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Title	**A method of shortening the duration of scanning neighbor BSs**
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Re:	IEEE 802.16e D4 Draft
Abstract	A method of shortening the duration of scanning neighbor BSs
Purpose	To incorporate the changes here proposed into the 802.16e D4 draft.
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1 Introduction

The scanning function is getting more important since the handover schemes such as SHO/FBSS handover is added to IEEE 802.16 standards. According to contribution IEEE C802.16e_04/171r1, the scanning function to support the SHO/FBSS handover is to report the records of arrival time difference between a serving BS and neighbor BSs, CINR of neighbor BSs, using MOBHO_RSP messages. Also according to contribution IEEE C802.16e_04/157, a periodic scan is possible without transmitting any extra SCN_REQ message. These cause the following problems.

1) Decrease of data throughput caused by oftenly repeated scanning.
2) Dissipation of resource such as a battery, time of scanning a neighbor BS which has improper CINR during scanning
   the whole neighbor BSs.
3) dissipation of BS's resources if these BSs are added applying SHO/FBSS, when there are a number of BSs which have available CINR.

1. SHO :

according to IEEE C802.16e-04/171r1

Soft handover (SHO) in the DL is defined as two or more BSs transmitting the same MAC/PHY PDUs to the MSS at the same time interval such that diversity combining can be performed by the MSS. SHO in the UL is defined as two or more BSs receiving (demodulating, decoding) from the MSS at the same time interval. Diversity combining of the received PHY frames is performed among the BSs.

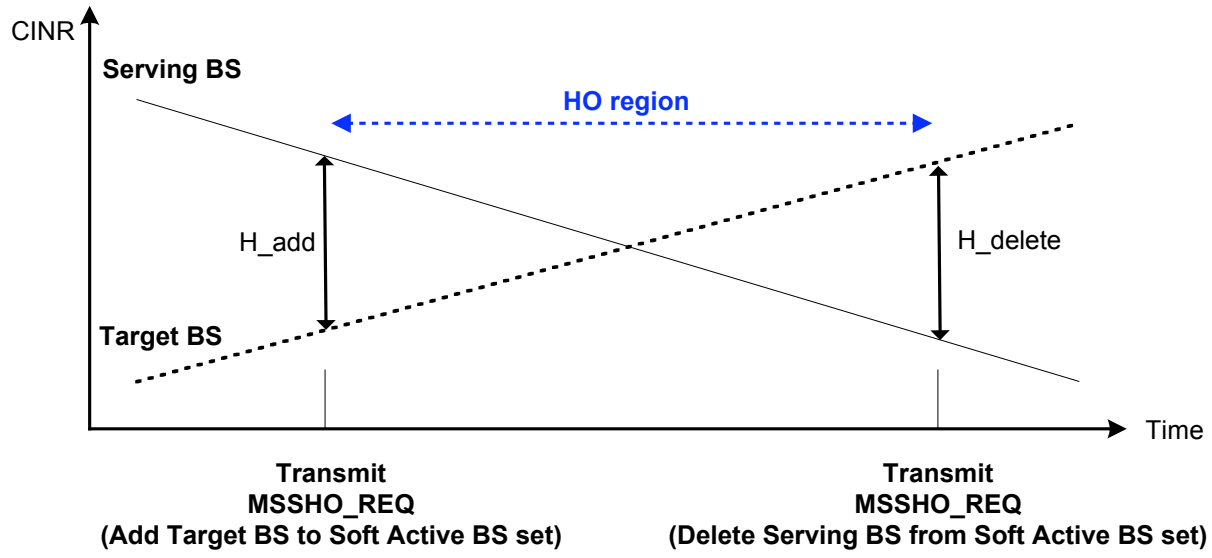
2. FBSS :

according to IEEE C802.16e-04/171r1

Fast BS Switching (FBSS) Handover utilizes selection diversity and fast switching mechanism to improve link quality. The MSS is only transmitting/receiving data to/from one of the serving BS (Anchor BS) at any given frame. The anchor BS can change from frame to frame depending on the BS selection scheme.

3. SHO/FBSS procedure

according to IEEE C802.16e-04/171r1



The MSS entering into SHO region shall scan the preamble CINR of neighbor BSs as shown in the Figure 1. If the preamble CINR margin between the Anchor BS and a neighbor BS is smaller than H_add. The MSS shall transmit MOB-MSSHO_REQ message to request to add the neighbor BS to the Active Set list. The decision of the type of HO, i.e. normal HO or SHO/FBSS, is performed by the BS after receiving the MOB_MSSHO_REQ message from the MSS. One criterion that is needed by the BS to make HO decision is the difference in frame arrival time between the Anchor BS and that of the neighbor BS. The arrival time difference shall be smaller than CP (cyclic prefix) in order to effectively support SHO and FBSS. The MSS shall send the arrival time difference information in the MOB_MSSHO_REQ message. The BS then decides the type of HO based on the CINR and arrival time differences information in the MOB_MSSHO_REQ and the other factors including capability of neighbor BSs and radio resource management strategy.

