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Re:	
Abstract	This contribution describes Fast BS/Sector Switching in OFDMA PHY mode
Purpose	Adopting of proposed method into P802.16e
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Fast BS/Sector Switching in OFDMA PHY mode

Introduction

It is well known that fast BS/sector switching can improve the performance, especially for the users on cell boundary region. In contrast to soft handover, fast BS/sector switching doesn't need to increase much complexity and overhead. ZTE proposed a fast BS/sector switching scheme [1], where MSS reports preferred anchor BS over fast feedback channel. However, the ZTE proposed scheme may suffer from the round-corner problem--It takes place when the channel to the anchor BS is suddenly un-usably deteriorated while the channels to other active BS still remain good. But, since there is no dedicated control channel to others, the call may be simply dropped or the MSS should perform all HO network re-entry procedure.--and increased interference during the extended time period before the actual handover takes place. In this contribution, we propose a fast BS switching scheme which solves the afore-mentioned problem.

Overview of Proposed Solution

The basic concept and the HO flow of the proposed fast BS/sector switching are similar to those proposed by ZTE in IEEE 802.16e Handover Adhoc [1]. In fast BS/sector switching, the MSS is transmitting/receiving data to/from only one of the serving BS/sectors at any given frame. The MSS monitors the downlink of all serving BS/sectors in the active set and updates its preferred BS/sector based on received CINR from all serving BS/sectors. The method for the MSS to report its preferred BS/sector in this contribution is different from that of ZTE's proposal [1]. It will be explained in the following.

Every BS/sector assigns FCS pointing channel (FPCH) for the MSS to report preferred BS/sector, while the Active BS set is updated. This channel is composed of one uplink subchannel similar to FAST_FEEDBACK channel. The MSS in fast BS/sector switching is assigned an FPCH and one codeword from each BS/sector in its active set. The MSS chooses preferred BS/sector based on received CINR from all serving BS/sectors, and sends the codeword over the assigned FPCH corresponding to the selected BS/sectors. Every BS/sector receives signals in the assigned FPCH and knows whether it is selected as the preferred BS/sector or not. If a BS receives the codeword from the MSS, the BS becomes a new anchor BS and transmits the downlink data to the MSS. If the previous anchor BS detects that the MSS stops transmitting the allocated codeword to it, it stops the DL transmission and the UL allocation from then on. The example call flow is shown in Figure 1.

We explain the proposed scheme with the example shown in Figure 2. In Figure 2, an MSS communicates with 3 BS/sectors (A, B, and C) at the same time, i.e. the three BS/sectors are in the active set. BS/sector A assigns FPCH #0 and codeword #1 to the MSS, BS/sector B assigns FPCH #0 and codeword #5, and BS/sector C assigns FPCH #0 and codeword #5. If the MSS selects BS/sector C as preferred BS/sector, it sends the codeword #5 over the FPCH of BS/sector C. Even if the FPCH number and the codeword number are identical for BS/sector B and for BS/sector C in this example, the BS/sector B would not decide that the signal is toward itself since its FPCH structure is different from that of BS/sector C.

