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Re:	Call for inputs for commentary of p802.16e/D1
Abstract	This contribution describes Enhanced Handover Mechanism for supporting Active BS Set in IEEE P802.16e/D1-2004.
Purpose	Discuss and Adopt enhanced feature of p802.16e/D1
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Enhanced Handover Mechanism for supporting Active BS Set in IEEE P802.16e/D1-2004

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1. Introduction

In the handover scheme according to the current IEEE P802.16e/D1-2004, there are two major disadvantages because of the absence of a concept of active BS set.

- Too long handover break-time

Although the current IEEE P802.16e/D1-2004 says that an MSS can perform a handover to another BS using fast network re-entry procedure, the network re-entry procedure is still long and slow due to heavy message exchanges (ranging, capability negotiation, re-authorization, registration). During this network re-entry, all service flows should be interrupted, which may cause large packet losses and service degradations to real-time applications.

- Incapability of fast cell switching

A ping-pong effect that an MSS may repetitively perform network re-entry with two BSs due to rapid back and forth movement between them is detrimental and therefore should be mitigated with fast cell switching. This approach cannot be adopted into the current IEEE P802.16e/D1-2004 because the draft makes an old Serving BS to discard the context associated with an MSS after its network re-entry with a new Target BS.

To address these problems, this contribution introduces the concept of active BS set and presents the enhanced handover procedures.

In general, service flows of an MSS may be added, changed, or deleted easily. But, when an MSS has been associated with a set of active BSs, it may become another story. In such a case, the manipulations of service flows of an MSS should be done simultaneously at each active BS for consistency of context such as service flow parameters, security association, MSS capabilities, and so on. Therefore, an MSS that has more than two active BSs needs additional procedures to manipulate service flows in active BSs other than the current serving BS. In result, the number of service flows for an MSS in one active BS is always preserved to be equal to that of another active BS.

2. Proposed Enhanced Handover Mechanism

2.1 Concept of active BS set for enhanced handover

Figure1 shows how to manage the active BS set by procedures of ‘Combined addition and switch’, ‘Addition’, ‘Switch’, and ‘Removal’.

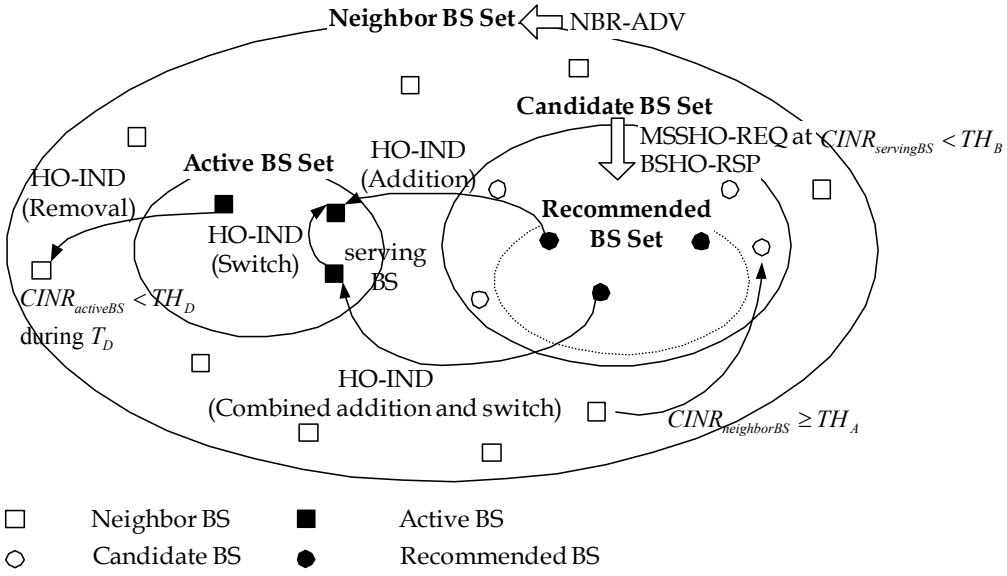

Figure 1 – Active BS set management

- Definitions
  - Neighbor BS set: This is defined as the set of neighbor BSs whose downlink/uplink channel descriptors are notified to the MSS through NBR-ADV from current Serving BS. The MSS can demodulate the downlink transmission from any neighbor BSs.

