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Re:	This is a response to a Call for Comments IEEE802.16e Handover Adhoc.
Abstract	In this contribution, a method of supporting periodic scanning is provided.
Purpose	This document is submitted for review by 802.16e Working Group members
Notice	
Release	
Patent Policy and Procedures	

incorporated into a draft standard being developed within the IEEE 802.16 Working Group. The Chair will disclose this notification via the IEEE 802.16 web site <http://ieee802.org/16/ipr/patents/notices>.

A method of scanning neighbor BSs periodically

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1. Introduction

In current IEEE802.16e specification, handover procedure is defined to support the mobility of an MSS. The CINR is the main basis for either MSS or BS to determine handover. To provide reliable CINR information, an MSS should continuously measure CINR of the neighbor BSs and average the measured CINR for a given duration. The consecutive CINR measurement of an MSS is inevitable in all handover schemes such as hard handover, soft handover and fast BS switching. However, in the current specification, the MSS should exchange MOB-SCN-REQ/RSP messages with the serving BS whenever the MSS tries to scan. So the frequent exchange of Scanning related messages cause too much overhead and result in wasting of bandwidth and battery power. Even though the Maximum Length of scan duration is defined to approximately $20\sec(\approx 2^{12} \times 5ms)$, this duration is too long for one scanning duration. Thus, in this contribution, we propose a method of enabling an MSS to scan neighbor BSs periodically to reduce the number of scanning request and response messages.
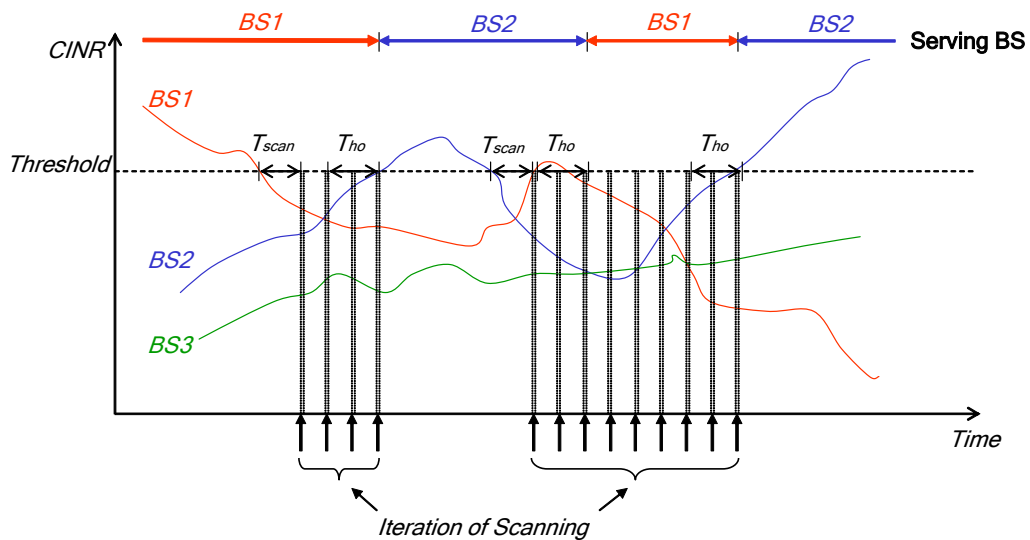
2. Scanning Process for Handover

Figure1. Example of Scanning

It can be an implementation issue to decide when an MSS starts to scan neighbor BSs and performs handover to other BSs. In this contribution, however, we assume the operation of an MSS as follows.

- An MSS can measure the signal power from the serving BS without any scanning request message.
- An MSS starts to scan neighbor BSs, if the signal power from the serving BS is lower than a given threshold for T_{scan} time.
- The handover procedure will be started, if the signal power of other BS is higher than that of serving BS for T_{ho} time.

As shown in the Figure1, an MSS should scan neighbor BSs frequently in handover region. The MSS may request periodic scanning if the MSS is considered in the handover region. The serving BS may also order the MSS to start periodic scanning if the MSS is considered in the handover region.