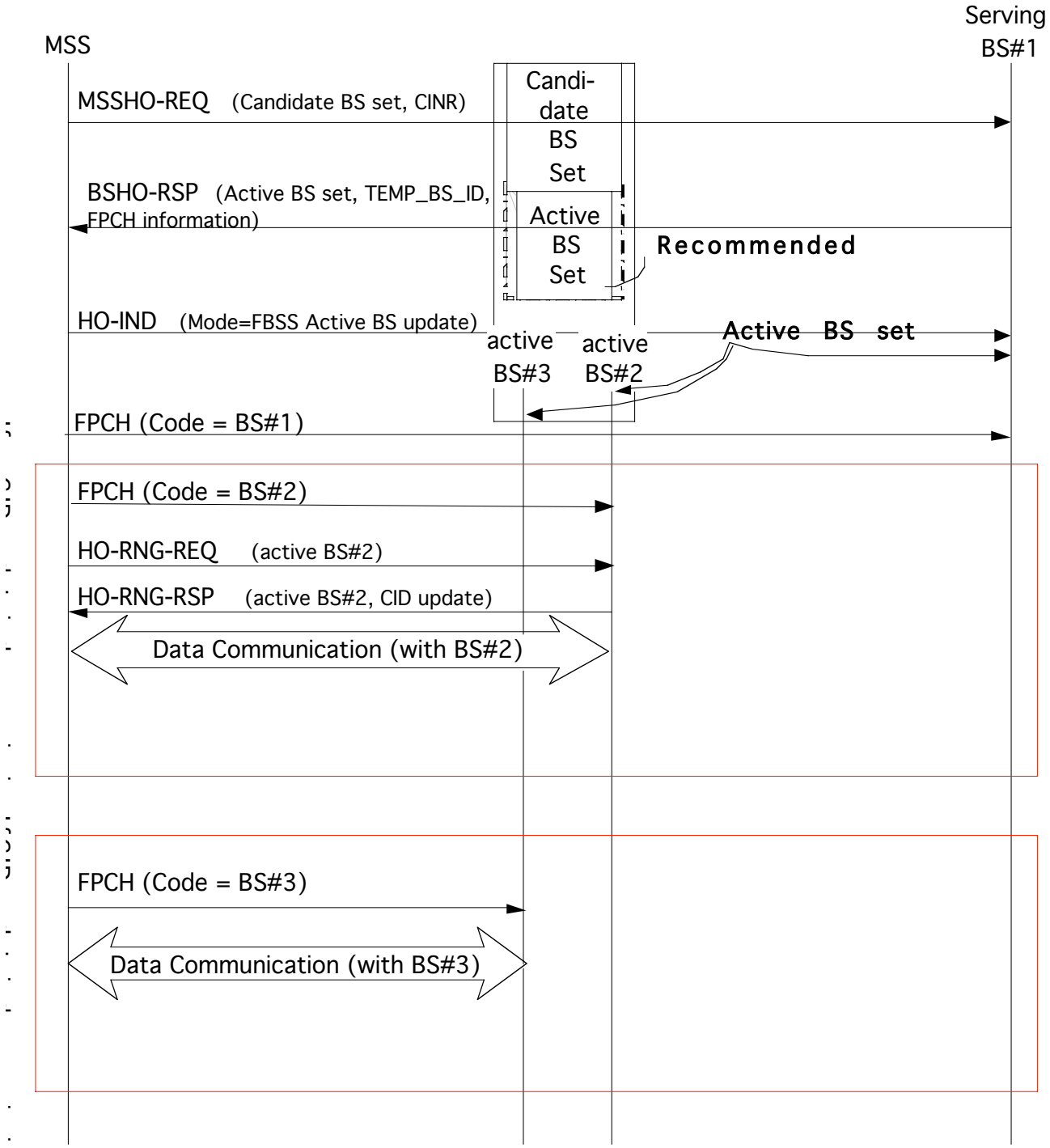

Figure 1. Call Flow of Fast BS Switching

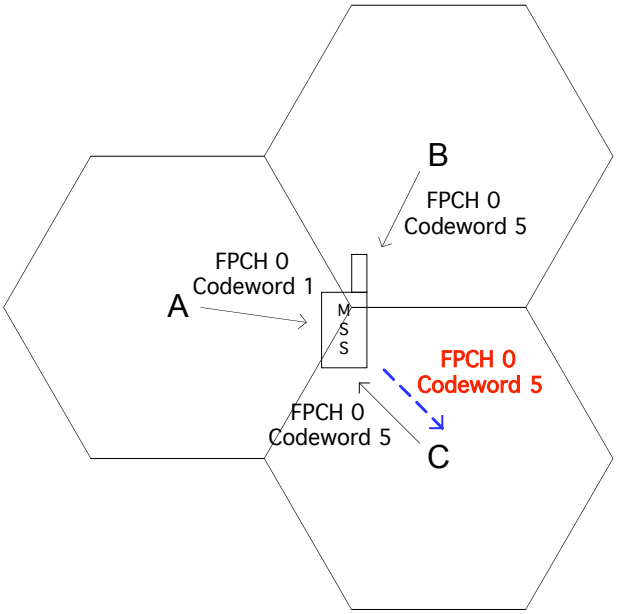

Figure 2. Illustration of proposed fast BS/sector switching

Suggested change to the standard

[*Modify the BS HO Response (MOB_BSHO-RSP) message, to indicate the list of recommended BSs for SHO*]

6.3.2.3.56 BS HO Response (MOB_BSHO-RSP) message

[…]

