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Title	**Effective Neighbor BS Advertisement Signaling**
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Re:	This contribution is for call for contribution about IEEE P802.16e/D5-2004
Abstract	This contribution proposes the neighbor BS advertisement procedure using MOB-NBR-ADV message.
Purpose	
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Effective MOB-NBR-ADV message signaling

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1. Problem statements

According to the present 802.16e/D5 specification, serving BS shall be capable of periodically transmitting a MOB-NBR-ADV message to identify the network and define the characteristics of neighbor BS(s) to potential MSS seeking the initial network entry or handover. For any MSS, a neighbor BS can have either the same Operator ID as one of the MSS's serving BS or not. The format of the present MOB-NBR-ADV message is as follows.

Table 106d—MOB_NBR-ADV Message Format

Syntax	Size	Notes
MOB_NBR-ADV_Message_Format() {		
Management Message Type = 53	8 bits	
Operator ID	24 bits	Unique ID assigned to the operator
Configuration Change Count	8 bits	Incremented each time the information for the associated neighbor BS has changed.
Fragmentation Index	4 bits	This field indicates the current fragmentation index.
Total Fragmentation	4 bits	This field indicates the total number of fragmentations.
Skip-Optional-Fields Flag	1 bit	If set to '1' and if a neighbor has OFDMA PHY the BS-ID for that neighbor is omitted in this message. If set to '0', BS-ID is not omitted for any neighbor.
N_NEIGHBORS	8 bits	
For (j=0 ; j<N_NEIGHBORS ; j++) {		
Length	8 bits	Length of message information within the iteration of N_NEIGHBOR in bytes.
PHY Profile ID	8 bits	Aggregated IDs of Co-located FA Indicator, FA Configuration Indicator, FFT size, Bandwidth, Operation Mode of the starting subchannelization of a frame, and Channel Number
if (FA Index Indicator == 1) {		
FA Index	8 bits	This field, Frequency Assignment Index, is present only the FA Index Indicator in PHY Profile ID is set. Otherwise, the neighbor BS has the same FA Index or the center frequency is indicated using the TLV encoded information.
}		
if (BS EIRP Indicator == 1) {		
BS EIRP	8 bits	Signed Integer from -128 to 127 in unit of dBm This field is present only if the BS EIRP indicator is set in PHY Profile ID. Otherwise, the BS has the same EIRP as the serving BS.
}		
Neighbor BS-ID	24 bits	This is an optional field for OFDMA PHY and it is omitted or skipped if Skip Optional Fields Flag = '1'
Preamble Index	8 bits	The index for the PHY profile specific preamble. 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

HO Process Optimization	8 bits	HO Process Optimization is provided as part of this message is indicative only. HO process requirements may change at time of actual HO. For each Bit location, a value of '0' indicates the associated reentry management messages shall be required, a value of '1' indicates the reentry management message may be omitted. Regardless of the HO Process Optimization TLV settings, the Target BS may send unsolicited SBC-RSP and/or REG-RSP management messages Bit #0: Omit SBC-REQ/RSP management messages during current re-entry processing Bit #1: Omit PKM-REQ/RSP management message during current re-entry processing Bit #2: Omit REG-REQ/RSP management during current re-entry processing Bit #3: Omit Network Address Acquisition management messages during current re-entry processing Bit #4: Omit Time of Day Acquisition management messages during current reentry processing Bit #5: Omit TFTP management messages during current re-entry processing Bit #6: Full service and operational state transfer or sharing between Serving BS and Target BS (ARQ, timers, counters, MAC state machines, etc…)
Scheduling Service Supported	4 bits	Bitmap to indicate if BS supports a particular scheduling service. '1' indicates support, '0' indicates not support: bit 0: Unsolicited Grant Service (UGS) bit 1: Real-time Polling Service (rtPS) bit 2: Non-real-time Polling service (nrtPS) bit 3: Best Effort value of '1111' indicates no information on service available
Available Radio Resource	4 bits	Percentage of reported average available subchannels and symbols resources per frame 0000: 0% 0001: 20% 0010: 40% 0011: 60% 0100: 80% 0101: 100% 0110-1110: reserved 0110-1110: reserved value of '1111' indicates no information on service available
Hand Off Neighbor Preference	2 bits	00 Normal 01 Preferred 10 Non-Preferred 11 Reserved
DCD Configuration Change Count	4 bits	This represents the Neighbor BS current DCD configuration change count
UCD Configuration Change Count	4 bits	This represents the Neighbor BS current UCD configuration change count
TLV Encoded Neighbor information	Variable	TLV specific
}		
}		

