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| Title | **Fast Anchor BS Switching Feedback Report Mechanism and Sleep Mode Support for SHO and FBSS** |
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| Re: | IEEE P802.16e/D4-2004 |
| Abstract | In this contribution, the fast Anchor BS switching feedback mechanism and sleep mode support for SHO/FBSS are proposed. The revision is highlighted in 'green' |
| Purpose | Review and Adopt the suggested changes into P802.16e/D4 |
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# 1 Introduction

In this contribution, we propose an anchor BS switching reporting mechanism in SHO and FBSS using CQICH. After the session #33, the number of information bits that can be carried over a CQICH has been increased from 4 to 5 or 6 bits. Hence, using the increased available codewords of CQICH, the anchor BS switching report can be made without making a separate physical layer control channel.

# 2 Overview of Proposed Anchor Switching Reporting Algorithm

The proposed algorithm is composed of three components. The first one is that requesting an anchor switch would be accomplished through the MSS' CQICH. The second is that the time axis is slotted to prevent ping pong HOs and to synchronize the anchor switch event. The third is the procedure that the MSS should perform when it fails to switch its anchor using the fast feedback channel.

## 2.1 Anchor Switch Report using CQICH

When an MSS in a SHO/FBSS zone finds out that it needs to switch its anchor BS, it reports the desired anchor BS through its CQICH allocated by the serving anchor BS. In D4, the optional enchanced FAST_FEEDBACK channel has 64 codewords. With 32 codewords used for CQI report and 7 codewords reserved for mode selection feedback, and remaining 25 codewords can be used for other purpose. In this contribution, 9 codewords from the remaining 25 codewords are used for SHO/FBSS handoff, in which 8 codewords for anchor BS reporting and one codeword for acknowledgement.

## 2.2 Slotting Time Axis and Call Flow

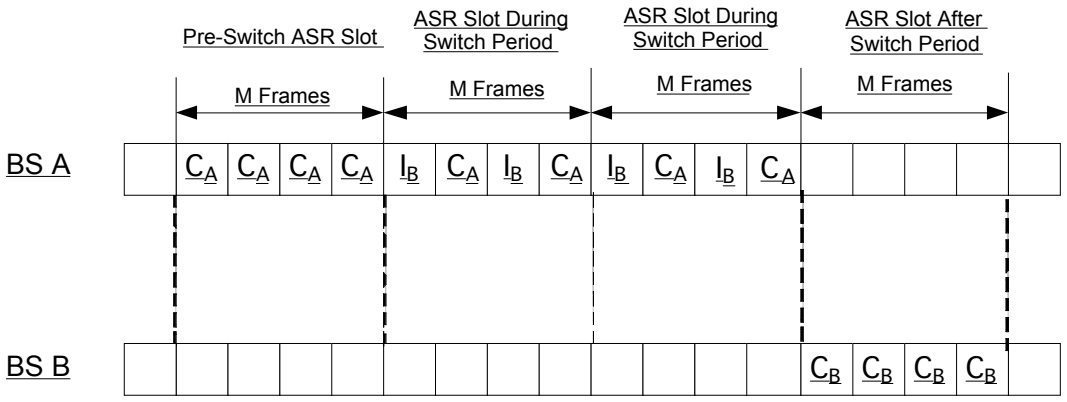
As mentioned above, to prevent from faulty operations due to the inexistence of the time reference, the MSS and the network should have a time reference. In addition, the anchor BS should not be switched in the middle of H-ARQ retransmission or during backhaul context transfer between the current and the new Anchor BS. Hence, two things should be provided; the first one is a time reference, and the second one is that a switching period is introduced whose duration is long enough that the transmission of H-ARQ encoded packet and backhaul context transfer can be completed. To accomplish the first goal, the time axis is slotted by an ASR (Anchor Switch Reporting) slot which is M frame long. If the current frame number is N, then the ASR slot number would be the integer quotient of N divided by M. An ASR slot shall start at the frame where frame number modulus M equals to zero. M shall be configured by DCD. To achieve the second goal, we introduce a switching period which is L ASR slots, where L is configured by DCD.