Table 92j- MOB-BSHO-RSP Message Format

Syntax	**Size**	**Notes**
MOB-BSHO-RSP_Message_Format() {		
Management Message Type = 54	8 bits	
Mode	3 bits	000: HHO response 001: SHO response: Anchor BS update with CID update 010: SHO response: Anchor BS update without CID update 011: SHO response: Active Set update with CID update 100: SHO response: Active Set update without CID update 101: FBSS response: Active Set update with CID update and FPCH allocation 110: FBSS response: Active Set update without CID update and with FPCH allocation 111: reserved

If (Mode == 000) {		
N_Recommended	8 bits	
For (i= 0;i<N_Recommended; I++) {		
Neighbor BS_ID	48 bits	Base station ID
Service level prediction	8 bits	
}		
}		
else if (Mode == 001) {		
TEMP_BS_ID	3 bits	TEMP_BS_ID of the recommended Anchor BS
N_CIDs	8 bits	Number of CIDs needed to be reassigned
For (i= 0;i<N_CIDs;i++) {		
Current CID	16 bits	Currently assigned CID
New CID	16 bits	New CID to be used after Active Set is updated
}		
}		
else if (Mode == 010) {		
TEMP_BS_ID	3 bits	TEMP_BS_ID of the recommended Anchor BS
}		
else if (Mode == 011) {		
N_new_BSs	3 bits	Number of new BSs which are recommended to be added to the Active Set of the MSS
for (i= 0; i < N_new_BSs; i++) {		
Neighbor BS_ID	48 bits	
TEMP_BS_ID	3 bts	Active Set member ID assigned to this BS
Service level prediction	8 bits	
}		
N_current_BSs	3 bits	Number of BSs currently in the Active Set of the MSS, which are recommended to be remained in the Active Set
for (i=0;i< N_current_BSs;i++) {		
TEMP_BS_ID	3 bits	Active Set member ID assigned to this BS
Service level prediction	8 bits	
}		
TEMP_BS_ID_Anchor	3 bits	Temp BS ID for Anchor BS
N_CIDs	8 bits	Number of CIDs needed to be reassigned
For (i= 0;i<N_CIDs;i++) {		
Current CID	16 bits	Currently assigned CID
New CID	16 bits	New CID to be used after Active Set is updated
}		

}		
Else if (Mode == 100) {		
N_new_BSs	3 bits	Number of new BSs which are recommended to be added to the Active Set of the MSS
for (i= 0; i < N_new_BSs; i++) {		
Neighbor BS_ID	48 bits	
TEMP_BS_ID	3 bts	Active Set member ID assigned to this BS
Service level prediction	8 bits	
}		
N_current_BSs	3 bits	Number of BSs currently in the Active Set of the MSS, which are recommended to be remained in the Active Set
for (i=0;i< N_current_BSs;i++) {		
TEMP_BS_ID	3 bits	Active Set member ID assigned to this BS
Service level prediction	8 bits	
}		
TEMP_BS_ID_Anchor	3 bits	Temp BS ID for Anchor BS
}		
else if (Mode == 101) {		
N_new_BSs	3 bits	Number of new BSs which are recommended to be added to the Active Set of the MSS
for (i= 0; i < N_new_BSs; i++) {		
Neighbor BS_ID	48 bits	
TEMP_BS_ID	3 bts	Active Set member ID assigned to this BS
Service level prediction	8 bits	
FPCH_OFDMA_symbol_offset	8 bits	
FPCH_Subchannel_offset	7 bits	
FPCH_code_index	3 bits	
}		
N_current_BSs	3 bits	Number of BSs currently in the Active Set of the MSS, which are recommended to be remained in the Active Set
for (i=0;i< N_current_BSs;i++) {		
TEMP_BS_ID	3 bits	Active Set member ID assigned to this BS
Service level prediction	8 bits	
}		
TEMP_BS_ID_Anchor	3 bits	Temp BS ID for Anchor BS
N_CIDs	8 bits	Number of CIDs needed to be reassigned
For (i= 0;i<N_CIDs;i++) {		
Current CID	16 bits	Currently assigned CID
New CID	16 bits	New CID to be used after Active Set is updated