3. Proposed Changes

[Modify the Table 92e – MOB-SCN-REQ Message Format]

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

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 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	8 bits	
Scan Duration	12 bits	Units are frames
Interleaving Interval	**8 bits**	Units are frames
Scan Iteration	**8 bits**	
Reserved	4 bits	
HMAC Tuple	21 bytes	See 11.~~4.11~~1.2
}		

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

Scan Duration

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

Interleaving Interval

The period interleaved between Scanning Intervals when MSS may perform Normal Operation.

Scan Iteration

The requested number of iterating scanning interval by an MSS

HMAC Tuple (see 11.~~4.11~~1.2 in IEEE Standard P802.16-REVd/D~~3~~5-2004)

The HMAC Tuple Attribute contains a keyed Message digest (to authenticate the sender).

[Modify the Table 92f – MOB-SCN-RSP Message Format]

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

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. The message shall be transmitted on the basic CID.

The format of the MOB-SCN-RSP message is depicted in Table 92f.

Table 92f—MOB-SCN-RSP Message Format

Syntax	Size	Notes
MOB-SCN-RSP_Message_Format(){		
Management Message Type = 50	8 bits	
Scan Duration	12 bits	In frames
Strart Frame	4 bits	
Interleaving Interval	**8 bits**	
Scan Iteration	**8 bits**	
Report mode	**2 bits**	**00 : no report** **01 : periodic report** **10 : event triggered report** **11 : reserved**
Reserved	**6 bits**	
Scan Report Period	**8 bits**	**Available when the value of Scan Report is set to 01.**
HMAC Tuple	21 bytes	See 11.~~4.11~~1.2
}		

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

Interleaving Interval

The period interleaved between Scanning Intervals when MSS may perform Normal Operation.

Scan Iteration

The number of iterating scanning interval

Report mode

Action code for an MSS's report of CINR measurement

00 : The MSS measures channel quality of the neighbor BSs without reporting.

01 : The MSS reports the result of the measurement to serving BS periodically. The period of reporting is different from that of scanning

10 : Thee MSS reports the result of the measurement to serving BS after each measurement.

11 : reserved

Scan Report Period

The period of MSS's report of CINR measurement when the MSS is required to report the value periodically

HMAC Tuple (see 11.~~4.11~~1.2 in IEEE Standard P802.16-REVd/D~~3~~5-2004)

The HMAC Tuple Attribute contains a keyed Message digest (to authenticate the sender).

[Add text to section 6.3.20.1.2 MSS Scanning of neighbor BS]

6.3.20.1.2 MSS Scanning of neighbor BS

A BS may allocate time intervals to MSS's for the purpose of seeking and monitoring neighbor BS suitability as targets for HO. The time during which the SS scans for neighbor BS will be referred to as a scanning interval.

An MSS may request an allocation of a scanning interval using the MOB-SCN-REQ MAC Management message. 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. 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. When neighbor BS are identified, the MSS shall attempt to synchonize with their downlink transmissions, and estimate the quality of the PHY channel.

The BS may buffer incoming data addressed to the MSS during the scanning period, and transmit that data after the scanning period. An MSS may terminate scanning and return to Normal Operation anytime. If a Serving BS receives a PDU from an MSS that is supposed to be in scanning mode, the BS shall assume that the MSS is no longer in scanning mode. Any UL message from the MSS to the Serving BS shall interrupt the scanning interval, shall signal the Serving BS that the MSS is still active and has not dropped the connection during its scanning interval.