Table 106e—Bit-by-bit definition of PHY Profile ID of the BS using OFDMA

Item	Size	Notes
Co-located FA Indicator	1 bit	If the BS (or FA) is co-located with the serving BS, this bit is set to 1.
FA Configuration Indicator	1 bit	If this bit is set 1, the BS has the same FA configuration (the same number of FAs as well as their frequencies) as the BS broadcasting the NBR-ADV.
Time/Frequency Synchronization Indicator	2 bits	00 = Unsynchronized 01 = Time synchronization 10 = Time and Frequency synchronization If time synchronization is indicated then the downlink frames transmitted by the serving BS and the Neighbor BS shall be synchronized to a level of at least 1/8 cyclic prefix length. If frequency synchronization is indicated, then the BS reference clocks shall be synchronized to a level that yields RF center frequency offset of no more than 4% of the OFDMA carrier spacing of the Neighbor BS.
BS EIRP Indicator	1 bit	If this bit is set, the BS EIRP follows the PHY Profile ID.
DCD/UCD Reference Indicator	1 bit	1: The DCD/UCD settings of this neighbor BS are the same as those of the preceding neighbor BS unless the TLV information specifies. 0: The DCD/UCD settings of this neighbor BS are the same as those of the serving BS unless the TLV information specifies.
FA Index Indicator	1 bit	Only if this bit is set to 1, the FA Index follows the PHY Profile ID. In addition, if the FA Indicator is followed, the DL center frequency shall be omitted in the DCD/UCD difference TLV information.
Reserved	1 bit	Reserved for future use

This message contains the individual Preamble Indices, PHY Profile ID parameters for each neighbor BS and one Operator ID for all included neighbor BS(s). If neighbor BS(s) and the serving BS belong to the same operator's system, its/their Operator ID parameter may not need to be signaled to MSS(s). Furthermore, if neighbor BS(s) and the serving BS belong to the different operator's system, their Operator ID parameters and the neighbor BS(s) information shall be signaled using different MOB-NBR-ADV message. It causes the additional generic MAC header overhead, signaling delay.

2. Proposed remedy

For any MSS, neighbor BS(s) can be divided into two categories. One is the intra-operator neighbor BS(s) and the other is the inter-operator neighbor BS(s).

- ***Intra-operator neighbor BS(s)*** are BS(s) whose downlink physical frequency belongs to same operator system and its downlink transmission can be demodulated by the MSS.
- ***Inter-operator neighbor BS(s)*** are BS(s) whose downlink physical frequency belongs to another operator system and its downlink transmission can be demodulated by the MSS.

For any of intra-operator neighbor BS(s), its Operator ID may be abstracted from DL-MAP of the serving BS, but Operator IDs of inter-operator neighbor BS(s) shall be included in MOB-NBR-ADV message in order to indicate different Operator ID to the MSS.

3. Proposed text change

[Modify MOB-NBR-ADV message in Page 62-65, Table 106d]