}		
}		
Else if (Mode == 110) {		
N_new_BSs	3 bits	Number of new BSs which are recommended to be added to the Active Set of the MSS
for (i= 0; i < N_new_BSs; i++) {		
Neighbor BS_ID	48 bits	
TEMP_BS_ID	3 bts	Active Set member ID assigned to this BS
Service level prediction	8 bits	
FPCH_OFDMA_symbol_offset	8 bits	
FPCH_Subchannel_offset	7 bits	
FPCH_code_index	3 bits	
}		
N_current_BSs	3 bits	Number of BSs currently in the Active Set of the MSS, which are recommended to be remained in the Active Set
for (i=0;i< N_current_BSs;i++) {		
TEMP_BS_ID	3 bits	Active Set member ID assigned to this BS
Service level prediction	8 bits	
}		
TEMP_BS_ID_Anchor	3 bits	Temp BS ID for Anchor BS
}		
Action time	8 bits	Recommended action time when the Active Set shall be updated
Reserved	Variable	As required
HMAC tuple	21 bytes	
}		

[*Modify the BS HO Request (MOB-BSHO-REQ) message, to indicate the list of recommended BSs for SHO*]

6.3.2.3.54 BS HO Request (MOB-BSHO-REQ) message

[…]

Table 92h- MOB-BSHO-REQ message Format

Syntax	**Size**	**Notes**
MOB-BSHO-REQ_Message_Format() {		
Management Message Type = 52	8 bits	
Network Assisted HO supported	1 bit	Indicate that the BS supports Network assisted HO
Mode	3 bits	000: HHO request 001: SHO request: Anchor BS update with CID update

		010: SHO request: Anchor BS update without CID update 011: SHO request: Active Set update with CID update 100: SHO request: Active Set update without CID update 101: FBSS request: Active Set update with CID update and FPCH allocation 110: FBSS request: Active Set update without CID update and with FPCH allocation 111: reserved
If (Mode == 000) {		
N_Recommended	8 bits	
For (i= 0;i<N_Recommended; i++) {		
Neighbor BS_ID	48 bits	Base station ID
Service level prediction	8 bits	
}		
}		
else if (Mode == 001) {		
TEMP_BS_ID	3 bits	TEMP_BS_ID of the recommended Anchor BS
N_CIDs	8 bits	Number of CIDs needed to be reassigned
For (i= 0;i<N_CIDs;i++) {		
Current CID	16 bits	Currently assigned CID
New CID	16 bits	New CID to be used after Active Set is updated
}		
}		
else if (Mode == 010) {		
TEMP_BS_ID	3 bits	TEMP_BS_ID of the recommended Anchor BS
}		
else if (Mode == 011) {		
N_new_BSs	3 bits	Number of new BSs which are recommended to be added to the Active Set of the MSS
for (i= 0; i < N_new_BSs; i++) {		
Neighbor BS_ID	48 bits	
TEMP_BS_ID	3 bts	Active Set member ID assigned to this BS
Service level prediction	8 bits	
}		
N_current_BSs	3 bits	Number of BSs currently in the Active Set of the MSS, which are recommended to be remained in the Active Set
for (i=0;i< N_current_BSs;i++) {		
TEMP_BS_ID	3 bits	Active Set member ID assigned to this BS
Service level prediction	8 bits	

}		
TEMP_BS_ID_Anchor	3 bits	Temp BS ID for Anchor BS
N_CIDs	8 bits	Number of CIDs needed to be reassigned
For (i= 0;i<N_CIDs;i++) {		
Current CID	16 bits	Currently assigned CID
New CID	16 bits	New CID to be used after Active Set is updated
}		
}		
else if (Mode == 100) {		
N_new_BSs	3 bits	Number of new BSs which are recommended to be added to the Active Set of the MSS
for (I= 0; i < N_new_BSs; i++) {		
Neighbor BS_ID	48 bits	
TEMP_BS_ID	3 bts	Active Set member ID assigned to this BS
Service level prediction	8 bits	
}		
N_current_BSs	3 bits	Number of BSs currently in the Active Set of the MSS, which are recommended to be remained in the Active Set
for (i=0;i< N_current_BSs;i++) {		
TEMP_BS_ID	3 bits	Active Set member ID assigned to this BS
Service level prediction	8 bits	
}		
TEMP_BS_ID_Anchor	3 bits	Temp BS ID for Anchor BS
}		
else if (Mode == 101) {		
N_new_BSs	3 bits	Number of new BSs which are recommended to be added to the Active Set of the MSS
for (i= 0; i < N_new_BSs; i++) {		
Neighbor BS_ID	48 bits	
TEMP_BS_ID	3 bts	Active Set member ID assigned to this BS
Service level prediction	8 bits	
FPCH_OFDMA_symbol_offset	8 bits	
FPCH_Subchannel_offset	7 bits	
FPCH_code_index	3 bits	
}		
N_current_BSs	3 bits	Number of BSs currently in the Active Set of the MSS, which are recommended to be remained in the Active Set
for (i=0;i< N_current_BSs;i++) {		
TEMP_BS_ID	3 bits	Active Set member ID assigned to this BS