The BS may allocate group of intervals, which are composed of Scan Duration and Interleaving Interval, for the purpose of reducing the number of MOB-SCN-REQ and MOB-SCN-RSP messages when frequent scanning is required. The MSS scans neighbor BSs, and the BS may buffer incoming data addressed to the MSS during the scan duration. The buffered data is transmitted to the MSS during Interleaving Interval. Scan duration and Interleaving Interval repeat with the number of Scan Iteration. The group of intervals is terminated at any time if the BS sends MOB-SCN-RSP message with setting the parameters (Scan Duration, Interleaving Interval, and Scan Iteration) to all zeros. The MSS may request the periodic scanning. This group of intervals is terminated any time if the MSS sends MOB-SCN-REQ message with setting the parameters (Scan Duration, Interleaving Interval, and Scan Iteration) to all zeros.
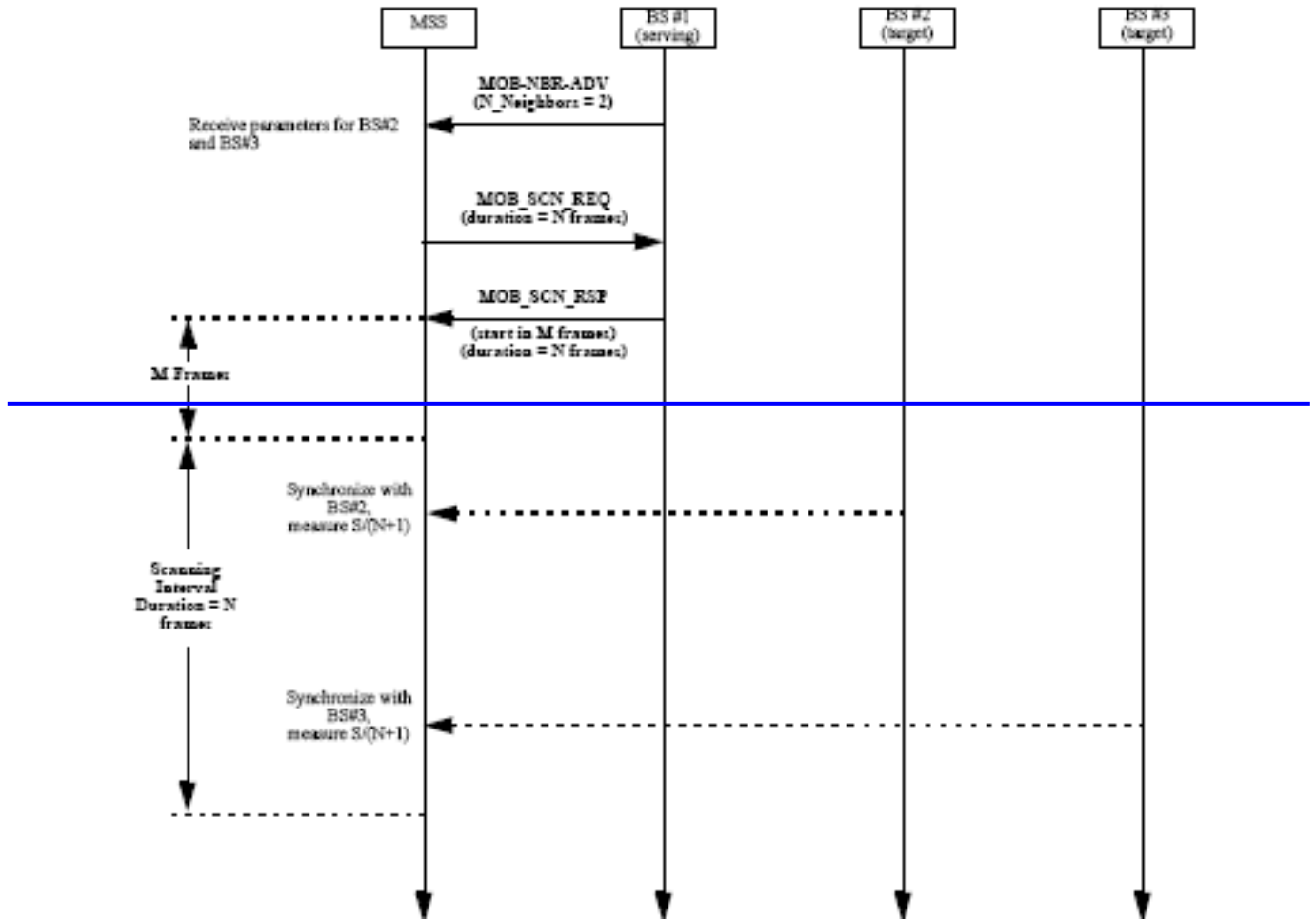
After scanning for neighbor BSs using the allocated scanning interval, the MSS shall report the scanning result to the Serving BS through MOB-SCAN-REPORT message periodically based on MAHO report period in MOB-NBR-ADV. Addition to the periodic reporting scheme, the MSS may report the scanning results in case of a specific event which can be that the rank of the received CINR of neighbor BSs is changed. This scanning report may assist Serving BS to recommend suitable BSs for BS initiated handover operation.