Syntax	Size	Notes
MOB-NBR-ADV_Message_Format() {		
Management message type = 53	8 bits	
~~**Operator ID**~~	~~24 bits~~	~~Unique ID assigned to the operator~~
Configuration Change Count	8 bits	Incremented each time the information for the associated neighbors BS has changed
Fragmentation Index	4 bits	This field indicates the current fragmentation index.
Total Fragmentation	4 bits	This field indicates the total number of fragmentations.
Skip-Optional-Fields Flag	1 bits	If set to '1' and if a neighbor has OFDMA PHY the BS-ID for that neighbor with same operator ID is omitted in this message. If set to '0', BS-ID with same operator ID is not omitted for any neighbor.
Different Operator Indication	1 bit	This field indicates that information about inter-operator neighbor BS(s) is(are) included in MOB-NBR-ADV message.
N_NEIGHBORS	8 bits	
For (j=0;j<N_NEIGHBORS;j++) {		
Length	8 bits	Length of message information within the iteration of N_NEIGHBOR in bytes.
PHY Profile ID	8 bits	Aggregated IDs of Co-located FA Indicator, FA Configuration Indicator, FFT size, Bandwidth, Operation Mode of the starting subchannelization of a frame, and Channel Number
if (FA Index indicator==1){		
FA Index	8 bits	This field, Frequency Assignment Index, is present only the FA Index Indicator in PHY Profile ID is set. Otherwise, the neighbor BS has the same FA Index or the center frequency is indicated using the TLV encoded information.
}		
if (BS EIRP indicator==1){		
BS EIRP	8 bits	Signed Integer from -128 to 127 in unit of dBm This field is present only if the BS EIRP indicator is set in PHY Profile ID. Otherwise, the BS has the same EIRP as the serving BS.
}		
Neighbor BS-ID	24 bits	This is an optional field for OFDMA PHY and it is omitted or skipped if Skip Optional Fields Flag = '1'
Preamble Index	8 bits	The index for the PHY profile specific preamble. 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
HO Process Optimization	8 bits	HO Process Optimization is provided as part of this message is indicative only. HO process requirements may change at time of actual HO. For each Bit location, a value of '0' indicates the associated reentry management messages shall be required, a value of '1' indicates the reentry management message may be omitted. Regardless of the HO Process Optimization TLV settings, the Target BS may send unsolicited SBC-RSP and/ or REG-RSP management messages Bit #0: Omit SBC-REQ/RSP management messages during current re-entry processing Bit #1: Omit PKM-REQ/RSP management message during current re-entry processing Bit #2: Omit REG-REQ/RSP management during current re-entry processing Bit #3: Omit Network Address Acquisition management messages during current reentry processing Bit #4: Omit Time of Day Acquisition management messages during current reentry processing Bit #5: Omit TFTP management messages during current re-entry processing Bit #6: Full service and operational state transfer or sharing between Serving BS and Target BS (ARQ, timers, counters, MAC state machines, etc…)
Scheduling Service Supported	4 bits	Bitmap to indicate if BS supports a particular scheduling service. '1' indicates support, '0' indicates not support: bit 0: Unsolicited Grant Service (UGS) bit 1: Real-time Polling Service (rtPS) bit 2: Non-real-time Polling service (nrtPS) bit 3: Best Effort value of '1111' indicates no information on service available
Available Radio Resource	4 bits	Percentage of reported average available subchannels and symbols resources per frame 0000: 0% 0001: 20% 0010: 40% 0011: 60% 0100: 80%

		0101: 100% 0110-1110: reserved 0110-1110: reserved value of '1111' indicates no information on service available
Handoff Neighbor Preference	2 bits	00 Normal 01 Preferred 10 Non-Preferred 11 Reserved
DCD Configuration Change Count	4 bits	This represents the Neighbor BS current DCD configuration change count
UCD Configuration Change Count	4 bits	This represents the Neighbor BS current UCD configuration change count
TLV Encoded Neighbor information	Variable	TLV specific
}		
if (Different Operator Indication ==1) {		
do {		
Operator ID	24 bits	Unique ID assigned to the operator
N_INTER_OPT_NBRS	8 bits	Number of inter-operator neighbors BS(s) with operator ID
For (j=0;j<N_INTER_OPT_NBRS;j++) {		
Length	8 bits	Length of message information within the iteration of N_INTER_OPT_NBRS in bytes.
PHY Profile ID	8 bits	Aggregated IDs of Co-located FA Indicator, FA Configuration Indicator, FFT size, Bandwidth, Operation Mode of the starting subchannelization of a frame, and Channel Number
if (FA Index Indicator==1) {		
FA index	8 bits	This field, Frequency Assignment Index, is present only the FA Index Indicator in PHY Profile ID is set. Otherwise, the neighbor BS has the same FA Index or the center frequency is indicated using the TLV encoded information. In case of inter-operator neighbor BS(s), the neighbor BS has the other FA index or the center frequency.
}		
if (BS EIRP indicator==1){		
BS EIRP	8 bits	Signed Integer from -128 to 127 in unit of dBm This field is present only if the BS EIRP indicator is set in PHY Profile ID. Otherwise, the BS has the same EIRP as the serving BS.
}		
Neighbor BS-ID	24 bits	This is an optional field for OFDMA PHY and it is omitted or skipped if Skip Optional Fields Flag = '1'