Service level prediction	8 bits	
}		
TEMP_BS_ID_Anchor	3 bits	Temp BS ID for Anchor BS
N_CIDs	8 bits	Number of CIDs needed to be reassigned
For (i= 0;i<N_CIDs;i++) {		
Current CID	16 bits	Currently assigned CID
New CID	16 bits	New CID to be used after Active Set is updated
}		
}		
Else if (Mode == 110) {		
N_new_BSs	3 bits	Number of new BSs which are recommended to be added to the Active Set of the MSS
for (i= 0; i < N_new_BSs; i++) {		
Neighbor BS_ID	48 bits	
TEMP_BS_ID	3 bts	Active Set member ID assigned to this BS
Service level prediction	8 bits	
FPCH_OFDMA_symbol_offset	8 bits	
FPCH_Subchannel_offset	7 bits	
FPCH_code_index	3 bits	
}		
N_current_BSs	3 bits	Number of BSs currently in the Active Set of the MSS, which are recommended to be remained in the Active Set
for (i=0;i< N_current_BSs;i++) {		
TEMP_BS_ID	3 bits	Active Set member ID assigned to this BS
Service level prediction	8 bits	
}		
TEMP_BS_ID_Anchor	3 bits	Temp BS ID for Anchor BS
}		
Action time	8 bits	Recommended action time when the Active Set shall be updated or the Anchor BS shall be updated
Reserved	Variable	As required
HMAC tuple	21 bytes	
}		

[ADD the following text after 8.4.5.4.16]

8.4.5.4.17 UL FCS Pointing Channels

FPCH_Alloc_IE() is introduced to reserve the uplink FPCH (Fast cell switching Pointing Channel) region. In that region, each user in FCS environment can be assigned a user-specific codeword from BS.

Table xx-FPCH Alloc IE format

Syntax	Size	Notes
FPCH_Alloc_IE() {		
Extended UIUC	4 bits	FPCH = 0x05
Length	4 bits	
OFDMA symbol offset	8 bits	
Subchannel offset	7 bits	
No. OFDMA symbols	4 bits	
No. subchannels	4 bits	
}		

The uplink FPCH provides uplink feedback of preferred BS/sector. This channel shall only be supported by SS supporting fast cell switching. The SS transmits the assigned codeword over the FPCH to preferred BS/sector. One UL FPCH occupies half subchannel, which is 3 pieces of 3x3 uplink tile in the case of optional PUSC or 3 pieces of 4x3 uplink tile in the case of PUSC. Each UL FPCH can carry 8 codewords. Table yy defines the mapping between the codeword number and the subcarrier modulation in FPCH.

Table yy – FPCH subcarrier modulation

Codeword number	Vector indices per Tile Tile(0), Tile(1), … , Tile(5)
0	0, 0, 0, 0, 0, 0
1	1, 1, 1, 1, 1, 1
2	2, 2, 2, 2, 2, 2
3	3, 3, 3, 3, 3, 3
4	4, 4, 4, 4, 4, 4
5	5, 5, 5, 5, 5, 5
6	6, 6, 6, 6, 6, 6
7	7, 7, 7, 7, 7, 7

The UL FPCH is orthogonally modulated with QPSK symbols. Let $M_{n,8m+k}$ ($0 \le k \le 7$) be the modulation symbol index of the k-th modulation symbol in the m-th uplink tile of the n-th UL FPCH. The possible modulation patterns composed of $M_{n,8m}$, $M_{n,8m+1}$, … , $M_{n,8m+7}$ in the m-th tile of the n-th UL FPCH are defined in Table aa.

