Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**	
Title	Soft Handover and Fast BS Switching Procedure	
Date Submitted	**2004-07-08**	
Source(s)	Hang Zhang, Mo-Han Fong, Jianglei Ma, Peiying Zhu, Wen Tong Nortel Networks	mhfong@nortelnetworks.com
	Itzik Kitroser, Yigal Leiba, Yossi Segal, Zion Hadad Runcom Technologies	itzikk@runcom.co.il
	Sohyun Kim, Changhoi Koo, Jaewon Cho, Seung Joo Maeng, Myung-Kwang Byun, Jungwon Kim Samsung Electronics	binde.kim@samsung
	Mary Chion, Jing Wang ZTE	mchion@ztesandiego.com
	Min-Sung Kim KT	cyberk@kt.co.kr
	Donnie Dongkie Lee SK Telecom	galahad@nate.com
Re:	IEEE P802.16e/D3-2004	
Abstract	In this contribution, the soft handover and fast BS switching mechanism is proposed	
Purpose	Review and Adopt the suggested changes into P802.16e/D3	
Notice	This document has been prepared to assist IEEE 802.16. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) reserve(s) the right to add, amend or withdraw material contained herein.	
Release	The contributor grants a free, irrevocable license to the IEEE to incorporate material contained in this contribution, and any modifications thereof, in the creation of an IEEE Standards publication; to copyright in the IEEE's name any IEEE Standards publication even though it may include portions of this contribution; and at the IEEE's sole discretion to permit others to reproduce in whole or in part the resulting IEEE Standards publication. The contributor also acknowledges and accepts that this contribution may be made public by IEEE 802.16.	
Patent Policy and Procedures	The contributor is familiar with the IEEE 802.16 Patent Policy and Procedures <http://ieee802.org/16/ipr/patents/policy.html>, including the statement "IEEE standards may include the known use of patent(s), including patent applications, provided the IEEE receives assurance from the patent holder or applicant with respect to patents essential for compliance with both mandatory and optional portions of the standard." Early disclosure to the Working Group of patent information that might be relevant to the standard is essential to reduce the possibility for delays in the development process and increase the likelihood	

1 Introduction

In this contribution, two HO solutions are introduced, namely soft handover and Fast Base Station Switching Handover. Both solutions are aimed to provide diversity gain which is important in increasing the cell coverage as well as increasing the QoS offering at the cell edge.

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.

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.

2 Overview of Proposed Solutions

There are several conditions that are required to enable soft handover and or Fast BS Switching handover between MSS and a group of BSs. These conditions are listed below:

- The BSs involving in SHO/FBSS HO are synchronized based on a common time source;
- The frames sent by the BSs involving in SHO/FBSS HO at a given frame time arrive at the MSS within the prefix interval
- BSs involving in SHO/FBSS HO have synchronized frame structure
- BSs involving in SHO/FBSS HO have level 3 context transfer or sharing
- BSs involving in SHO/FBSS HO have the same frequency assignment
- BSs involving in SHO shall use the same set of CIDs for the connections that are established with the MSS.

SHO further requires the following conditions:

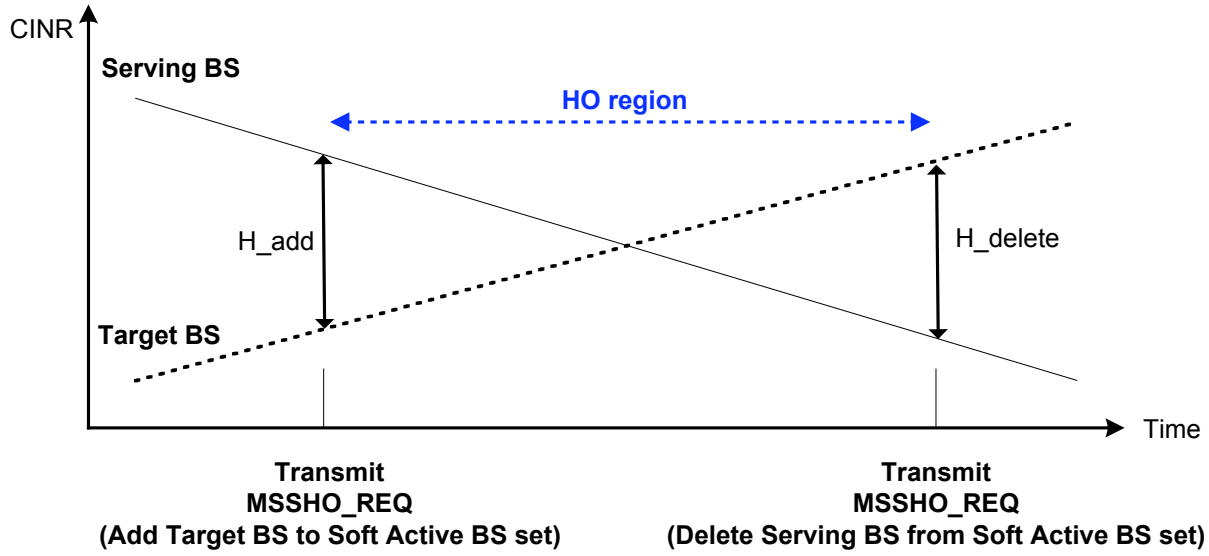
- The same MAC/PHY PDUs shall be multicast by the BSs involving in SHO to the MSS