  - Candidate BS set: This is a subset of the neighbor BS set and includes the candidate BSs of which CINRs are above a predefined threshold (TH_A). In order to ask the Serving BS for handover, an MSS may send MSSHO-REQ message including each (BS ID, CINR) pair of all candidate BSs.

  - Recommended BS set: This is a subset of the candidate BS set and is notified to an MSS, which sent MSSHO-REQ message, through BSHO-RSP from the current Serving BS. A recommended BS can provide the MSS with some level of service.

  - Active BS set: This is defined as the set of BSs with which an MSS can skip all procedures except ranging process at network re-entry. The MSS will select one or more recommended BSs from which the MSS can expect good service, and will insert it or them into active BS set. The MSS can also remove one or more BSs from active BS set.

2.2 Dynamic service flow management in active BS Set

In this document we describe the procedures to add/change/delete a service flow when a certain MSS has multiple active BSs. The active BS denotes a BS that has "MSS service context" and need not network re-entry procedures except initial ranging when the MSS hand-over to the BS. An active BS set consist of one or more number of active BSs for an MSS.

2.2.1 Dynamic Service Addition

In Figure D.14, an example of service flow addition procedures in active BS set containing three active BSs is depicted. We assume that both MSS and BS know that the MSS has three active BSs. An MSS which has three active BSs (S-BS, A-BS1, and A-BS2) sends a DSA-REQ message to S-BS (Serving-BS) to add a

service flow in each active BS (Step ①). The S-BS sends a DSX-RVD message (Step ②) when it receives the DSA-REQ message and also sends an I-am-host-of message (Step ③) to notify other active BSs that the MSS is currently registered with the S-BS.

The active BSs that received the I-am-host-of message sends MSS-info-request message to request information about an MSS. The MSS-info-request message contains a number of MSS unique identifiers including the MSS identifier in the received I-am-host-of message. Note that the steps ③ and ④ can be omitted if we use an ***unsolicited*** EHC-MSS-info-response message. Several messages are already defined in an unsolicited fashion in current IEEE 802.16d/e documents.

The S-BS sends an EHC-MSS-info-response message (see Table C5a) to both A-BS1 and A-BS2 in response to the received MSS-info-request (Step ⑤). The EHC-MSS-info-response contains a number of NSIE (Network Service Information Element) and associated SFID (service flow ID) as well as PKM-, SBC-, and REG-related information. The SFID is added in this proposal to maintain consistency in the process of hand-over among active BSs. A connection of an MSS has the same SFID in active BS set whereas the CID (Connection ID) of the connection may be different to each other. Both A-BS1 and A-BS2 check if the MSS identifier in the received EHC-MSS-info-response corresponds to one of MSSs they perform as an active BS. If an active BS detects the MSS identifier corresponding to the MSS it serves as an active BS, it checks if the MSS information in the message is the same as the information they have for the MSS.

In the case of the Figure D.14 (dynamic service addition: DSA), the active BSs detect an additional NSIE. Thus each BS add a new service flow for the MSS and return parameters of the service flow to the S-BS via MSS-info-confirm message (Step ⑥). The MSS-info-confirm message is newly defined in this proposal to carry TLV encoded information as in DSA-RSP, DSC-RSP, DSD-RSP messages. The S-BS that received MSS-info-confirm messages from active BSs sends a DSA-RSP message to the MSS (Step ⑦). The existing DSA-RSP message is modified to contain DSA-related TLV parameters from every active BSs as shown in Table 3. As a final step, the MSS transmits a DSA-ACK message to the S-BS. The S-BS that received MSS-info-confirm messages from active BSs sends a DSA-RSP message to the MSS (Step ⑦). As a final step, the MSS transmits a DSA-ACK message to the S-BS.