[Modify the Figure E.1– Example BS advertisement and scanning (without association) by MSS request]

E.1 Hand-over MSCs

E.1.1 Neighbors advertisement and scanning of neighbors

The following figures describes the messages flow for neighbors advertisement and scanning of neighbors by the MSS request, BS request and periodic scanning of neighbors during hand-over.
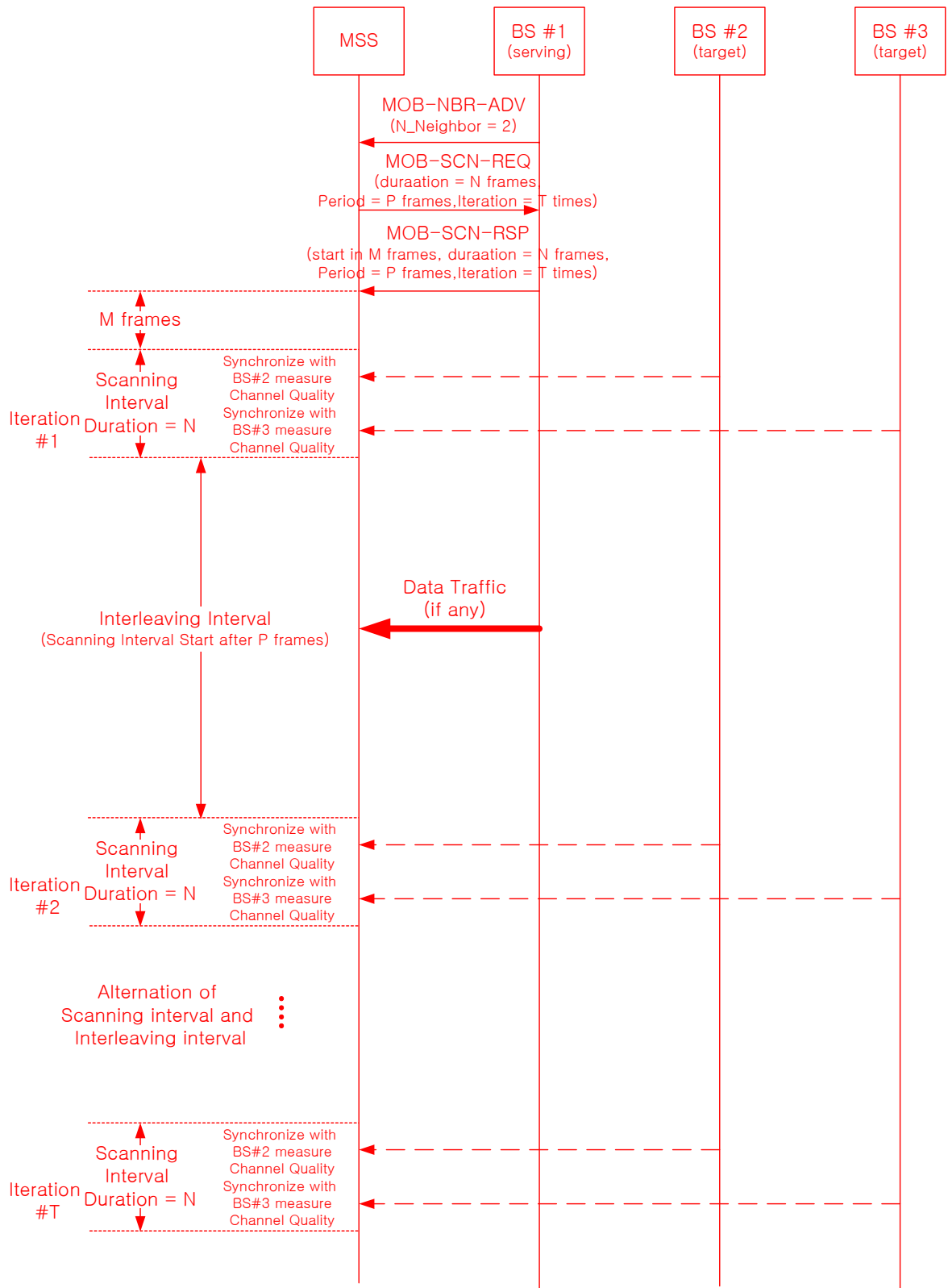
Figure E.1—Example BS advertisement and scanning (without association) by MSS request