Before a detail description can be made for SHO/FBSS HO, a few definitions need to be made:

- ~~*Serving*~~ *Active BS*: An active ~~serving~~ BS ~~is a BS that has~~ may allocate~~d~~ resources to the MSS, i.e. assigned Basic CID, Primary Management CID, Secondary Management CID and data CIDs to the MSS. An ~~serving~~ active BS is informed of the MSS' capabilities, security parameters, service flows and full MAC context information. ~~MSS should keep synchronization with a serving BS at all times~~. For SHO, the MSS transmit/receive data to/from all ~~serving~~ active BS in the Active Set.
- *Target BS*: A target BS is a BS that the MSS is intended to HO to. Once the HO process is successfully completed, a target BS becomes an anchor or active ~~serving~~ BS.
- *Anchor BS*: Anchor BS should allocate resources to the MSS, i.e. assigned Basic CID, Primary Management CID, Secondary Management CID and data CIDs to the MSS. The MSS shall keep synchronization with the Anchor BS at all times. The MSS shall perform ranging with only the Anchor BS. For FBSS HO, an Anchor BS is the serving BS that is designated to transmit/receive data to/from the MSS at a given frame. For SHO, The MSS monitors the anchor BS for DL control information, i.e. DL_MAP, UL_MAP, FCH, and DL broadcast messages.

- *Active Set*: The active set contains a list of ~~serving~~ active BSs to the MSS. The active set is managed by the MSS and BS.

Similar call flow, procedures and HO messages exchange as defined in IEEE802.16e/D3 can be used for setting up the Active Set and Anchor BS for SHO/FBSS. Some modifications are required on the existing messages.



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.

If the CINR margin between the Anchor BS and a BS in the Active Set is larger than H_delete, the MSS shall request to remove the BS from the Active Set as shown in Figure 1 by sending the MOB-MSSHO-REQ.

The MOB-BSHO-RSP message is modified to indicate the recommended Active Set members based on the MOB-MSSHO-REQ request. In the MOB-BSHO-RSP message, a 3-bit temporary BS ID (TEMP_BS_ID) is assigned to each member BS of the recommended Active Set. This TEMP_BS_ID is used by the MSS and the BS to uniquely identify a BS within the Active Set. The use of TEMP_BS_ID will significantly reduce the overhead compared to the 48-bit BS_ID and allow the MSS uses Anchor BS Report channel to report the preferred Anchor BS. The MOB-HO-IND message shall also be modified to enable a MSS to indicate its final Active Set decision.

The BS can initiate an update of the Active Set by sending MOB-BSHO-REQ message, which needs to be modified to include the recommended Active Set member and assign the TEMP_BS_ID to each of the member. The MOB-MSSHO-RSP also needs to be modified to include the recommended Active Set member.

The MSS monitors the downlink preamble of all serving BSs in the active set and updates its preferred Anchor BS based on received CINR from all serving BS. An Anchor BS Report channel is defined and is used by the MSS to report its preferred Anchor BS. The Anchor BS can change from frame to frame depending on the BS selection scheme. The MSS is informed of the switching of Anchor BS through three possible methods:

- The MSS is required to process DL_MAP and UL_MAP from all serving BSs at each frame and determines which serving BS is the Anchor BS for the current frame;
- ~~The MSS is required to process DL/UL_MAP from the current Anchor BS. The current Anchor BS sends a Anchor BS switch information element to command the MSS to switch to the new target Anchor BS.~~
- As an alternative approach, the BS may inform the MSS of the new Anchor BS through MOB_BSHO_REQ message.

Since the FBSS HO and SHO shares a common MAC HO call flow procedures and maintain the same MAC parameters such as active set and anchor BS, the MSS can be involved in either FBSS HO or SHO without explicit knowledge of which type of HO is performed. On both the MAC and PHY layer, the difference of FBSS HO and SHO is transparent to the MSS. Hence, a hybrid of FBSS HO and SHO is possible for the BS to carry out. For a MSS, the BS can perform SHO on a connections by multicasting DL traffic over all serving BSs in the active set for that connection while perform FBSS HO on an different connection by sending DL traffic through the anchor BS. As an example, SHO can be performed for management connections identified by Basic/Primary Management/Secondary Management CID and delay sensitive service flow. FBSS HO can be performed for connections that carry delay less sensitive service flow for the same MSS.