Another example of service flow addition procedures in active BS set is depicted in Figure D15. The differences in the procedures shown in Figure D14 and Figure D15 are differentiated DSA-RSP messages in Figure D15. The DSA-RSP message should be received before timer T7 expires. Therefore the addition delay in transactions between S-BS and other active BSs (A-BS1 and A-BS2) will be a problem. We can solve this problem by using differentiated DSA-RSP message that compose of two messages DSA-RSP (for S-BS) and DSA-RSP (for other active BSs, A-BS1 & A-BS2). As shown in Figure D15, the S-BS sends DSA-RSP message for S-BS before the DSA-RSP message for other active BSs. The MSS sends DSA-ACK message for each corresponding DSA-RSP message.

2.2.2 Dynamic Service Change

In Figures D16 and D17, examples of service flow change procedures in active BS set containing three active BSs is depicted. The detail description on the figures is omitted because the procedures in Figures

D16 and D17 are similar to those in the Figures D14 and D15.

2.2.3 Dynamic Service Deletion

In Figure D18, an example of service flow deletion procedures in active BS set containing three active BSs is depicted. We assume that both MSS and BS know that the MSS has three active BSs. An MSS which has three active BSs sends a DSD-REQ message to S-BS to delete a service flow in each active BS (Step ①). The S-BS deletes the service flow denoted by SFID and sends a DSD-RSP message (Step ②). When the S-BS receives the DSA-REQ message, it also does the similar transactions as shown in Figure D14. However, in the case of the Figure D18 (dynamic service deletion: DSD), the active BSs detect an deleted NSIE. Thus each BS delete an existing service flow for the MSS and return results to the S-BS via MSS-info-confirm message (Step ⑥).

2.3 BS set management and enhanced handover procedures

2.3.1 Combined addition and switch

Compared with the existing procedure (HO_IND_type=Serving BS release), there is a little difference between them, but in our combined addition and switch procedure, the termination of service with the previous Serving BS shall not take place until the MSS requests to the previous Serving BS the termination via current Serving BS. In other words, the MSS maintains the active BS set containing the previous Serving BS and current Serving BS after the handover by 'combined addition and switch'.

2.3.2 Switch

Assuming that an MSS has its active BS set containing two or more active BSs, the MSS can quickly migrate from the air-interface provided by the current Serving BS to the air-interface provided by another active BS. The quick migration (so called switch) where the MSS can skip all procedures except ranging process at network re-entry with the active BS is possible because the active BS maintains the MSS service context.

The MSS can switch into the another active BS by sending/receiving SCN-REQ/RSP message to/from the current Serving BS, there is, however, two major limitations as follow: 1) the MSS should return to the Serving BS after scan duration; 2) the target active BS is not able to provide a non-contention based initial-ranging opportunity because it has no idea when the MSS enters. Thus, we re-use HO-IND MAC message, expanding the HO_IND_type of 2 bits into 8 bits and adding 'switch' type to the HO_IND_type. The MSS sends EHC-EHC-HO-IND(HO_IND_type=switch) MAC message to the current Serving BS, and the Serving BS should be able to notify the MSS' switch to the corresponding active BS. The active BS is required to provide fast ranging IE in order to support the quick migration.

2.3.3 Removal

An MSS which maintains the active BS set must periodically scan its active BSs. Based on the information obtained by the scanning, the MSS should be able to remove one or more BSs from its active BS set if their CINR is below the predefined threshold (TH_D). In this case, we also use EHC-HO-IND MAC message where HO_IND_type has new type 'Removal'.

