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Re:	This contribution is response to call for contribution about IEEE 802.16e-D4
Abstract	**Compression of Neighbor BS ID using MOB-NBR-ADV message**
Purpose	Adoption of proposed changes into P802.16e-D4-2004
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Compression of Neighbor BS ID using MOB-NBR-ADV message

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1. Introduction

A BS shall broadcast information about the network topology using the MOB-NBR-ADV MAC Management message. When an MSS performs the scanning of neighbor BSs, it may use the channel information about neighbor BSs acquired from this message. After scanning for neighbor BSs using the scanning interval allocated by the serving BS, the MSS shall report the scanning result to the Serving BS through MOB-SCAN-REPORT message, periodically or 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.

However, IEEE P802.16e/D4 has defined the use of the least significant 24 bits of the BS ID instead of 48 bit BS MAC address as "Neighbor BS ID" in neighbor BS list in MOB-NBR-ADV message, by considering that the most significant 24 bits of the BS ID is operator ID, because this 48 bit MAC address of the BS is the too long information. Moreover, 3 bit "Temp BS-ID" is used as BS ID in Active Set in some messages such as MOB-MSS-HO-REQ, MOB-BSHO-RSP etc. This "Temp BS-ID" is explicitly known by MOB-BSHO-RSP only when the corresponding BSs belong to Active set. But, 48 bit BS MAC addresses are still used as Neighbor BS IDs in MOB-SCAN-REPORT and when MSSs request the addition of the BSs to Recommended Set in MOB-MSSHO-REQ. In this case, 48 bit MAC addresses of the BSs are the too long information and it is desirable that the sizes of these IDs are reduced for the efficient use of the limited uplink wireless resources because these messages may generally include more neighbor BSs than one, if there are some solutions.

So, this contribution suggests the method to reduce the length of the neighbor BS ID when all neighbor BSs in the MOB-SCAN-REPORT message are members of the list of neighbor BSs in MOB-NBR-ADV message which the MSS receives within the some interval (NBR_BS_Index_Validity_Time). In this case, 8-bit "neighbor BS index" can be used instead of 48-bit MAC address of the BS, as neighbor BS ID. Here, "neighbor BS index" means the position in the list of neighbor BSs in MOB-NBR-ADV message, which is the same as loop index, *j*, of "For" statement of MOB-NBR-ADV message format in Table 106d. However, the MOB-SCAN-REPORT message has to include the value of "Configuration Change Count" of the referring MOB-NBR-ADV message in order to use neighbor BS index instead of MAC address of the BS, because the MOB-NBR-ADV message is broadcasted at a periodic interval (MOB-NBR-ADV interval). However, the MSS should decide whether it applies the compression of neighbor BS ID, using the timer of which the duration is NBR_BS_Index_Validity_Time, because this neighbor BS ID compression method may not be applied in case that it may not receive a number of MOB-NBR-ADV messages for some time due to the bad channel environment. If the compression cannot be applied, the conventional method is applied and so the corresponding messages such as MOB-SCAN-REPORT and MOB-MSSHO-REQ should indicate whether the compression of neighbor BS ID is applied or not, through the indication bit (Comp_NBR_BS_ID_IND). As stated in 6. 3. 20 MAC layer HO procedures, page 68 ~ page 82, handover operations may generally be assisted by MOB-NBR-ADV messages and so this compression method can effectively be used.

To support this compression method of neighbor BS ID using MOB-NBR-ADV, the BS has to keep mapping-table of neighbor BS MAC addresses and neighbor BS indexes transmitted through MOB-NBR-ADV message, for each Configuration Change Count. However, MSS can calculate the difference of MOB_SCAN_REPORT message transmitting time and MOB_NBR_ADV message receiving time, from Frame number of DL-MAP PHY Synchronization Field (Section 8.4.5.1 in IEEE P802.16-REVd/D5), and use neighbor BS index if this difference time is smaller than NBR_BS_Index_Validity_Time. Here, NBR_BS_Index_Validity_Time should

be set to the value larger than the general difference value of MOB_SCAN_REPORT message transmitting time and MOB_NBR_ADV message receiving time

Similarly, this compression of neighbor BS ID can also be applied to MOB-MSSHO-REQ.

Fig 1 shows an example to illustrate the method of neighbor BS ID compression using MOB-NBR-ADV message.