3 Proposed Text Changes

3.1 HO Message Modification

[Modify the MSS HO Request (MOB-MSSHO-REQ) message, to indicate the list of recommended BSs for FBSS/SHO and provide the necessary CINR information of those BS and to add BS remove mechanism from the Active Set]

6.3.2.3.55 MSS HO Request (MOB-MSSHO-REQ) message

[…]

Table 92i- MOB-MSSHO-REQ message Format

Syntax	Size	Notes
MOB-MSSHO-REQ_Message_Format() {		
Management Message Type = 53	8 bits	
N_new_BSs	3 bits	Number of new BSs which are recommended by the MSS
For (i= 0; i < N_new_BSs; i++) {		
Neighbor 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 BS HO Response (MOB_BSHO-RSP) message, to indicate the list of recommended BSs for FBSS/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 request 001: SHO/FBSS request: Anchor BS update with CID update 010: SHO/FBSS request: Anchor BS update without CID update 011: SHO/FBSS request: Active Set update with CID update 100: SHO/FBSS request: Active Set update without CID update 101~111: 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 SHO, N_CIDs shall be set to zero.
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
}		
Action time	8 bits	Recommended action time when the Active Set shall be updated
Reserved	Variable	As required
HMAC tuple	21 bytes	
}		

[*Modify the HO indication (MOB-HO-IND) message, to indicate the decided list of BSs for FBSS/SHO*]

6.3.2.3.57 HO Indication (MOB-HO-IND) message

[…]

Table 92k- MOB-HO-IND Message Format

Syntax	**Size**	**Notes**
MOB-HO-IND_Message_Format () {		
Management Message Type = 56	8 bits	
Reserved	5 bits	
Mode	2 bits	00: HO request 01: SHO/FBSS request: Anchor BS update 10: SHO/FBSS request: Active Set update 11: reserved
if (Mode == 00) {		
HO_IND_Type	2 bits	00: serving BS release 01: HO cancel 10: HO reject 11: reserved
Target_BS_ID	48 bits	
}		
else if (Mode == 01) {		
SHOFBSS_IND_Type	2 bits	00: confirm Anchor BS update 01: Anchor BS update cancel 10: Anchor BS update reject 11: reserved
If (SHOFBSS_IND_Type == 00) {		
Anchor BS ID	3 bits	TEMP_BS_ID of the Anchor BS

Action_time	8 bits	Action time when the Anchor BS shall be updated
}		
}		
if (Mode == 10) {		
SHOFBSS_IND_Type	2 bits	00: confirms Active Set update 01: Active Set update cancel 10: Active set update reject 11: reserved
if (SHOFBSS_IND_Type == 00) {		
Active Set Included Indicator	1 bit	1: Final decision of Active Set members included in the message 0: Active Set members are as specified in MOB_xxHO_RSP message. No Active Set information included in this message.
if (Active Set Included Indicator == 1) {		
Anchor BS ID	3 bits	TEMP_BS_ID of the Anchor BS
N_BS	3 bits	Number of BS in the Active Set, excluding the Anchor BS
for (i = 0; i < N_BS; i++) {		
TEMP_BS_ID	3 bits	Active Set member ID assigned
}		
}		
Action_time	8 bits	Action time when the Active Set shall be updated
}		
}		
HMAC tuple	21 bytes	
}		

[*Modify the BS HO Request (MOB-BFBSS-REQ) message, to indicate the list of recommended BSs for FBSS/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/FBSS request: Anchor BS update with CID update 010: SHO/FBSS request: Anchor BS update without CID update 011: SHO/FBSS request: Active Set update with CID update 100: SHO/FBSS request: Active Set update without CID update 101~111: 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 SHO, N_CIDs shall be set to zero.
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
}		
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	
}		

[*Modify the MSS HO Response (MOB-MSFBSS-RSP) message, to indicate the list of recommended BSs for FBSS and provide the necessary CINR information of those BS*]

6.3.2.3.xx MSS HO Response (MOB-MSSHO-RSP) message

[…]

Table xx- MOB-MSSHO-RSP message Format

Syntax	Size	Notes
MOB-MSSHO-RSP_Message_Format() {		
Management Message Type = 59	8 bits	
Mode	2 bits	01: SHO/FBSS request: Anchor BS update 10: SHO/FBSS request: Active Set update 11: reserved
if (Mode == 01) {		
TEMP_BS_ID	3 bits	TEMP_BS_ID of the recommended Anchor BS
BS CINR mean	8 bits	
Estimated action time	8 bits	Estimated action time when the Anchor BS is updated
}		
Else if (Mode == 10) {		
Anchor_BS ID	3 bit	TEMP_BS_ID of the recommended Anchor BS
Anchor BS CINR mean	8 bits	
N_BS	3 bits	Number of BSs excluding the Anchor BS, in the recommended Active Set
for (i= 0; i < N BSs; i++) {		
TEMP_BS_ID	3 bits	
BS CINR mean	8 bits	
}		
Estimated action time	8 bits	Estimated action time when the Active Set is updated
}		
Reserved	Variable	As required
HMAC tuple	21 bytes	
}		

3.2 Additional Text changes

[*Add the following text to section 6.3.20.2, page 47, line 11*]

In addition to the above procedures, when working in a SHO or FBSS mode, the MSS shall perform the following stages:

- SHO Decision - A SHO begins with a decision for an MSS to transmit to and receive from multiple BSs at the same time interval. A SHO can be triggered by either MOB_MSSHO_REQ or MOB_BSHO_REQ messages.
- FBSS HO Decision - A FBSS handover begins with a decision for an MSS to monitor and be synchronized with multiple BSs at the same time while transmits/receives from the Anchor BS. A FBSS handover can be triggered by either MOB_MSSHO_REQ or MOB_BSHO_REQ messages.