Figure D18 depicts an example of MSS-initiated handover procedures by 'combined addition and switch', 'switch', and 'removal'. The ping-pong effect can be mitigated by the procedure of switch between active BSs. In figure D18, a new inter-base station message, HO-command, is introduced. This message is sent by Serving BS to notify target BS (or active BS) what a certain MSS intends to do. The primary use is to notify

target BS that the MSS will enter it. The target BS may provide fast ranging IE in UL-MAP for the MSS. The message may be sent upon switch of Serving BS and removal of active BS. The message contains the following information (tbd).

In addition to the above mitigation of ping-pong effect, a near-seamless handover to new target BS is needed. For the purpose, we introduce 'addition' procedure as follows.

2.3.4 Addition

After three way handshake of handover process, an MSS can add one or more BSs into its active BS set while maintaining the air-interface provided by current serving BS. In this procedure, some negotiations in network re-entry should be performed between new active BSs and the MSS through the intermediation of current serving BS. After sending MSSHO-REQ and receiving BSHO-RSP, the MSS sends to the current Serving BS EHC-HO-IND MAC message with new type of 'addition' as HO_IND_type. The EHC-HO-IND MAC message may include one or more new active BSs, and so we suggest the MAC message to be modified as follows in Table 85m. Receiving the EHC-HO-IND MAC message, the current Serving BS sends a new-defined inter-base station message, ABS-addition-request, to new active BS referenced in the EHC-HO-IND MAC message. The message is exactly same to the existing EHC-MSS-info-response message but the message type in global header. We suggest new message type in order to specifically express the MSS intention. If a new active BS received the ABS-addition-request, the active BS is required to send another new-defined inter-base station message, ABS-addition-response which contains the information in Table 2. Receiving the ABS-addition-response message from new active BS, the current Serving BS sends to the MSS a new-defined MAC management message, ABS-ADD which is constructed based on the information in the ABS-addition-response message (see Table 85o). The ABS-ADD MAC message shall be transmitted on the primary CID over the air-interface provided by the current Serving BS.

In Figure D19, an example of MSS-initiated handover procedures by 'addition', 'switch', and 'removal' is depicted.

2.4 Handover based on decisions made by the mobile user

It is also possible to adopt the following procedure to enhance the handoff procedure in the IEEE 802.16e. The neighboring set defined in Section 2.1 can be modified to include the QoS capabilities of the BSs in the set of neighbors advertised in the MOB_NBR_ADV message. On obtaining the MOB_SCN_RSP message from the BS, the mobile shall scan the neighboring set and use the CINR measurements and the QoS capabilities in the MOB_NBR_ADV message to compute the active set of BS and inform the serving BS of the active set of BS. The combined addition and switch procedure can be deployed to switch to the target BS and maintain the connection with the old serving BS to reduce handoff latency in the event of a ping-pong. The signaling messages for the combined add and switch for this type of handover is shown in Figure D20.

The add, switch and remove procedures are similar to those explained in Section 2.2 handover.

3. Proposed IE and MAC message

3.1 EHC-MOB_EHC-HO-IND message

- Newly proposed.
- If the system support active BS set the MSS sends this message to the serving BS in 802.16e-D1.

- This message have next information
  - HO_IND new type: Combined addition and switch , Switch , Removal, Addition

3.2 ABS-addition-response message

- Newly proposed
- If the system support active BS set the Active BS sends this message to serving BS in 802.16e-D1.
- The message is exactly same to the existing EHC-MSS-info-response message but the message type in global header.

3.3 ABS-ADD message

- Newly proposed
- If the system support active BS set the serving BS sends this message to MSS in 802.16e-D1.
- The serving BS sends this message to the MSS in order to response to MOB_ABS-addition-response message.

3.4 EHC-EHC-MSS-info-response message

- Newly proposed.
- If the system support active BS set the serving BS sends this message to active BS in 802.16e-D1.
- The Serving BS sends this message to Active BSs in response to the received MSS-info-request.
- This message have next information
  - SFID: maintain consistency in the process of hand-over among active BSs.