4. Periodic neighbor BS scanning

according to IEEE C802.16e-04/157

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_SCNREQ/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(5 *ms* _2^12), 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.

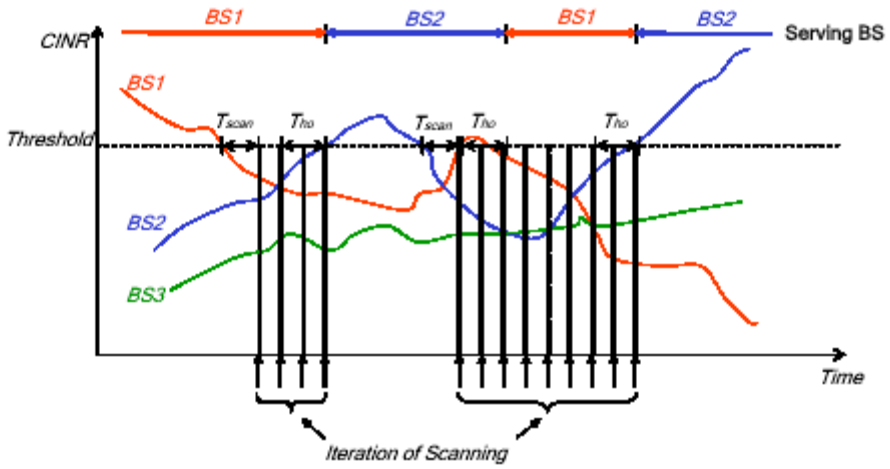


Figure1. Example of Scanning

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 TBscanB time. The handover procedure will be started, if the signal power of other BS is higher than that of serving BS for TBhoBtime. 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.

2 The example of a method for shortening the scanning duration

More regard should be paid to the CINR and arrival time difference when handover between BSs is strongly required, because a MSS is located in the boundary area of several serving BSs. Also, when the MSS is located in the boundary area of several serving BSs, the service quality tends to degrade, because there is much possibility that low grade modulation method is provided. In this situation, if the MSS tries to scan a BS and assigns lots of time to do handover, the service quality would be getting lower.

The aim of scanning procedure is to find the target BS which can support the handover as fast as possible. The number of target BSs should be managed not to be excessive to prevent the waste of resource of BS.

In more detail, a MSS requests MAX_duration upon transmitting a SCN_REQ message to scan neighbor BSs. After receiving the SCN_REQ message, a BS transmits a SCN_RSP message including the information which can be used to select the target BSs. By using this information, the MSS can find the number of k BSs which have lower A.T.D (Arrival time difference) than CP among BSs with CINR over the threshold. When the MSS finds available k BSs while scanning, it stops scanning and transmits HO_REQ message including the target BSs and related information such as CINR, A.T.D so that the scanning duration can be decreased.

Our scanning method is different from the existing scanning method because the MSS is participated in the decision of target BSs for handover. It manages the resource of BS to control the number of times of SHO handover and improves the quality of data throughput by reducing the scanning time.

We propose the message format to reduce the scanning time and find the proper number of target BSs. The message format is presented below.

Specific text changes

(Try to harmonize with IEEE802.16-e4/157)

Table 106f—MOB-SCN-RSP Message Format

Syntax	Size	Notes
MOB-SCN-RSP_Message_Format(){		
Management Message Type = 50	12 bits	
Max Scan Duration	***8 bits***	***In frames, expected maximum spent time when scanning all neighbor BSs***
Strart Frame	4 bits	
Interleaving Interval	8 bits	
Scan Iteration	8 bits	
Report mode	2 bits	0b00 : no report 0b01 : periodic report 0b10 : event triggered report 0b11 : reserved
Reserved	6 bits	
CINR threshold	**8bits**	**In dB, signed, 0.5step**
Object room	**3bits**	**Room count**

Scan Report Period	8 bits	Available when the value of Scan Report is set to 01
HMAC Tuple	21 bytes	See 11.1.2
}		

(Try to harmonize with IEEE802.16-e4/171r1)