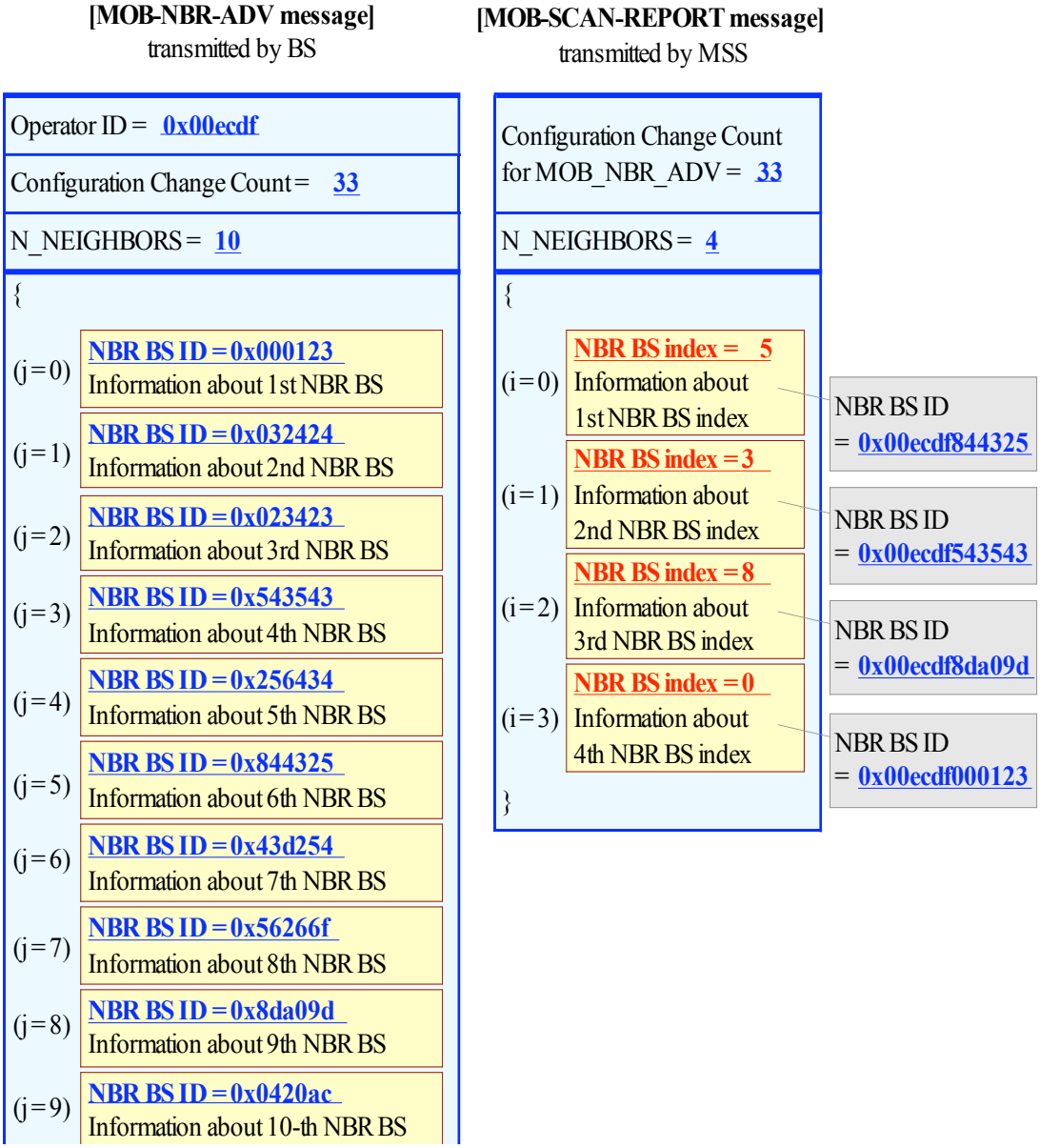

Fig 1 An example of the compression of neighbor B IDs using MOB-NBR-ADV message

2. Effect of the use of neighbor BS index

For the simplicity, we ignore the size of Comp_NBR_BS_ID_IND bit, which indicates whether the neighbor BS IDs are compressed or not.

So, the number of bits saved by using the compression of neighbor BS ID is as follows.

N_NEIGHBORS * (the size of BS MAC address – the size of neighbor BS index)
– the size of Change Configuration Count
= N_NEIGHBORS * 40 – 8 (bits)

where **N_NEIGHBORS (N_NEW_BSs)** means the size of neighbor BS list in MOB_SCAN_REPORT (MOB-MSSHO-REQ).