- Active Set Selection/Update – An MSS is required to scan the neighbor BS and selects BSs that are suitable to be included in the active set. The MSS shall report the selected BSs and the active set update procedure shall be performed by the BS and the MSS.
- Active Set selection/update– MSS shall scan the neighbors BSs and shall find the BSs which are suitable to work with in the SHO process
- Anchor BS Selection/Update – An MSS is required to continuously monitor the signal strength of the BSs that are included in the active set. The MSS shall select one BS from its current Active Set to be the Anchor BS and reports the selected Anchor BS ~~on the Anchor BS Report channel~~.

[*Add a section 6.3.20.2.6*]

6.3.20.2.6. SHO and FBSS Decision and Initiation

While in SHO or FBSS, the MSS and the BS shall maintain a list of BSs that are involved in SHO or FBSS with the MSS. The list is called the Active Set. Among the BSs in the Active Set, an Anchor BS is defined. ~~The MSS shall synchronize with all BSs in the Active Set~~ When operating in FBSS, the MSS only communicates with the Anchor BS for UL and DL unicast messages and traffic. When operating in SHO, the MSS communicates with all BSs in the Active Set for UL and DL unicast messages and traffic.

There are two methods for the MSS to monitor DL control information (i.e. DL-MAP, UL-MAP and FCH) and DL broadcast messages. The first method is the MSS monitors only the Anchor BS for DL control information and DL broadcast messages. The second method is the MSS monitors all the BSs in the Active Set for DL control information and DL broadcast messages. The method to be used by MSS is defined during the SBC-REQ and SBC-RSP handshake.

When an Active Set and an Anchor BS are maintained at the MSS and the BS, the BS can decide to put the MSS in either SHO or FBSS on a per burst allocation basis, based on ~~factor~~ such as QoS of a particular service flow being transmitted. A SHO begins with a decision for an MSS to transmit/receive unicast messages and traffic from multiple BSs at the same time interval. For DL SHO, two or more BSs provide synchronized transmission of MSS downlink data such that diversity combining can be performed by the MSS. For UL SHO, the transmission from a MSS is received by multiple BSs such that selection diversity ~~combining~~ of the information received by multiple BSs can be performed. A FBSS begins with a decision for an MSS to transmit/receive unicast messages and traffic from only the Anchor BS.

The BS supporting SHO or FBSS shall broadcast the DCD message that includes the H_Add Threshold and H_Delete Threshold. These thresholds are used by the FBSS/SHO capable MSS to determine if MOB-MSSHO-REQ should be sent. When long-term CINR of a serving BS is less than H_Delete Threshold, the MSS shall send MOB_MSSHO_REQ to requires dropping this serving BS from the active set; when long-term CINR of a neighbor BS is higher than H_Add Threshold, the MSS shall send MOB_MSSHO_REQ to require adding this neighbor BS to the active set.

The decision to update the Active Set or Anchor BS begins with a notification by the MSS through the MOB-MSSHO-REQ MAC management message or by the BS through the MOB-BSHO-REQ management message. Acknowledgement with MOB-BSHO-RSP of a notification is required, but one with MOB-MSSHO-RSP is recommended by not required.

If an MSS that transmitted a MOB-MSSHO-REQ message detects an incoming MOB-BSHO-REQ message, it may respond with a MOB-MSSHO-RSP message and ignore its own request. Similarly, a BS that transmitted a MOB-BSHO-REQ message shall ignore any MOB-MSSHO-REQ messages from the same MSS and shall await a MOB-MSSHO-RSP message or MOB-HO-IND message, or retry the MOB-BSHO-REQ message.

The BSs involving in SHO with a MSS shall use the same set of CIDs for the connections that are established with the MSS. BS may assign a new set of CIDs to the MSS during Active Set update through MOB-BSHO-REQ message and MOB-BSHO-RSP message.

6.3.20.2.6.1 Active Set Update

When MOB-MSSHO-REQ is sent by an MSS, the MSS may indicate possible list of BSs to be included in the MSS' Active Set. The MSS may evaluate the possible list of BSs through the received MOB-NBR-ADV MAC management message, and previously performed signal strength measurement, propagation delay measurement, scanning, ranging, and association activity. When MOB-BSHO-RSP is sent by the Serving BS or BSs in the MSS' current Active Set, the BSs may indicate the recommended list of BSs to be included in the MSS' Active Set.

When MOB-BSHO-REQ is sent by the Serving BS or BSs in the MSS' current Active Set, the BSs may indicate the recommended list of BSs to be included in the MSS' Active Set. The BSs criteria for the recommendation may include factors such as expected recommended BSs QoS performance to MSS requirements and list of BSs that can be involved in SHO/FBSS as broadcast in MOB-NBR-ADV. When MOB-MSSHO-RSP is sent by the MSS, the MSS may indicate the recommended list of BSs to be included in the MSS' Active Set. The MSS criteria for the recommendation may include factors such as previously performed signal strength measurement, propagation delay measurement, scanning, ranging, and association activity.

MSS actual pursuit of handover with the Active Set BSs listed in MOB_xxxHO-RSP is recommended, but not required. However, the actual Active Set chosen by the MSS shall be a subset of those listed in MOB_xxxHO-RSP and shall be indicated in MOB-HO-IND, with SHOFBSS_IND_type field in MOB-HO-IND set to '00'(confirm Active Set update). The MSS may reject the SHO/FBSS instruction by the BS, by setting the SHOFBSS_IND_type field in MOB-HO-IND to '10' (Active Set update reject). The BS may reconfigure the Active Set BSs list and retransmit MOB-BSHO-RSP message to the MSS.