Table 106i- MOB-MSSHO-REQ Message Format

Syntax	Size	Notes
MOB-MSSHO-REQ_Message_Format() {		
Management Message Type = 53	8 bits	
N_new_BSs	3bits	Number of new BSs which are recommended by the MSS
For (i= 0; i < N_new_BSs; i++) {		
~~***Neighbor BS_ID***~~ ***Recommended Target BS_ID***	**48 bits**	
BS CINR mean	8 bits	
Arrival Time Difference Indication	1 bit	If SHO/FBSS is not supported by either BS or MSS, this bit shall be set to '0'.
If (Arrival Time Difference Indication == 1) {		
Arrival Time Difference (t)	4 bits	Relative difference in arrival time between the neighbor BS and the Anchor BS, in terms of fraction of CP,
}		
}		
N_current_BSs	3 bits	Number of BSs are currently in the Active Set of the MSS
For (i=0;i< N_current_BSs;i++) {		
TEMP_BS_ID	3 bits	Active Set member ID assigned when this BS is added to the Active Set
BS CINR mean	8 bits	
}		
Estimated action time	8 bits	The estimated action time shall be the time for the recommended target BS
Reserved	Variable	As required
HMAC tuple	21 bytes	
}		

[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 with the using the method of shortening duration of scanning time.