Preamble Index	8 bits	The index for the PHY profile specific preamble. 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
HO Process Optimization	8 bits	HO Process Optimization is provided as part of this message is indicative only. HO process requirements may change at time of actual HO. For each Bit location, a value of '0' indicates the associated reentry management messages shall be required, a value of '1' indicates the reentry management message may be omitted. Regardless of the HO Process Optimization TLV settings, the Target BS may send unsolicited SBC-RSP and/ or REG-RSP management messages Bit #0: Omit SBC-REQ/RSP management messages during current re-entry processing Bit #1: Omit PKM-REQ/RSP management message during current re-entry processing Bit #2: Omit REG-REQ/RSP management during current re-entry processing Bit #3: Omit Network Address Acquisition management messages during current reentry processing Bit #4: Omit Time of Day Acquisition management messages during current reentry processing Bit #5: Omit TFTP management messages during current re-entry processing Bit #6: Full service and operational state transfer or sharing between Serving BS and Target BS (ARQ, timers, counters, MAC state machines, etc…)
Scheduling Service Supported	4 bits	Bitmap to indicate if BS supports a particular scheduling service. '1' indicates support, '0' indicates not support: bit 0: Unsolicited Grant Service (UGS) bit 1: Real-time Polling Service (rtPS) bit 2: Non-real-time Polling service (nrtPS) bit 3: Best Effort value of '1111' indicates no information on service available
Available Radio Resource	4 bits	Percentage of reported average available subchannels and symbols resources per frame 0000: 0% 0001: 20% 0010: 40% 0011: 60%

		0100: 80% 0101: 100% 0110-1110: reserved 0110-1110: reserved value of '1111' indicates no information on service available
Handoff Neighbor Preference	2 bits	00 Normal 01 Preferred 10 Non-Preferred 11 Reserved
DCD Configuration Change Count	4 bits	This represents the Neighbor BS current DCD configuration change count
UCD Configuration Change Count	4 bits	This represents the Neighbor BS current UCD configuration change count
TLV Encoded Neighbor information	Variable	TLV specific
Continued	1 bit	This index indicates whether a group of neighbor BS(s) with different Operator ID is continued or not. If set to '1', a group of neighbor BS(s) with different Operator ID shall be continued. If set to '0', no more group of neighbor BS(s) shall be indicated after a group of neighbor BS(s) with corresponding Operator ID.
} (Continued==1)		
}		
}		

[PHY Profile ID in Page 68, Table 106e]

Item	Size	Notes
Co-located FA Indicator	1 bit	If the BS (or FA) is co-located with the serving BS, this bit is set to 1.
FA Configuration Indicator	1 bit	If this bit is set 1, the BS has the same FA configuration (the same number of FAs as well as their frequencies) as the BS broadcasting the NBR-ADV.
Time/Frequency Synchronization Indicator	2 bits	00 = Unsynchronized 01 = Time synchronization 10 = Time and Frequency synchronization If time synchronization is indicated then the downlink frames transmitted by the serving BS and the Neighbor BS shall be synchronized to a level of at least 1/8 cyclic prefix length. If frequency synchronization is indicated, then the BS reference clocks shall be synchronized to a level that yields RF center frequency offset of no more than 4% of the OFDMA carrier spacing of the Neighbor BS.
BS EIRP Indicator	1 bit	If this bit is set, the BS EIRP follows the PHY Profile ID.
DCD/UCD Reference Indicator	1 bit	1: The DCD/UCD settings of this neighbor BS are the same as those of the preceding neighbor BS unless the TLV information specifies. 0: The DCD/UCD settings of this neighbor BS are the same as those of the serving BS unless the TLV information specifies.
FA Index Indicator	1 bit	Only if this bit is set to 1, the FA Index follows the PHY Profile ID. In addition, if the FA Indicator is followed, the DL center frequency shall be omitted in the DCD/UCD difference TLV information.
Reserved	1 bit	Reserved for future use