After an MSS or BS has initiated an Active Set update using MOB-MSSHO/BSHO-REQ, the MSS may cancel the Active Set update at any time. The cancellation shall be made through transmission of a MOB-HO-IND with SHOFBSS_IND_type field set to '01'.

If the MSS is operating in SHO or FBSS, when adding a new BS to the MSS' Active Set, the network entry procedures as depicted in Figure 130h are not required and shall not be performed by the MSS. If the MSS is operating in FBSS, when adding a new BS to the MSS' Active Set, the MSS may optionally perform ranging but shall not perform the rest of the procedures in Figure 130h, namely, synchronize and obtain parameters with new DL and UL; perform re-authorization, re-register/re-establish service flows, and re-establish IP connectivity.

6.3.20.2.6.2 Anchor BS Update

There are two mechanisms for the MSS to report the preferred Anchor BS. The first mechanism is by using the HO MAC management message, i.e. MOB-MSSHO-REQ message. The second mechanism is by using the fast Anchor BS selection feedback mechanism as defined in Section 6.3.20.2.6.2.1.~~The MSS reports its preferred anchor BS via the Anchor BS Report (ABSR) channel periodically. The ABSR channel is a fast feedback channel assigned by the BS.~~ The preferred Anchor BSs shall be within the current Active Set of the MSS. The MSS may select the preferred Anchor BS through the previously performed signal strength measurement. The BS decides the target Anchor BS based on the MSS report.

There are two methods used by the BS to inform the MSS of the new Anchor BS. The first method is using DL/UL-MAP. . ~~If the MSS monitors only the Anchor BS for DL/UL-MAP, the Anchor BS shall send a Anchor_BS_Switch_IE() to the MSS to indicate the target Anchor BS. If the MSS monitors the DL/UL-MAP from all BSs in the Active Set, the MSS is informed of the target Anchor BS based on receiving a unicast DL/UL-MAP from that BS.~~ If the MSS monitors the DL/UL-MAP from all BSs in the Active Set as defined in the capability exchange (Section 11.7.10.2), the MSS shall decode DL/UL traffic corresponding to the DL/UL-MAP received from the BS(s). The BS may explicitly command the MSS to switch to a new Anchor BS. If the MSS does not receive any explicit command, i.e. MOB-BSHO-REQ/RSP, to switch to a new Anchor BS, the MSS may autonomously select one of the BS in the Active Set as the Anchor BS based on factors such as signal strength measurement. If the MSS monitors only DL/UL-MAP from one BS as defined in the capability exchange (Section 11.7.10.2), the MSS shall monitor the DL/UL-MAP from the the BS which it regards as its anchor BS.

The second method is using MAC management message. The BS informs the MSS of the Anchor BS update through MOB-BSHO-REQ or MOB-BSHO-RSP message with the estimated switching time. The MSS shall update its Anchor BS based on the information received in MOB-BSHO-REQ or MOB-BSHO-RSP. The MSS also shall indicate its acceptance of the new anchor BS through MOB-HO-IND, with SHOFBSS_IND_type field set to "00". The MSS may reject the Anchor BS update instruction by the BS, by setting the SHOFBSS_IND_type field in MOB-HO-IND to '10' (Anchor BS update reject). The BS may reconfigure the Anchor BS list and retransmit MOB-BSHO-RSP or MOB-BSHO-REQ message to the MSS. After an MSS or BS has initiated an Anchor BS update using MOB-MSSHO/BSHO-REQ, the MSS may cancel Anchor BS update at any time. The cancellation shall be made through transmission of a MOB-HO-IND with SHOFBSS_IND_type field set to '01'

When switching to a new Anchor BS within the MSS' Active Set, the network entry procedures as depicted in Figure 130h are not required and shall not be performed by the MSS.

6.3.20.2.6.2.1 ~~ABSR Channel Operation~~ Fast Anchor BS Selection Feedback Mechanism

The MSS can transmit fast Anchor BS selection information to the BS using the fast Anchor BS selection feedback channel.

~~When a SS is in SHO or FBSS with an active set larger than 1, the Anchor BS shall allocate a ABSR channel to the SS. The SS monitors the DL preamble from all the BSs in the Active Set and reports its preferred Anchor BS via ABSR channel. The preferred Anchor BS is identified by TEMP_BS_ID assigned to the BSs in an Active Set.~~

~~One option for ABSR channel is to use the fast feedback channel as defined in 8.4.5.4.10. In this approach the reporting format for the 4-bit payload is defined in 8.5.4.5.10.4. The ABSRCH_Alloc_IE() is used to allocate/de-allocate a ABSR channel to a SS. The allocation IE is defined in 8.4.5.4.15.~~
~~A second option for ABSR channel is to define a new dedicated UL physical channel to support fast Anchor BS selection feedbac.~~

~~[*Add a section 8.4.5.4.10.4*]~~

~~**8.4.5.4.10.4 Anchor BS Report Feedback**~~

~~When allocated by ABSRCH_Alloc_IE(), MSS in the optional SHO/FBSS HO procedure shall send its selection of the preferred Anchor BS to the current Anchor BS.~~