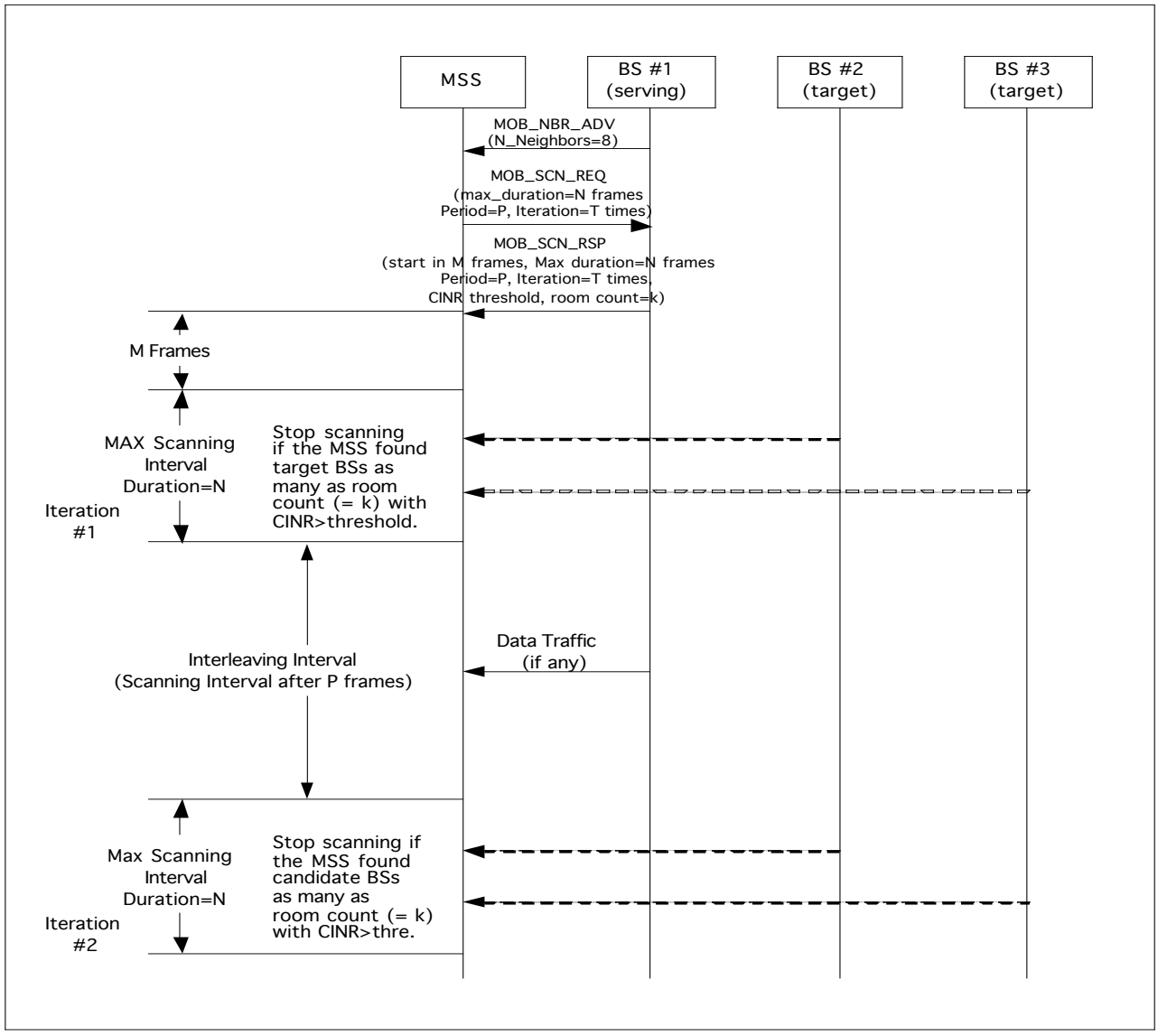
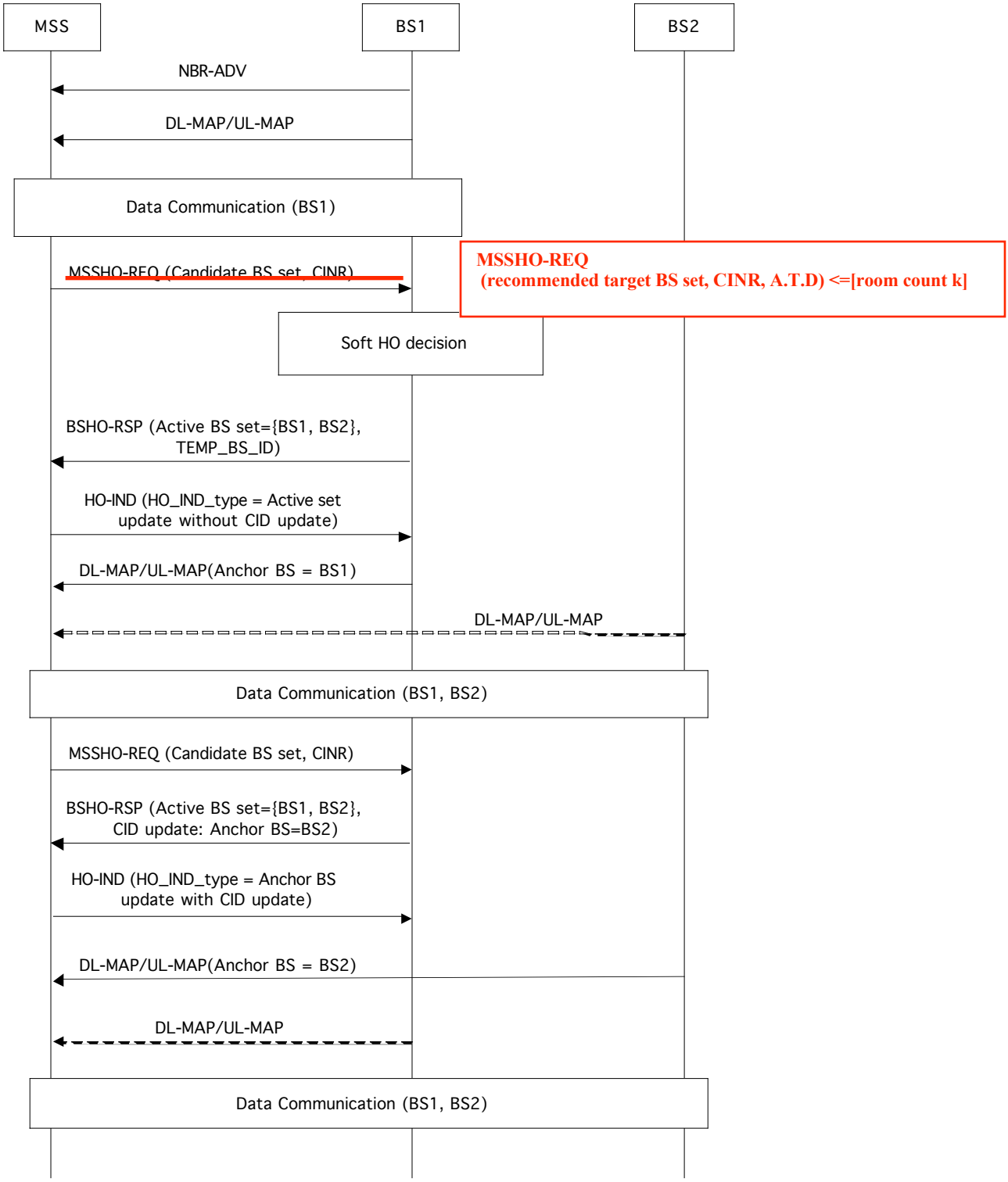


Figure E.5 – Example of periodic scanning during HO process with using the method of shortening scanning time



according to IEEE C802.16e-04/157

Figure E.1—Example BS advertisement and scanning (without association) by MSS request

References:

[1] IEEE P802.16e/D3 Air Interface for Fixed and Mobile Broadband Wireless Access Systems – Amendment for Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands

---------End text proposal-------