Table aa—Orthogonal Modulation Index in UL FPCH

Vector index	$M_{n,8m}$, $M_{n,8m+1}$, …, $M_{n,8m+7}$

0	P0, P1, P2, P3, P0, P1, P2, P3
1	P0, P3, P2, P1, P0, P3, P2, P1
2	P0, P0, P1, P1, P2, P2, P3, P3
3	P0, P0, P3, P3, P2, P2, P1, P1
4	P0, P0, P0, P0, P0, P0, P0, P0
5	P0, P2, P0, P2, P0, P2, P0, P2
6	P0, P2, P0, P2, P2, P0, P2, P0
7	P0, P2, P2, P0, P2, P0, P0, P2

Where

$P0 = \exp(j \cdot \frac{\pi}{4}),$

$P1 = \exp(j \cdot \frac{3\pi}{4}),$

$P2 = \exp(-j \cdot \frac{3\pi}{4}),$

$P3 = \exp(-j \cdot \frac{\pi}{4})$.

$M_{n,8m+k}$ is mapped to UL FPCH tile as shown in Figure bb1 for PUSC uplink subchannel and in Figure bb2 for optional PUSC uplink subchannel. An UL FPCH is mapped to one subchannel composed of 6 tiles.

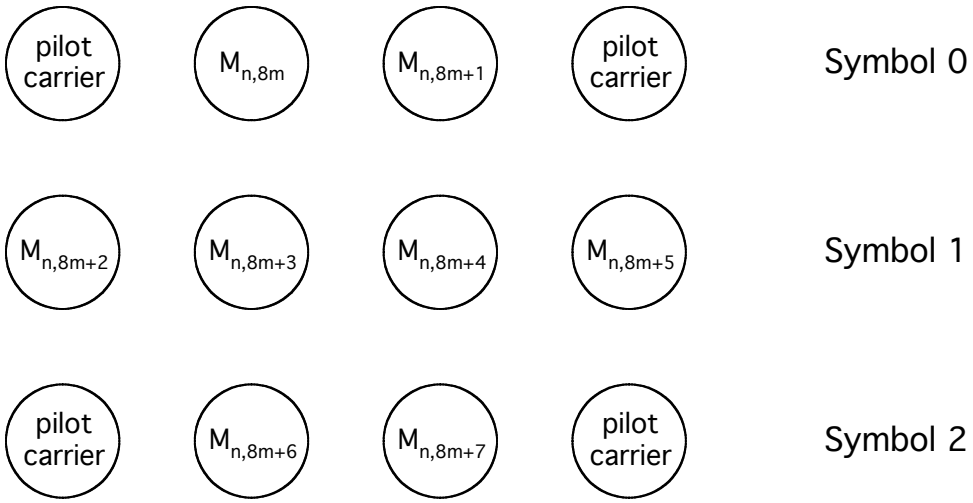

Figure bb1—Subcarrier Mapping of UL FPCH Modulation Symbols for PUSC

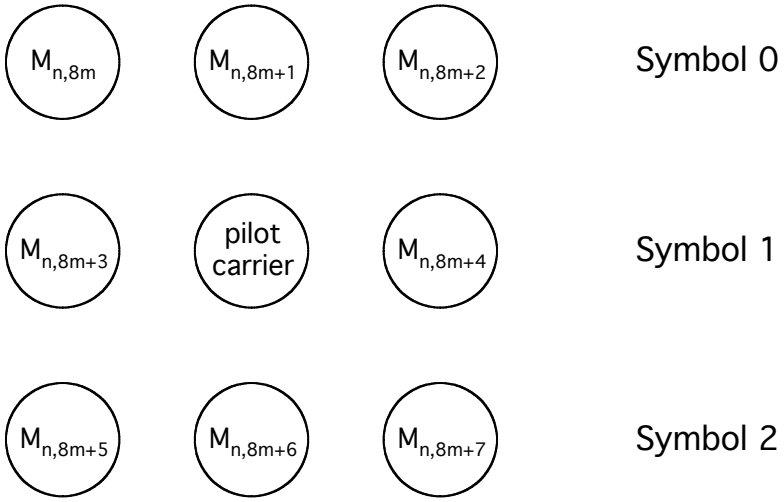

Figure bb2—Subcarrier Mapping of UL FPCH Modulation Symbols for Optional PUSC

Reference

[1] *Fast BS Switching Handover*, Mary Chion, Jing Wang