~~Table xxx—Encoding of BS numbering in Active Set~~

~~**Value**~~	~~**Description**~~
~~0b0000~~	~~BS #1 in Active Set~~
~~0b0001~~	~~BS #2 in Active Set~~
~~0b0002~~	~~BS #3 in Active Set~~
~~….~~	~~…..~~
~~0b0007~~	~~BS #7 in Active Set~~

~~In SHO/FBSS HO procedure, the MSS monitors the signal strength of the serving BSs every frame and choose it's preferred Anchor BS and send it to current Anchor BS through the assigned Fast-feedback channel. Table xxx shows the encoding of BS numbering in the Active Set. The BS in active set is identified by TEMP_BS_ID.~~

~~[*Add section8.4.5.4.15*]~~

~~**8.4.5.4.15 Anchor BS Report Channel Allocation IE**~~

~~The Anchor BS Report Channel Allocation IE is used by the BS to allocate/de-allocate a ABSR channel for a SS. The SS uses the allocated ABSR channel to transmit its preferred Anchor BS while in SHO or FBSS HO.~~

~~Table xxx–Anchor BS Report Channel Allocation IE~~

~~**Syntax**~~	~~**Size**~~	~~**Notes**~~
~~ABSRCH_Alloc_IE() () {~~		
~~——Extended UIUC~~	~~4 bits~~	~~ABSR-Channel = 0x06~~
~~——Length~~	~~4 bits~~	~~Length = 0x03~~
~~——Allocation offset~~	~~6 bits~~	~~Index to the fast-feedback channel region marked by UIUC = 0.~~

~~Period (p)~~	~~5 bits~~	~~Preferred Anchor BS is reported on the ABSR channel every p frames.~~
~~Frame offset~~	~~3 bits~~	~~The SS starts reporting at the frame of which the number has the same 3 LSB as the specified frame offset. If the current frame is specified, the SS should start reporting in 8 frames~~
~~Duration (d)~~	~~4 bits~~	~~Preferred Anchor BS is transmitted on the ABSR channels indexed 10 x d frames.~~ ~~If d == 0, the ABSRCH is deallocated.~~ ~~If d == 0b1111, the SS should report until the BS command for the SS to stop.~~
~~Reserved~~	~~6 bits~~	

[*Modify section 11.4.1*]

11.4.1 DCD channel encoding

Name	**Type**	**Length**	**Value (variable length)**	**PHY Scope**
Downlink_Burst_Profile	1		May appear more than once (see 6.3.2.3.1). The length is the number of bytes in the overall object, including embedded TLV items	All
BS EIRP	2	2	Signed in units of 1 dBM.	All
….	…..	….	…..	….
H-ARQ ACK delay for DL burst	17	1	1 = 1 frame offset 2 = 2 frame offset 3 = 3 frame offset	OFDMA
HO type support	18	1	Bit 0: Break before Make Bit 1: Make before Break Bit 2: Soft HO Bit 3: FBSS HO Bit 4-7: reserved	OFDMA
H_Add Threshold	19	1	Threshold used by the the MSS to add a neighbor BS to the active set. ~~When CINR of a neighbor BS is higher than H_Add Threshold,~~ When the the CINR of a neighbor BS is lower than the CINR of an anchor BS by less than H_Add , the MSS should send MOB_MSSHO_REQ to request adding this neighbor BS to the active set. This threshold is used for the MSS that is perform SHO/FBSS HO. It is in	OFDMA

			the unit of dB If the BS does not support FBSS HO/SHO, this value is not set.	
H_Delete Threshold	20	1	Threshold used by the MSS to drop a serving BS from the active set. ~~When CINR of a serving BS is less than H_Delete Threshold.~~ When the CINR of a serving BS is lower than the CINR of an anchor BS by more than H_Delete., the MSS should send MOB_MSSHO_REQ to request dropping this serving BS from the active set.This threshold is used for the MSS that is performing SHO/FBSS HO. It is in the unit of dB. If the BS does not support FBSS HO/SHO, this value is not set.	OFDMA

[*Add a section 11.7.10.2*]

11.7.10.2 Handoff supported

This field indicates what type(s) of HO the BS and the MSS supports. A bit value of 0 indicates "not supported" while 1 indicates it is supported.

Type	Length	Value	Scope
19	1	Bit #0: SHO/FBSS HO - Single-BS MAP Supported Bit #1: SHO/FBSS HO – Multi-BS MAP Supported Bit #2 - #7: reserved, shall be set to zero	SBC_REQ SBC_RSP

~~*[Add section 8.4.5.4.16]*~~

~~8.4.5.4.16 Anchor_BS_Switch_IE~~

~~The Anchor_BS_switch_IE is sent by a BS to indicate to one or more MSS(s) to switch to a new specified Anchor BS.~~