Example for Effect of the use of neighbor BS index						
N_NEIGHBORS (N_NEW_BSs)	1	2	3	4	5	6
Number of saved bits (bytes)	32 (4)	72 (9)	112 (14)	152 (19)	192 (24)	232 (29)

3. Text Change

[In 6.3.2.3.47 Neighbor Advertisement (MOB-NBR-ADV) message, page 35, line 42, modify as]:

BSs supporting mobile functionality shall be capable of transmitting a MOB_NBR-ADV management message at a periodic interval (MOB-NBR-ADV interval, see Table 269a) to identify the network and define the characteristics of neighbor BS to potential MSS seeking initial network entry or hand-over. For the compression of neighbor BS IDs using this message in MOB-SCAN-REPORT and MOB-MSSHO-REQ message, BSs have to keep mapping-tables of neighbor BS MAC addresses and neighbor BS indexes transmitted through MOB-NBR-ADV message, for each Configuration Change Count. Using these mapping-tables, BSs can derive 48 bit neighbor BS ID from neighbor BS index included in MOB-SCAN-REPORT or MOB-MSSHO-REQ message.

If neighbor information is not available, this message need not be transmitted.

[In 6.3.2.3.50 Scanning Result Report (MOB-SCAN-REPORT) message, page 40, line 4, modify as]:

Table 92g-MOB-SCAN-REPORT Message Format

Syntax	Size	Notes
MOB-SCAN-SCAN-REPORT_Message_Format(){		
Management Message Type = ??		
Report Mode	~~2~~ 1 bits	~~00~~ 0: Event-triggering ~~01-11~~ 1 : reserved
Comp_NBR_BS_ID_IND	1 bit	
If (Comp_NBR_BS_ID_IND == 1){		

Configuration Change Count for MOB_NBR_ADV	8 bits	Configuration Change Count value of referring MOB_NBR_ADV message
}		
N_NEIGHBORS	8 bits	
For (i=0; i<N_NEIGHBORS; i++) {		
If (Comp_NBR_BS_ID_IND == 1){		
Neighbor BS index	8 bits	
}		
Else{		
Neighbor BS ID	48 bits	
}		
BS CINR mean	8 bits	
BS RSSI mean	8 bits	
}		
}		

A MSS shall generate MOB-SCAN-REPORT messages in the format shown in Table XXX. The following parameters shall be included in the MOB-SCAN-REPORT message.

Report Mode

This parameter indicates the report mode:

Event-triggered: the MSS reports the scan result in the case that specific event has been triggered.

BS RSSI mean

This parameter indicates the Received Signal Strength measured by the MSS from the particular BS. The value shall be interpreted as an unsigned byte with units of 0.5dB, an MSS shall be able to report values in the range -100dBm to -40dBm.

Comp_NBR_BS_ID_IND

This bit indicates whether neighbor BS IDs are compressed or not. MSS can compress BS ID, only when NBR_BS_Index_Validity_Time is larger than the difference of MOB_SCAN_REPORT message transmitting time and MOB_NBR_ADV message receiving time (MOB_NBR_ADV message should be referred in order to compress neighbor BS IDs). This difference time is calculated from Frame number of DL-MAP PHY Synchronization Field.

Configuration_Change_Count_for_MOB_NBR_ADV

The value of Configuration Change Count in MOB_NBR_ADV message referred in order to compress neighbor BS ID

For each neighbor BS, the following parameter shall be included:

Neighbor BS-ID

Same as the Base Station ID parameter in the DL-MAP message of neighbor BS.

Neighbor BS index

The position in the list of neighbor BSs in MOB-NBR-ADV message of which Configuration Change Count is equal to "Configuration Change Count for MOB_NBR_ADV". BS should keep mapping-table of neighbor BS MAC address and neighbor BS index transmitted through MOB-NBR-ADV message, for each Configuration Change Count.

BS CINR mean

This parameter indicates the CINR measured by the MSS from the particular BS. The value shall be interpreted as an unsigned byte with the resolution of 0.25dB.