The following figure shows how the MSS requests the anchor switch. In the first ASR slot, the MSS detects the channel from BS B is better than BS A. However, for the purpose of synchronization, the MSS postpones the transmission of anchor BS switch indicator until the beginning of the next ASR slot.

At the start of the second ASR slot, the MSS shall start a switching timer with value equals to the switching period. Starting from the second ASR slot and for the subsequent ASR slots prior to the expiry of the switching timer, the MSS shall transmit the anchor switch indicator through CQICH allocated by the current Anchor BS (BS A) and the anchor BS may send the Anchor_Switch_IE prior to the expiry of the switching timer to do one of the following: 1) acknowledge the MSS' switch indication and/or assign a CQICH at the new Anchor BS (BS B), and/or specify a new action time when the switch shall occur, and/or specify a new anchor BS to switch to; 2) cancel the MSS switching event. If the MSS does not receive an Anchor_BS_switch_IE prior to the expiry of the switching timer, the MSS shall switch to the new Anchor BS after the expiry of the switching timer. If the MSS receives an Anchor_BS_Switch_IE prior to the expiry of the switching timer with no cancellation and no new action time specified, the MSS shall switch to the new Anchor BS after the expiry of the switching timer. If the MSS receives an Anchor_BS_Switch_IE prior to the expiry of the switching timer with new action time specified, the MSS shall switch to the new Anchor BS at the action time specified. If the MSS receives an Anchor_BS_Switch_IE with cancellation prior to the expiry of the switching timer, the MSS shall cancel the switching operation. If the MSS successfully decodes the Anchor_BS_Switch_IE, it shall confirm the reception of the IE using the allocated codeword over the CQICH. Prior to the expiry of the switching timer, the MSS shall report CQI of BS A and anchor switch indication on alternate frames. Prior to the expiry of the switching timer, if the MSS has intention to cancel the switching due to factor such as the signal strength of BS B is no longer higher than that of BS A by a certain threshold,

the MSS shall continue to indicate BS B in the CQICH during the switching period. However, the MSS can initiate the cancellation of the anchor BS switch by the following way, if and only if no Anchor_BS Switch_IE with cancellation flag disabled is received prior to the expiry of the switching timer. In such case, after the expiry of the switching timer, the MSS shall stay with BS A and shall transmit the CQI on the same CQICH allocated by BS A in the same fashion as prior to the switch operation starts. ~~the codeword indicating BS A at the first frame in the next ASR slot to let the current anchor BS know that it cancels the anchor switch. In addition, BS A shall check if the MSS stays with BS A to cancel the anchor switch at the next ASR slot.~~ On the BS side, after the expiry of the switching timer, the BS A shall continue to monitor the same CQICH allocated to the MSS for an implementation dependent duration. If CQI transmission is detected, the BS A shall assume that the MSS has cancelled the switch. The MSS shall not initiate cancellation of the switch if Anchor_BS_Switch_IE with cancellation flag disabled is received prior to the expiry of the switching timer.

If no cancellation occurs, after the expiry of the switching timer, the MSS shall switch to BS B and monitor the downlink of BS B. If the BS B has already pre-allocated a CQICH to the MSS (this can be done using MOB-BSHO-RSP or Anchor_Switch_IE), the MSS reports the CQI using the allocated CQICH and may begin the normal communication with BS B starting from the first frame after the expiry of the switching timer. If CQICH is not pre-allocated to the MSS prior to the switch, the MSS shall monitor the MAP from BS B and waits for the CQICH allocation after the switch. If after the switch, the MSS does not receive a CQICH allocation within duration equals to the switching period, the MSS may start the HO network re-entry with BS B. The following figure shows an example where the switching timer is equals to 2 ASR slots.




## 2.3 CQICH Allocation for New Anchor/Active BS

There are three CQICH allocation options for a new anchor BS or newly added active BSs. The first one is that the CQICHs for newly added active BSs are pre-allocated using MOB_BSHO_RSP message while the BSs are added to the active set (1st ASR slot or before in the above figure). The second one is that CQICH for the target anchor BS is allocated in the switching period (in the 2nd or 3rd slot in the above figure) through Anchor_Switch_IE. The third one is that CQICH for a new anchor BS is allocated immediately after the switching period (in the 4th ASR slot in the above figure) using its MAP message.