~~Table xx. Anchor_switching_IE format~~

~~Syntax~~	~~Size~~	~~Notes~~

Anchor_BS switch_IE() {	-	-
Extended DIUC	4 bits	AS = 0x07
Length	4 bits	Length of the message in bytes
N_Anchor_BS_switch	4 bits	Number of Anchor BS switching indicated in this IE
for (i = 0; i< N_Anchor_BS_switch; i++) {	-	-
CID	16 bit	Basic CID of a MSS whose anchor BS switching is indicated in this IE
TEMP_BS_ID	3 bits	TEMP_BS_ID of the anchor BS to switch to. (TEMP_BS_ID is the assigned ID to the BS when it was added to the active set of a MSS)
CQICH Allocation Indicator	1 bit	To indicate if CQICH allocation at the new Anchor BS is included in this IE.
If (CQICH Allocation Indicator == 1) {		
CQICH_ID	Variable	Index to uniquely identify he CQICH resource assigned to the MSS after the MSS switched to the new anchor BS
Feedback channel offset	6 bits	Index to the fast feedback channel region of the new Anchor BS marked by UIUC
Period (=p)	2 bits	A CQI feedback is transmitted on the CQICH every 2p frames.
Frame offset	3 bits	The SS starts reporting at the frame of which the number has the same 3 LSB as the specified frame offset. If the current frame is specified, the SS should start reporting in 8 frames
Duration (=d)	3 bits	A CQI feedback is transmitted on the CQI channels indexed by the CQICH_ID for 10 x 2^d frames. If d == 0, the CQI-CH is de-allocated. If d == 111, the SS should report until the BS command for the SS to stop.
MIMO_permutation_feedback_cycle	2 bits	00 = No MIMO and permutation mode feedback 01 = the MIMO and permutation mode indication shall be transmitted on the CQICH indexed by the CQICH_ID every 4 frames. The first indication is sent on the 8th CQICH frame. 10 = the MIMO mode and permultation mode indication shall be transmitted on the

		CQICH indexed by the CQICH_ID every 8 frames. The first indication is sent on the 8th CQICH frame. 11 = the MIMO mode and permultation mode indication shall be transmitted on the CQICH indexed by the CQICH_ID every 16 frames. The first indication is sent on the 16th CQICH frame.
}		
ABSRCH Alloc Indicator	1 bit	To indicate if ABSCH allocation at the new Anchor BS is included in this IE
If (ABSRCH Alloc Indicator == 1) {		
Allocation offset	6 bits	Index to the fast feedback channel region marked by UIUC = 0
Period (p)	5 bits	Preferred Anchor BS is reported on the ABSR channel every p frames
Frame offset	3 bits	The SS starts reporting at the frame of which the number has the same 3 LSB as the specified frame offset. If the current frame is specified, the SS should start reporting in 8 frames.
Duration (d)	4 bits	Preferred Anchor BS is transmitted on the ABSR channels indexed 10xd frames. If d == 0, the ABSRCH is deallocated If d ==0b1111, the SS should report until the BS command for the SS to stop
}		
}		
}		

[Add the following call flows to Appendix E]