3.5 MSS-info-confirm message

- Newly proposed
- If the system support active BS set the active BS sends this message in 802.16e-D1.
- The Active BS sends this message to the serving BS after receiving EHC-MSS-info-response message.
- The MSS-info-confirm message is newly defined in this proposal to carry TLV encoded information as in DSA-RSP, DSC-RSP, DSD-RSP messages.

3.6 DSA-RSP message

- Add new parameter in DSA-RSP message.
- If the system support active BS set the serving BS sends this message instead of the DSA-RSP message in 802.16d.
- The serving BS sends this message to MSS in order to response to a received DSA-REQ.
  - Connection_info parameter
  - Connection_setting parpameter

3.7 DSC-RSP message

- Add new parameter in DSC-RSP message.
- If the system support active BS set the serving BS sends this message instead of the DSA-RSP message in 802.16d.

- The serving BS sends this message to MSS in order to response to a received DSC-REQ.
  - Connection_info parameter
  - Connection_setting parpameter

4. Text to be inserted to standard

1.4.1.2 MAC layer HO procedures

[Add the following to section 1.4.1.2.4:]

1.4.1.2.5 Enhanced handover mechanism for supporting Active BS set.

This mechanism may be used for enhanced handover procedure.
At enhanced handover mechanism for supporting active BS set, the MSS performs the steps as shown in Figure D14-D19.

We describe the procedures to add/change/delete a service flow when a certain MSS has multiple active BSs. The active BS denotes a BS that has "MSS service context" and need not network re-entry procedures except initial ranging when the MSS hand-over to the BS. Active BS set consist of one or more number of active BSs for an MSS.

In general, service flows of an MSS may be added, changed, or deleted easily. But, when an MSS has been associated with a set of active BSs, the manipulations of service flows of an MSS should be done simultaneously at each active BS for consistency of context such as service flow parameters, security association, MSS capabilities, and so on. Therefore, an MSS that has more than two active BSs needs additional procedures to manipulate service flows in active BSs other than the current serving BS. In result, the number of service flows for an MSS in one active BS is always preserved to be equal to that of another active BS.

After procedures of add/change/delete a service flow is finished the MSS can quickly migrate from the air-interface provided by the current Serving BS to the air-interface provided by another active BS such as combined addition and switch, addition, switch and removal.

1.4.1.2.5.1 Dynamic service flow management in active BS Set

1.4.1.2.5.1 .1 Dynamic Service Addition

An MSS sends a DSA-REQ message to Serving BS to add a service flow in each active BS. The Serving BS sends a DSX-RVD message when it receives the DSA-REQ message and also sends an I-am-host-of message to notify other active BSs that the MSS is currently registered with the S-BS.

The active BSs that received the I-am-host-of message sends EHC-MSS-info-request message to request information about an MSS. The EHC-MSS-info-request message contains a number of MSS unique identifiers including the MSS identifier in the received I-am-host-of message. We can use an ***unsolicited*** EHC-EHC-MSS-info-response message.

The Serving BS sends an EHC-MSS-info-response message (see Table C9) to Active BSs in response to the received MSS-info-request. The EHC-EHC-MSS-info-response contains a number of NSIE (Network Service Information Element) and associated SFID (service flow ID) as well as PKM-, SBC-, and REG-related information. The SFID is added to maintain consistency in the process of hand-over among active BSs. A connection of an MSS has the same SFID in active BS set whereas the CID (Connection ID) of the connection may be different to each other.

In the case of dynamic service addition, the active BSs detect an additional NSIE. Thus each active BS add a new service flow for the MSS and return parameters of the service flow to the serving BS via MSS-info-confirm message. The MSS-info-confirm message is newly defined to carry TLV encoded information as in DSA-RSP, DSC-RSP, DSD-RSP messages (see Table C9). The Serving BS that received MSS-info-confirm messages from active BSs sends a DSA-RSP message to the MSS. As a final step, the MSS transmits a DSA-ACK message to the Serving BS.