The first allocation method has the advantage of the highest reliability of CQICH allocation, but also has the disadvantage of the more overhead since the CQICH is pre-allocated. The second and third methods would have smaller overhead but also suffer from lower reliability compared with the first one. If the anchor BS indicator from the MSS or the anchor switch IE from the serving anchor BS is received erroneously and the MSS is mandated to stay at BS A until the confirmation is obtained, then MSS should stay at BS A indefinitely, which results in the increase of BS switching latency. The third method has still less overhead but also has some delay in link adaptation as well as reliability problem before data transmission.

# 3 Proposed Text Changes

## 3.1 HO Message Modification

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

6.3.2.3.51 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<br>001: SHO/FBSS request: Anchor BS update with CID update<br>010: SHO/FBSS request: Anchor BS update without CID update<br>011: SHO/FBSS request: Active Set update with CID update<br>100: SHO/FBSS request: Active Set update without CID update<br>101: SHO/FBSS request: Active Set update with CID update for newly added BS<br>110: SHO/FBSS request: Active Set update with CID update and CQICH allocation for newly added BS<br>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 |

| | | |
|---|---|---|
| | | 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 |
| } | | |
| 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 |
| N_CIDs | 8 bits | Number of CIDs needed to be reassigned |
| 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 | |
| for (j= 0;j<N_CIDs;j++) { | | |
| New CID for BS_i | 16 bits | New CID to be used for new BS_i |
| } | | |
| } | | |
| 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 |
| } | | |
| TEMP_BS_ID_Anchor | 3 bits | Temp BS ID for Anchor BS |
| } | | |
| 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 |
| N_CIDs | 8 bits | Number of CIDs needed to be reassigned |
| 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 | |
| for (j= 0;j<N_CIDs;j++) { | | |

| | | |
|---|---|---|
| New CID for BS_i | 16 bits | New CID to be used for new BS_i |
| } | | |
| 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 2^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) | 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<br><br>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.<br><br>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.<br><br>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 |
| } | | |
| 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 |
| } | | |
| 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 | |
| } | | |

***New CID*** - New CIDs are enumerated by the ascending order of corresponding current CIDs. The MSS shall store the CIDs associated with the newly added BS and using the CIDs when the newly added BS becomes the anchor BS.
[*Modify the BS HO Response (MOB_BSHO-RSP) message, to indicate the list of recommended BSs for FBSS/SHO*]

6.3.2.3.53 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<br>001: SHO/FBSS request: Anchor BS update with CID update<br>010: SHO/FBSS request: Anchor BS update without CID update<br>011: SHO/FBSS request: Active Set update with CID update<br>100: SHO/FBSS request: Active Set update without CID update<br>101: SHO/FBSS request: Active Set update with CID update for newly added BS<br>110: SHO/FBSS request: Active Set update with CID update and CQICH allocation for newly added BS<br>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 |

| | | |
|---|---|---|
| } | | |
| 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 |
| N_CIDs | 8 bits | Number of CIDs needed to be reassigned |
| 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 | |
| for (j= 0;j<N_CIDs;j++) { | | |
| New CID for BS_i | 16 bits | New CID to be used for new BS_i |
| } | | |
| } | | |
| 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 |
| } | | |
| TEMP_BS_ID_Anchor | 3 bits | Temp BS ID for Anchor BS |
| } | | |
| 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 |
| N_CIDs | 8 bits | Number of CIDs needed to be reassigned |
| 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 | |
| for (j= 0;j<N_CIDs;j++) { | | |
| New CID for BS_i | 16 bits | New CID to be used for new BS_i |
| } | | |
| 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=0 |
| Period (=p) | 2 bits | A CQI feedback is transmitted on the CQICH every 2^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) | 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<br><br>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.<br><br>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.<br><br>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 |
| } | | |
| 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 |
| } | | |
| 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 | |
| } | | |

***New CID*** - New CIDs are enumerated by the ascending order of corresponding current CIDs. The MSS shall store the CIDs associated with the newly added BS and using the CIDs when the newly added BS becomes the anchor BS.