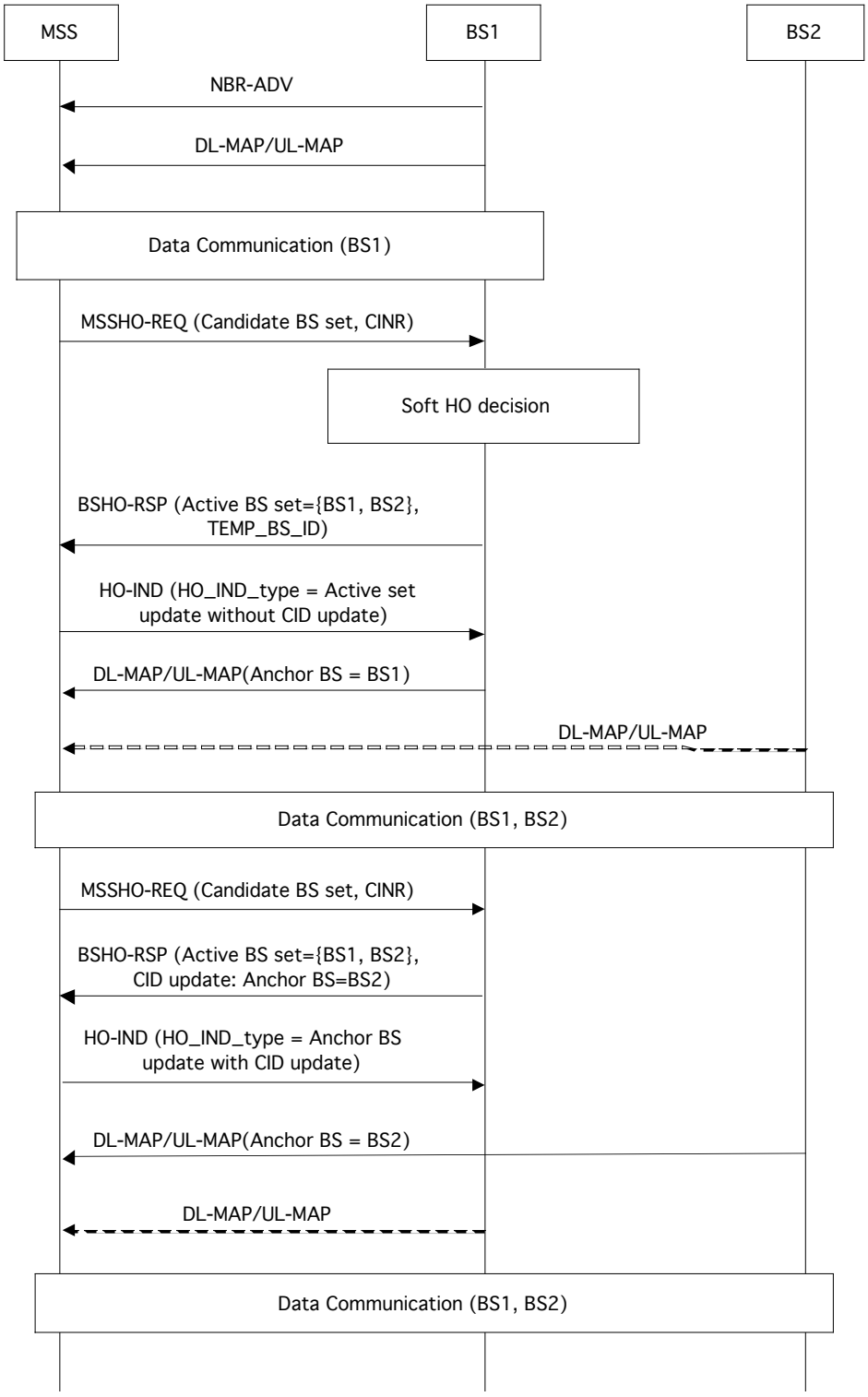


Figure E.12—Example Soft HO (Active BS set Update: Add)

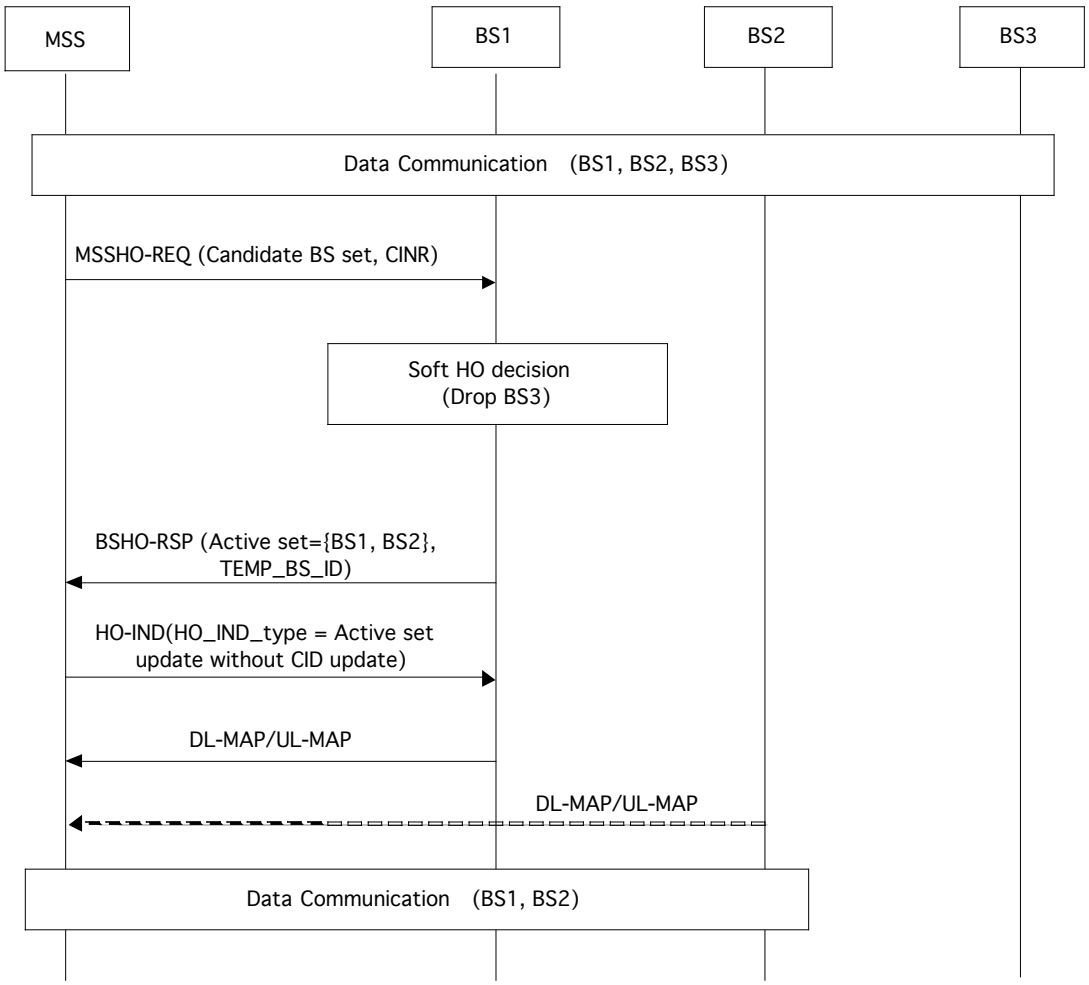


Figure E.13—Example Soft HO (Active BS set Update: Drop)

~~**Figure E.14—Example FBSS HO (Active BS set Update: Add)**~~