[In 6.3.2.3.52 Scanning Result Report (MOB-MSSHO-REQ) message, page 44, line 27, modify as]:

Table 106i-MOB-MSSHO-REQ Message Format

Syntax	Size	Notes
MOB-MSSHO-REQ_Message_Format(){		
Management Message Type = 57		
Comp_NBR_BS_ID_IND	1 bit	
if (Comp_NBR_BS_ID_IND == 1){		
Configuration Change Count for MOB_NBR_ADV	8 bits	Configuration Change Count value of referring MOB_NBR_ADV message
}		
N_new_BSs	3 bits	Number of new BSs which are recommended by the MSS
for (j=0; j<N_New_BSs; j++) {		N_Recommended can be derived from the known length of the message
if (Comp_NBR_BS_ID_IND == 1){		
Neighbor BS index	8 bits	
}		
else{		
Neighbor BS ID	48 bits	
}		
Preamble index	8 bits	
BS CINR mean	8 bits	

Service level prediction	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 (j=0; j<N_current_BSs; j++){		N_Recommended can be derived from the known length of the message
Temp BS-ID	3 bits	
BS CINR mean	8 bits	
}		
Estimated HO start	8 bits	The estimated HO time shall be the time for the recommended target BS
HMAC Tuple	21 bytes	See 11.1.2
}		

An MSS shall generate MOB-MSSHO-REQ messages in the format shown in Table 106i. The following parameters shall be included in the MOB-MSSHO-REQ message:

Estimated HO start

Estimated number of frames starting from the frame following the reception of the MOBBSHO-RSP message until the HO may take place. A value of zero in this parameter signifies that this parameter should be ignored.

HMAC Tuple (see 11.1.2)

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

Comp_NBR_BS_ID_IND

This bit indicates whether neighbor BS IDs are compressed or not. MSS can compress BS ID, only when NBR_BS_Index_Validity_Time is larger than the difference of MOB_SCAN_REPORT message transmitting time and MOB_NBR_ADV message receiving time (MOB_NBR_ADV message should be referred in order to compress neighbor BS ID). This difference time is calculated from Frame number of DL-MAP PHY Synchronization Field.

Configuration_Change_Count_for_MOB_NBR_ADV

The value of Configuration Change Count in MOB_NBR_ADV message referred in order to compress neighbor BS ID

For each recommended neighbor BS, the following parameters shall be included,

Neighbor BS-ID

Same as the Base Station ID parameter in the DL-MAP message of Neighbor BS.

Neighbor BS index

The position in the list of neighbor BSs in MOB-NBR-ADV message of which Configuration Change Count is equal to "Configuration Change Count for MOB_NBR_ADV". BS should keep mapping-table of neighbor BS MAC address and neighbor BS index transmitted through MOB-NBR-ADV message, for each Configuration Change Count.

Preamble index

The index for the PHY profile specific preamble for the Neighbor BS. Preamble Index is PHY specific for SCa and OFDMA. The value of Preamble Index shall be ignored and a value of '0x00' shall be used for OFDM PHY.

BS CINR mean

This parameter indicates the CINR in dB measured at the MSS on the downlink signal of a particular BS. The value shall be interpreted as an unsigned byte with the resolution of 1dB.

Service level prediction

This value indicates the level of service the MSS can expect from this BS. The following encodings apply:

1 = No service possible for this MSS

2 = Some service is available for one or several Service Flows authorized for the MSS.

3 = For each authorized Service Flow, a MAC connection can be established with QoS specified by the AuthorizedQoSParamSet.

4 = No service level prediction available.

[In 10.1 Global Values, page 175, line 10, modify Table 340a-Parameters and Constants]:

Table 340a-Parameters and Constants

System	Name	Time Reference	Minimum Value	Default Value	Maximum Value
MSS	Min_Sleep_Interval	Minimum sleeping time allowed to MSS	2 Frame		
MSS	Max_Sleep_Interval	Maximum sleeping time allowed to MSS			1024 Frames

MSS	Listening_Interval	The time duration during which the MSS, after waking up and synchronizing with the DL transmissions, can demodulate downlink transmissions and decide whether to stay awake or go back to sleep			64 Frames
BS	MOB-NBR-ADV interval	Nominal time between transmission of MOB-NBR-ADV messages			1s
MSS	NBR_BS_Index_Validity_Time	Time duration during which the MSS can use the neighbor BS list in MOB_NBR_ADV message for the compression of neighbor BS IDs.	1s		5s
BS	ASC-AGING-TIMER	Nominal time for aging of MSS associations	0.1s		1s
MSS	Serving BS ID AGING TIMER	Nominal time for aging of Serving BS association. Timer recycles on successful Serving BS DL-MAP read			5s
MSS	T28	Time the SS waits for MOB_BSHO-RSP message			
MSS	T29	MOB_HO-IND timeout when sent with HO_IND_type=10			
BS	Paging Retry Count	Number of retries on paging transmission. If the BS does not receive RNG-REQ from the MSS until this value decreases to zero, it determines that the MSS is unavailable.			