## 3.2 Additional Text changes

[*Add the following text to section 6.3.20.2, page 70, line 19*]

- Active Set Selection/Update – An MSS is required to scan the neighbor BS and select 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.
- 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 CQICH or MOB-MSSHO-REQ message.

[*Modify a section 6.3.20.2.6.2, page 76*]

### 6.3.20.2.6.2 Anchor BS Update

There are two mechanisms for the MSS and BS to perform Anchor BS update ~~to report the preferred Anchor BS~~. The first mechanism is by using the HO MAC management message~~s, 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 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 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.~~

For t~~T~~he ~~second~~ method ~~is~~ using MAC management message~~.~~, the MSS reports the preferred Anchor BS by using the MOB-MSSHO-REQ 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.

[*Modify a section 6.3.20.2.6.2.1, page 77*]

#### 6.3.20.2.6.2.1 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 the MSS has more than one BS in its active set, the MSS shall transmit fast Anchor BS selection information to the current Anchor BS using FAST_FEEDBACK channel. If the MSS needs to transmit Anchor BS selection information, it transmits the codeword corresponding to the selected Anchor BS via its FAST_FEEDBACK channel. The codeword is identified by TEMP_BS_ID assigned to the BSs in an active set.
FAST_FEEDBACK_channel shall be allocated by one of the following three methods:

1. Pre-allocated by MOB-BSHO-RSP or MOB-BSHO-REQ when a BS is added to the active set.
2. Allocated through Anchor_Switch_IE during anchor switching operation.
3. Allocated by UL_MAP of the new anchor BS after the switching period.

For FBSS operation, the time axis is slotted by an ASR (Anchor Switch Reporting) slot which is M frame long. If the current frame number is N, then the ASR slot number shall be the integer quotient of N divided by M. The ASR slot shall start at the frame where frame number modulus M equals to zero. M shall be configured by the DCD. A switching period is introduced whose duration is equals to L ASR slots. L shall be configured by the DCD to be long enough such that certain process (e.g. H-ARQ transmission, backhaul context transfer) can be completed at the current anchor BS before the MSS switches to the new anchor BS.

The switching operation for L = 2 is illustrated in figure xxx. In the first ASR slot, the MSS detects the signal strength from a BS in the active set (e.g. BS B) is better than that of the current anchor BS (e.g. BS A) such that a switch to the new anchor BS is desired. The MSS transmits the anchor BS switch indicator at the beginning of the next ASR slot. At the start of the second ASR slot, the MSS shall start a switching timer with value equals to the switching period. Starting from the second ASR slot and for the subsequent ASR slots prior to the expiry of the switching timer, the MSS shall transmit the anchor switch indicator through CQICH allocated by the current Anchor BS (e.g. BS A).

The current anchor BS may send the Anchor_Switch_IE prior to the expiry of the switching timer to do one of the following: 1) acknowledge the MSS' switch indication and/or assign a CQICH at the new Anchor BS (BS B), and/or specify a new action time when the switch shall occur, and/or specify a new anchor BS to switch to; 2) cancel the MSS switching event. If the MSS does not receive an Anchor_BS_switch_IE prior to the expiry of the switching timer, the MSS shall switch to the new Anchor BS after the expiry of the switching timer. If the MSS receives an Anchor_BS_Switch_IE prior to the expiry of the switching timer with no cancellation and no new action time specified, the MSS shall switch to the new Anchor BS after the expiry of the switching timer. If the MSS receives an Anchor_BS_Switch_IE prior to the expiry of the switching timer with new action time specified, the MSS shall switch to the new Anchor BS at the action time specified. If the MSS receives an Anchor_BS_Switch_IE with cancellation prior to the expiry of the switching timer, the MSS shall cancel the switching operation. If the MSS successfully decodes an Anchor_BS_Switch_IE, the MSS shall acknowledge the reception of the IE using the allocated codeword over the CQICH.