A BS shall generate MOB-NBR-ADV messages in the format shown in Table 106d. The following parameters shall be included in the MOB-NBR-ADV message unless otherwise noted as an optional item in which case they may be included,

~~**Operator ID**~~

~~The unique network ID shared by an association of BS~~

Configuration Change Count

Incremented by one (modulo 256) whenever any of the values relating to any included data element changes, including

DCD & UCD parameters. If the value of this count in a subsequent MOB-NBR-ADV message remains the same, the MSS can quickly disregard the entire message.

Fragmentation Index

This field indicates the current fragmentation index. The index for the first fragmentation is 0.

Total Fragmentation

This field set to 1 when no fragmentation exists. Otherwise, neighbor list is fragmented and this field indicates the total number of fragmentations. When the neighbor list is fragmented, the N_NEIGHBORS indicates the number of neighbors in the current fragmentation.

Skip-Optional-Fields Flag:

This is 1 bit Flag to show if the BS-ID fields are skipped fore neighbors with OFDMA PHY. Therefore if this flag is set to '1' and if a neighbor BS with same operator ID has OFDMA PHY, as indicated in its PHY Profile ID, then the BS-ID for that neighbor is not mentioned in this message. If this flag is set to '0', BSID with same operator ID is not omitted for any neighbor.

Different Operator Indication

This field indicates that information about inter-operator neighbor BS(s) is(are) included in MOB-NBR-ADV message.

N_NEIGHBORS

The count of the unique combination of Neighbor BS ID, Preamble Index and DCD.

For each advertised neighbor, the following parameters shall be included. Required message items may be omitted if duplicating the immediate previous iteration in the same message:

Length

Length of message information within the iteration of N_NEIGHBOR in bytes

Neighbor BS-ID

The least significant 24 bits of the Base Station ID parameter in the DL-MAP message of the Neighbor BS.

FA Index

Only if the FA Index Indicator bit in the PHY Profile ID is set to 1, the FA Index follows the PHY Profile ID. In addition, if the FA Indicator is followed, the DL center frequency shall be omitted in the DCD/UCD difference TLV information. The bit-by-bit definition shall be determined by a service provider or a governmental body like FCC.

For each advertised N_INTER_OPT_NBRS neighbor with each Operator ID, the following parameters shall be included. Required message items may be omitted if duplicating the immediate previous iteration of N_INTER_OPT_NBRS with each Operator ID in the same message:

Operator ID

The unique network ID shared by an association of BS

N_INTER_OPT_NBRS

The count of the unique combination of inter-operator Neighbor BS ID with Operator ID, Preamble Index and DCD.

Length

Length of message information within the iteration of N_INTER_OPT_NBRS in bytes

Neighbor BS-ID

24 bits of the Base Station ID parameter in the DL-MAP message of the corresponding inter-operator Neighbor BS.

FA Index

Only if the FA Index Indicator bit in the PHY Profile ID is set to 1, the FA Index follows the PHY Profile ID. In addition, if the FA Indicator is followed, the DL center frequency shall be omitted in the DCD/UCD difference TLV information. The bit-by-bit definition shall be determined by a service provider or a governmental body like FCC. In case of inter-operator neighbor BS(s), the neighbor BS has the other FA index or the center frequency and FA index indicator in PHY Profile ID shall be 1.

Continued

This index indicates whether a group of neighbor BS(s) with each different Operator ID is continued or not. If set to '1', a group of neighbor BS(s) with each different Operator ID shall be continued. If set to '0', no more group of neighbor BS(s) shall be indicated after a group of neighbor BS(s) with corresponding Operator ID.