The DSA-RSP message should be received before timer T7 expires. Therefore the addition delay in transactions between Serving BS and other active BSs will be a problem. This problem can be solved by using differentiated DSA-RSP message that compose of two messages DSA-RSP for Serving BS and DSA-RSP for other active BSs. The Serving BS can sends DSA-RSP message for Serving BS before the DSA-RSP message for other active BSs. The MSS sends DSA-ACK message for each corresponding DSA-RSP message.

In Figure D.14, an example of service flow addition procedures in active BS set containing three active BSs is depicted.

1.4.1.2.5.1.2 Dynamic Service Change

The detail procedures of Dynamic Service Change are similar to the procedure of Dynamic Service Addition.

1.4.1.2.5.1.3 Dynamic Service Delete

An MSS sends a DSD-REQ message to Serving BS to delete a service flow in each active BS. The Serving BS deletes the service flow denoted by SFID and sends a DSD-RSP message. When the Serving BS receives the DSA-REQ message, it is similar to procedure of Dynamic Service Addition. However, the active BSs detect an deleted NSIE. Thus each BS delete an existing service flow for the MSS and return results to the Serving BS via MSS-info-confirm message.

1.4.1.2.5.2 BS set management and enhanced handover procedures

1.4.1.2.5.2.1 Combined addition and switch

Compared with the existing procedure (HO_IND_type=Serving BS release), there is a little difference between them, but in our combined addition and switch procedure, the termination of service with the previous Serving BS shall not take place until the MSS requests to the previous Serving BS the termination via current Serving BS. In other words, the MSS maintains the active BS set containing the previous Serving BS and current Serving BS after the handover by ‘combined addition and switch’.

1.4.1.2.5.2.2 Switch

Assuming that an MSS has its active BS set containing two or more active BSs, the MSS can quickly migrate from the air-interface provided by the current Serving BS to the air-interface provided by another active BS. The quick migration (so called switch) where the MSS can skip all procedures except ranging process at network re-entry with the active BS is possible because the active BS maintains the MSS service context.

The MSS can switch into the another active BS by sending/receiving SCN-REQ/RSP message to/from the current Serving BS, there is, however, two major limitations as follow: 1) the MSS should return to the Serving BS after scan duration; 2) the target active BS is not able to provide a non-contention based initial-ranging opportunity because it has no idea when the MSS enters. Thus, we enhance EHC-HO-IND MAC message, expanding the HO_IND_type of 2 bits into 8 bits and adding ‘switch’ type to the HO_IND_type. The MSS sends EHC-EHC-HO-IND(HO_IND_type=switch) MAC message to the current Serving BS, and the

Serving BS should be able to notify the MSS' switch to the corresponding active BS. The active BS is required to provide fast ranging IE in order to support the quick migration.

1.4.1.2.5.2.3 Removal

An MSS which maintains the active BS set must periodically scan its active BSs. Based on the information obtained by the scanning, the MSS should be able to remove one or more BSs from its active BS set if their CINR is below the predefined threshold (TH_D). In this case, we also use EHC-EHC-HO-IND MAC message where HO_IND_type has new type 'Removal'.

Figure D18 depicts an example of MSS-initiated handover procedures by 'combined addition and switch', 'switch', and 'removal'. The ping-pong effect can be mitigated by the procedure of switch between active BSs. In figure D18, a new inter-base station message, HO-command, is introduced. This message is sent by Serving BS to notify target BS (or active BS) what a certain MSS intends to do. The primary use is to notify target BS that the MSS will enter it. The target BS may provide fast ranging IE in UL-MAP for the MSS. The message may be sent upon switch of Serving BS and removal of active BS. The message contains the following information (tbd).

In addition to the above mitigation of ping-pong effect, a near-seamless handover to new target BS is needed. For the purpose, we introduce 'addition' procedure as follows.