Prior to the expiry of the switching timer, the MSS shall report CQI of the current anchor BS (e.g. BS A) and anchor switch indication on alternate frames. If the MSS started the switching operation by indicating a BS within the active set (e.g. BS B) as the new anchor BS, the MSS shall not indicate another new anchor BS prior to the expiry of the switching timer. Prior to the expiry of the switching timer, if the MSS has intention to cancel the switching due to factor such as the signal strength of the new anchor BS (e.g. BS B) is no longer higher than that of the current anchor BS (e.g. BS A) by a certain threshold, the MSS shall continue to indicate BS B in the CQICH during the switching period. However, the MSS can initiate the cancellation of the anchor BS switch by the following way, if and only if no Anchor_BS Switch_IE with cancellation flag disabled is received prior to the expiry of the switching timer. In such case, after the expiry of the switching timer, the MSS shall stay with BS A and shall transmit the CQI on the same CQICH allocated by BS A in the same fashion as prior to the switch operation starts. ~~the codeword indicating BS A at the first frame in the next ASR slot to let the original anchor BS (e.g. BS A) know that it cancels the anchor switch. In addition, the original anchor BS (e.g. BS A) shall check if the MSS stays with BS A to cancel the anchor switch at the next ASR slot.~~ On the BS side, after the expiry of the switching timer, the BS A shall continue to monitor the same CQICH allocated to the MSS for an implementation dependent duration. If CQI transmission is detected, the BS A shall assume that the MSS has cancelled the switch. The MSS shall not initiate cancellation of the switch if Anchor_BS_Switch_IE with cancellation flag disabled is received prior to the expiry of the switching timer.

If no cancellation occurs, after the expiry of the switching timer, the MSS shall switch to the new anchor BS (e.g. BS B) and monitor the downlink of BS B. If the BS B has already pre-allocated a CQICH to the MSS (this can be done using MOB-BSHO-RSP or Anchor_Switch_IE), the MSS reports the CQI using the allocated CQICH and may begin the normal communication with the new anchor BS (e.g. BS B) starting from the first frame after the expiry of the switching timer. If CQICH is not pre-allocated to the MSS prior to the switch, the MSS shall monitor the MAP from the new anchor BS (e.g. BS B) and waits for the CQICH allocation after the switch. If after the switch, the MSS does not receive a CQICH allocation within duration equals to the switching period, the MSS may start the HO network re-entry with the new anchor BS (e.g. BS B).

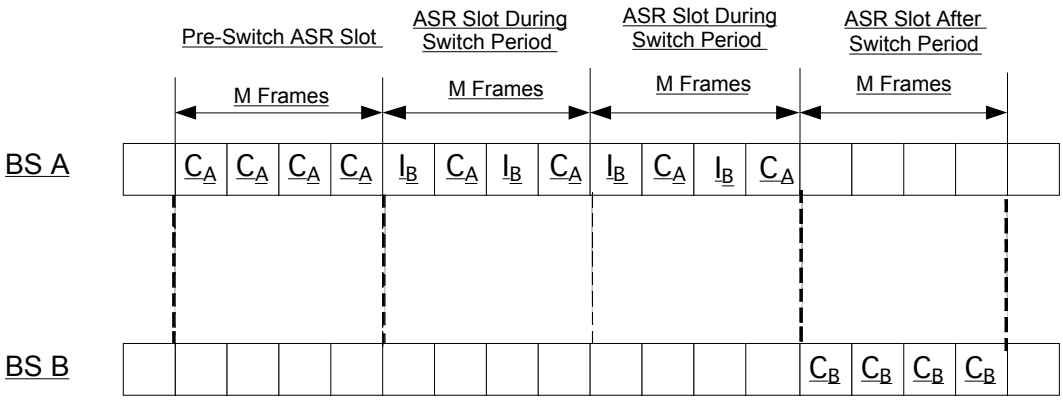



Figure xx. Fast Anchor BS Selection mechanism

[*Modify a section 8.4.5.4.10.3, page 133, line 41*]

