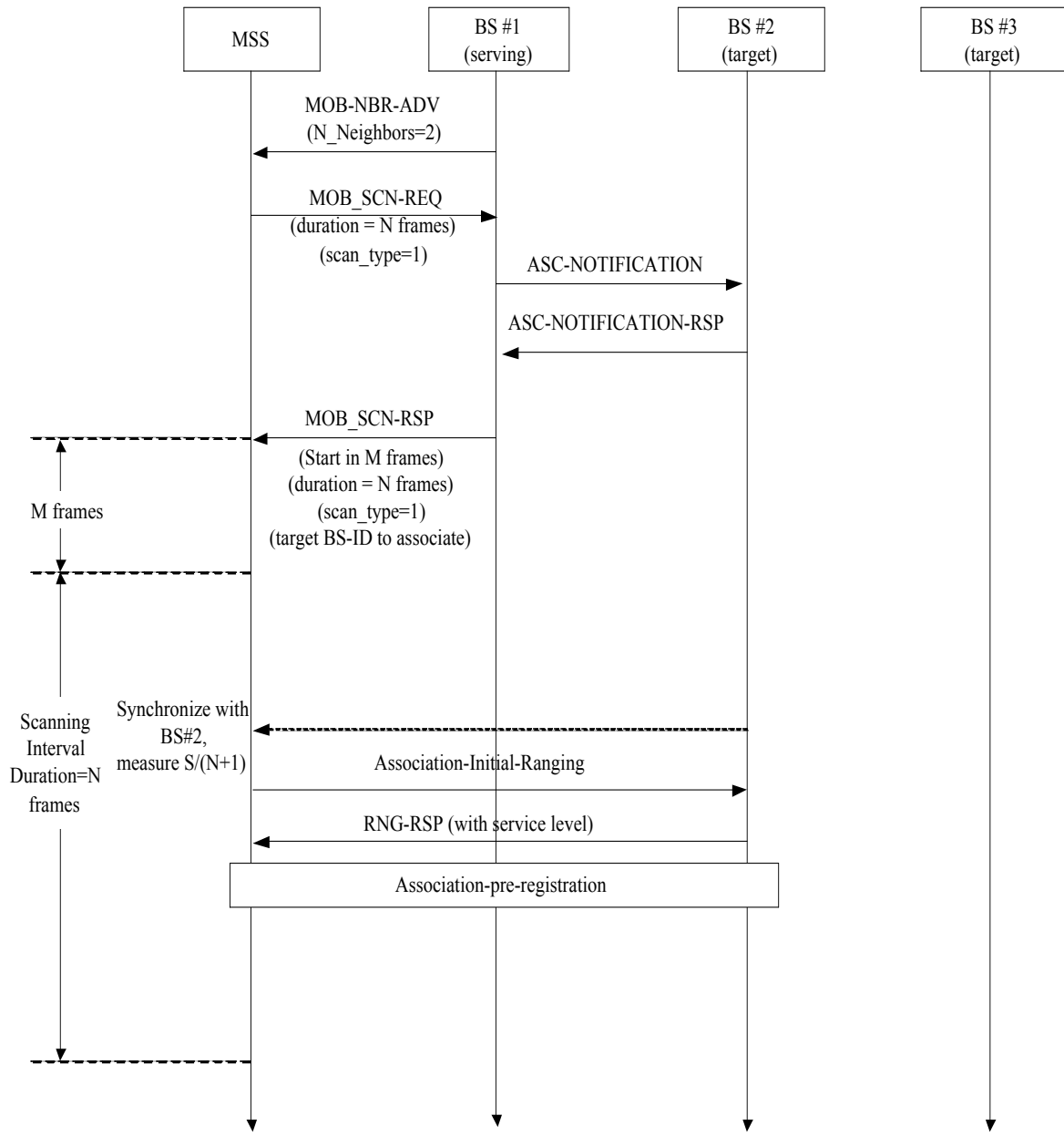
6.3.20.1.3 Association Procedure*[Proposed text change in Section 6.3.20.1.3]*

Association is an optional initial ranging parameter negotiation occurring during Initial Ranging of a BS. The function of association is to enable the MSS to record successful scanning and ranging attempts for the purpose of expediting a potential future hand-over of the MSS's active service flows to a target BS. An MSS may store successful ranging information of an associated BS for the purpose of setting initial ranging values in future ranging events. In order to perform association during scanning interval, a MSS may transmit MOB-SCN-REQ message to the Serving BS with Scan_Type field value '1'. A Target BS ID for association is added if the MSS already have selected one target BS based on neighbor information have gathered former scanning operation.

Upon reception of this message, the BS may request target BS to allocate invited ranging opportunity to MSS for association and receive response message from target BS. If Association is accepted, the Serving BS shall respond to the MSS with a MOB-SCN-RSP MAC Management message with Scan_Type=1 and neighbor BS ID that is requested by MSS or selected by the Serving BS.

Following reception of a MOB-SCN-RSP MAC Management message, an MSS shall try initial ranging to target BS that is recommended by target BS-ID in MOB-SCN-RSP message. The target BS may allocate invited ranging opportunity for the MSS.

Figure E.2—Example BS advertisement and scanning (with association) by MSS request



D.2.11 Association-notification (ASC-NOTIFICATION) message

This message is sent from one BS to another BS, typically to request information about a MSS. Typically the message will be sent as a reaction to reception of a MOB_SCN-REQ message with Scan_Type=1 or in cases where a BSS is trying to order a MSS to make association.

The message contains the following information

<u>Field</u>	<u>Size</u>	<u>Notes</u>
<u>Global Header</u>	<u>152 bits</u>	
<u>For (j=0; j<Num_Records;j++){</u>	<u>8 bits</u>	

<u>MSS unique ID</u>	<u>16 bits</u>	<u>Basic CID of the MSS</u>
<u>Estimated time to start Association</u>	<u>12 bits</u>	<u>Units are frame</u>
<u>Required BW</u>	<u>4 bits</u>	
<u>For (i=0; i<Num_SFID_Records: i++) {</u>		<u>Number of SFID records can be derived from the length field in MAC header of message</u>
<u>SFID</u>	<u>32 bits</u>	
<u>For(u=0; u<Num_QoS_Records: i++) {</u>		
<u>Required QoS</u>	<u>variable</u>	
<u>}</u>		
<u>}</u>		
<u>}</u>		
<u>Security Field</u>	<u>TBD</u>	

D.2.11 Association-notification response (ASC-NOTIFICATION-RSP) message

This message is sent from one BS to another BS, typically in response to a SCN-NOTIFICATION message. It does inform the BS of the level of service the MSS could expect when it associate. The message contains the following information

<u>Field</u>	<u>Size</u>	<u>Notes</u>
<u>Global Header</u>	<u>152 bits</u>	
<u>For (j=0; j<Num_Records: j++) {</u>	<u>8 bits</u>	<u>Num Records can be derived from the length fields in the MAC header of the message</u>
<u>MSS unique ID</u>	<u>48bits</u>	<u>MAC Address of the MSS</u>
<u>BW estimated</u>	<u>8 bits</u>	
<u>QoS estimated</u>	<u>variable</u>	
<u>}</u>		
<u>Security Field</u>	<u>TBD</u>	