For each advertised Neighbor BS, the following TLV parameters shall be included:

Preamble Index

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

PHY Profile ID

The PHY Profile ID is the aggregate ID's including the Co-located FA Indicator bit, the FA Configuration indicator bit, Time/Frequency Synchronization Indicator, BS EIRP Indicator, DCD/UCD Reference Indicator, FA Index Indicator, and the FA (Frequency Assignment) number. For systems using OFDMA, the bit-by-bit definition of the PHY Profile ID is shown. The ID for systems using other than OFDMA is . If the Co-located FA Indicator bit is set, the following field of the NBRADV element including Preamble Index, HO Process Optimization, DCD/UCD Configuration Change Count, and TLV Encoded Neighbor Information may be omitted.

BS EIRP

The neighbor BS EIRP is listed in a signed integer form from -128 to 127 in units of dBm. This field shall be omitted if the BS EIRP Indicator bit in PHY Profile ID is set zero.

HO Process Optimization

The HO Process Optimization that is provided as part of this message is indicative only. HO process requirements may change at time of actual HO. For each bit location, a value of '0' indicates the associated re-entry management messages shall be required and a value of '1' indicates the reentry management message may be omitted. Regardless of the HO Process Optimization TLV settings, the Target BS may send unsolicited SBC-RSP and/or REG-RSP management messages:

Bit #0: Omit SBC-REQ/RSP management messages during re-entry processing

Bit #1: Omit PKM-REQ/RSP management message during re-entry processing

Bit #2: Omit REG-REQ/RSP management message during re-entry processing

Bit #3: Omit IP address Acquisition management messages during re-entry processing

Bit #4: Omit Time of Day Acquisition management messages during re-entry processing

Bit #5: Omit TFTP management messages during re-entry processing

Bit #6: Full service and operational state transfer or sharing between Serving BS and Target BS

(ARQ, timers, counters, MAC state machines, etc…)

Scheduling Service Supported

Bitmap to indicate if BS supports a particular scheduling service. '1' indicates support, '0' indicates not support:

Bit #0: Unsolicited Grant Service (UGS)

Bit #1: Real-time Polling Service (rtPS)

Bit #2: Non-real-time Polling service (nrtPS)

Bit #3: Best Effort value of '1111' indicates no information on service available.

Available Radio Resource

Percentage of reported average available subchannels and symbols resources per frame, as determined by the BS call admission policy and measured over a vendor defined interval. The BS should take into consideration the average loading occupied by existing non-best-effort MSS as well as loading the BS intends to offer to the existing best-effort MSS, and then evaluate the extra radio resource available that the BS wishes to advertise.

0b0000: 0%

0b0001: 20%

0b0010: 40%

0b0011: 60%

0b0100: 80%

0b0101: 100%

0b0110-1110: *Reserved*

value of '1111' indicates no information on service available

Handoff Neighbor Preference

Defines the logical preference for handing off to a neighbor base stations as determined by the serving base station (see section 6.3.20.1.1.1)

DCD Configuration Change Count

Represents the Neighbor BS current DCD configuration change count.

UCD Configuration Change Count

Represents the Neighbor BS current UCD configuration change count.

For each advertised Neighbor BS, the following TLV parameters may be included:

Mode Feature Supported

Same as in 11.7.11.1.

When Mode Feature Supported bit indicate support for Idle-mode, following TLV parameters may be included:

Paging Group ID (16 bit)

One or more logical affiliation groupings of BS

All other parameters are coded as TLV tuples.

DCD_settings

The DCD_settings is a compound TLV value that encapsulates a DCD message that may be transmitted in the advertised BS downlink channel. This information is intended to enable fast synchronization of the MSS with the advertised BS downlink. The DCD settings fields shall contain only neighbor's DCD TLV values which are different from the Serving BS corresponding values. For values that are not included, the MSS shall assume they are identical to the corresponding values of the Serving BS.

UCD_settings

The UCD_settings is a compound TLV value that encapsulates a UCD message that may be transmitted in the advertised BS downlink channel. This information is intended to enable fast synchronization of the MSS with the advertised BS uplink. The UCD settings fields shall contain only neighbor's UCD TLV values which are different from the Serving BS's corresponding values. For values that are not included, the MSS shall assume they are identical to the Serving BS's corresponding values.