### 8.4.5.4.10.7 Mode Selection Feedback for enhanced FAST_FEEDBACK channel

[…]

**Table 296e—Encoding of payload bits for Fast-feedback slot with 6 bit payload**

| Value | Description |
|---|---|
| ~~0b100000~~ 0b101000 | STTD and PUSC/FUSC permutation |
| ~~0b100001~~ 0b101001 | STTD and adjacent-subcarrier permutation |
| ~~0b100010~~ 0b101010 | SM and PUSC/FUSC permutation |
| ~~0b100011~~ 0b101011 | SM and adjacent-subcarrier permutation |
| ~~0b100100~~ 0b101100 | Hybrid and PUSC/FUSC permutation |
| ~~0b100101~~ 0b101101 | Hybrid and adjacent-subcarrier permutation |
| ~~0b100110~~ 0b101110 | Beamforming and adjacent-subcarrier permutation |
| ~~0b100111~~ 0b101111 – 0b111111 | Reserved |

[*Add the following section in page 133, line 60*]

**8.4.5.4.10.8 Anchor BS Report**

The SS may send its Anchor BS selection using the 8 codewords numbered from 32 to 39. Table 296f shows the encoding of payload bits for the FAST_FEEDBACK slot (see 8.4.5.4.9).

**Table 296f—Encoding of payload bits for Fast-feedback slot**

| Value | Description |
|---|---|
| 0b100000 | Anchor BS for TEMP_BS_ID=000 |
| 0b100001 | Anchor BS for TEMP_BS_ID=001 |
| 0b100010 | Anchor BS for TEMP_BS_ID=010 |
| 0b100011 | Anchor BS for TEMP_BS_ID=011 |
| 0b100100 | Anchor BS for TEMP_BS_ID=100 |
| 0b100101 | Anchor BS for TEMP_BS_ID=101 |
| 0b100110 | Anchor BS for TEMP_BS_ID=110 |
| 0b100111 | Anchor BS for TEMP_BS_ID=111 |

Also, 40th codeword, i.e., 0b101000 is used as an acknowledgement for Anchor_BS_Switch_IE.

[*Add the following section in page 143, line 12*]

### 8.4.5.4.21 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 at specific action time, or to cancel the switch. The Anchor_BS_switch_IE can also be used to allocate CQICH at the new Anchor BS.

**Table 300i - Anchor_BS_switch_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 bits | Basic CID of a MSS whose anchor BS switching is indicated in this IE |
| Action code | 2 bits | 00 – The MSS shall switch to the Anchor BS specified in the fast Anchor BS selection information in the FAST FEEDBACK channel, at the default time specified by the switching period defined in the DCD.<br>01 – The MSS shall switch to the Anchor BS specified in this IE and at the action time specified in this IE. |

| | | |
|---|---|---|
| | | 10 – The MSS shall cancel all anchor switching procedure, stop switching timer and remain on the current anchor BS;<br>11 – reserved |
| If (Action code == 01) { | | |
| Action time (A) | 3 bits | In units of frames.<br><br>000 means the MSS shall switch at the default time specified by the switching period defined in the DCD |
| 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) |
| } | | |
| If ( Action code == 00 \|\| Action code == 01 ) | | |
| { | | |
| CQICH Alloction 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=0 |
| Period (=p) | 2 bits | A CQI feedback is transmitted on the CQICH every 2^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) | 3 bits | A CQI feedback is transmitted on the CQI channels indexed by the CQICH_ID for 10 x 2^d frames.<br>If d ==0, the CQI-CH is de-allocated.<br>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<br><br>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.<br><br>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. |
| } | | |
| } | | |
| } | | |

*[Add the following TLV parameter in 11.4.1]*

**11.4.1 DCD channel encoding**

| Name | Type | Length | Value (variable length) | PHY Scope |
|---|---|---|---|---|
| ASR(Anchor Switch Report) Slot Length (M) and Switching Period (L) | ?? | 1 | ~~Unit in the number of frames~~<br>Bit #0 - #3: M, in units of frames<br>Bit #4 - #7: L, in units of ASR slots | OFDMA |
| ~~Switching Period in FBSS (L)~~ | ~~??~~ | ~~1~~ | ~~Unit in the number of ASR slots~~ | ~~OFDMA~~ |

*[Modify the following TLV parameter in 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~~SHO/FBSS HO not supported when it is set to "1". When this bit is set to "1", the BS shall ignore all other bits.<br>Bit 1: ~~SHO/FBSS HO - Multi BS MAP Supported~~ FBSS/SHO DL RF combining supported with monintoring single MAP from anchor BS when this bit is set to "1"<br>~~Bit #2 - #7: reserved, shall be set to zero~~<br>Bit 2: FBSS/SHO DL RF Combining supported with monitoring MAPs | ~~SBC~~REG_REQ<br>~~SBC~~REG_RSP |

| | | | |
|---|---|---|---|
| | | from all active BS when this bit is set to "1"<br>Bit 3: SHO DL soft Combining supported with monintoring single MAP from anchor BS when this bit is set to "1".<br>Bit 4: SHO DL soft combining supported with monitoring MAPs from all active BS when this bit is set to "1"<br>Bit 5: FBSS/SHO UL single transmission<br>Bit 6: SHO UL Multiple transmission<br>Bit #7: reserved, shall be set to zero | |

## 3.3 Additional Text changes for SLEEP Mode FBSS/SHO Operation

*[Add a new paragraph in Section 6.3.2.3.45]*

[……]

If an MSS enters sleep mode after receiving a MOB-SLP-RSP message with Maintain Active Set and Anchor BS ID flag set to 1, the MSS shall maintain the Active set and Anchor BS ID for the SHO/FBSS duration specified in the MOB-SLP-RSP message. Before the SHO/FBSS duration expires, the MSS may continue to monitor the signal strength of neighbor BS and ~~shall~~ initiate transition into normal mode to perform Active Set update procedure (defined in Section 6.3.20.2.6.1) and Anchor BS update procedure (defined in Section 6.3.20.2.6.2). The MSS may also decide to perform normal HO to a target BS by initiating transition back to normal mode.

*[Modify Table 106b – Sleep-Response (MOB-SLP-RSP) message format]*

**Table 106b– Sleep-Response (MOB-SLP-RSP) message format**

| Syntax | Size | Notes |
|---|---|---|
| MOB-SLP-RSP_Message_Format() { | | |
| Management Message Type = 46 | 8 bits | |
| Sleep-approved | 1 bit | 0: Sleep-mode request denied<br>1: Sleep-mode request approved |
| If (Sleep-approved == 0 ) { | | |
| After-REQ-action | 1 bit | 0: The MSS may retransmit the MOB-SLP-REQ message after the time duration (REQ-duration)given by the BS in this message<br>1: The MSS shall not retransmit the MOB-SLP-REQ message and shall await the MOB-SLP-RSP message from the BS |
| REQ-duration | 4 bits | Waiting value for MOB-SLP-REQ message retransmission (measured in MAC frames) |
| Reserved | 2 bits | |
| } | | |
| Else { | | |
| If (SHO or FBSS capability enabled) { | | if SHO or FBSS capability is enabled in the REG~~SBC~~-REQ/RSP message exchange |
| Maintain Active Set and Anchor BS ID | 1 bit | 1: Active set and Anchor BS ID is maintained while in sleep mode for SHO/FBSS duration<br>0: Active set and Anchor BS ID is not maintained while in sleep mode |
| If (Active Set and Anchor BS ID maintained) { | | |
| SHO/FBSS duration (s) | 3 bits | Active set and Anchor BS ID is maintained for 10x2^s frames after entering sleep mode |
| } | | |
| } | | |
| Start frame | 6 bits | |
| Initial-sleep window | 6 bits | |
| Final-sleep window | 10 bits | |
| Listening interval | 4 bits | |
| Final-sleep window exponent | 3 bits | |
| SLPID | 10 bits | |
| } | | |
| Reserved | Variable | To ensure octet-aligned |
| } | | |