1.4.1.2.5.2.4 Addition

After three way handshake of handover process, an MSS can add one or more BSs into its active BS set while maintaining the air-interface provided by current serving BS. In this procedure, some negotiations in network re-entry should be performed between new active BSs and the MSS through the intermediation of current serving BS. After sending MSSHO-REQ and receiving BSHO-RSP, the MSS sends to the current Serving BS EHC-EHC-HO-IND MAC message with new type of 'addition' as HO_IND_type. The EHC-EHC-HO-IND MAC message may include one or more new active BSs, and so we suggest the MAC message to be modified as follows in Table 85m. Receiving the EHC-EHC-HO-IND MAC message, the current Serving BS sends a new-defined inter-base station message, ABS-addition-request, to new active BS referenced in the EHC-EHC-HO-IND MAC message. The message is exactly same to the existing EHC-MSS-info-response message but the message type in global header. If a new active BS received the ABS-addition-request, the active BS is required to send another new-defined inter-base station message, Receiving the ABS-addition-response message from new active BS, the current Serving BS sends to the MSS a new-defined MAC management message, ABS-ADD which is constructed based on the information in the ABS-addition-response message (see Table 85o). The ABS-ADD MAC message shall be transmitted on the primary CID over the air-interface provided by the current Serving BS.

In Figure D19, an example of MSS-initiated handover procedures by 'addition', 'switch', and 'removal' is depicted.

3. Definitions

3.5 Base Station

[Add the follwoing text to section 3.5:]

3.5.1 Serving BS

For any mobile subscriber station (MSS), the Serving BS is the BS with which the MSS has recently performed registration at initial network-entry or during an HO.

3.5.2 Target BS

The BS that an MSS intends to be registered with at the end of a HO.

3.5.3 Neighbor BS

For any MSS, a neighbor BS is a BS whose downlink transmission can be demodulated by the MSS.

3.5.4 Neighbor BS Set

This is defined as the set of neighbor BSs whose downlink/uplink channel descriptors are notified to the MSS through NBR-ADV from current Serving BS

3.5.5 Candidate BS Set

This is defined as the set of neighbor BSs whose downlink/uplink channel descriptors are notified to the MSS through NBR-ADV from current Serving BS

3.5.6 Recommended BS Set

This is a subset of the candidate BS set and is notified to an MSS, which sent MSSHO-REQ message, through BSHO-RSP from the current Serving BS. A recommended BS can provide the MSS with some level of service.

3.5.7 Active BS set

This is defined as the set of BSs with which an MSS can skip all procedures except ranging process at network re-entry. The MSS will select one or more recommended BSs from which the MSS can expect good service, and will insert it or them into active BS set.

6.4.2.3.53 Enhanced HO Indication (MOB_EHC-EHC-HO-IND) message

If the system support active BS set the serving BS sends the message in Table 85m. Compared with the existing procedure (HO_IND_type=Serving BS release), there is a little difference between them, but in our combined addition and switch procedure. An MSS shall transmit a MOB_EHC-HO-IND message for final indication that it is about to perform a HO. We can use an ***unsolicited*** EHC-EHC-HO-IND message to add the new Active BS and switch to the new Active BS demanded by MSS.

Table 85m— MOB_EHC-EHC-HO-IND Message Format

Syntax	Size	Notes
MOB_EHC-HO-IND_Message_Format () {		
Message Type	8 bits	0x36=54
HO_IND_type	8 bits	0x00: Serving BS release 0x01=HO cancel 0x02=HO reject 0x03=Combined addition and switch 0x04=Switch 0x05=Removal 0x06=Addition
If(HO_IND_type=0x03) || (HO_IND_type=0x04)		
SWITCh_BS ID	48 bits	Valid only if HO_IND_type is 0x03 or 0x04

Num_of_BSs	8 bits	if (HO_IND_type='Addition' or 'Removal' or 'Combined addition and switch')
		Number of BSs to add or remove
		else
		Not applicable

For (i=0; I<Num_of_BSs;i++) {		
BS ID	48 bits	Valid only if HO_IND_type is 0x00, 0x03, 0x05, or ox06
}		
HMAC Tuple		
}		

6.4.2.3.54 Active BS Addition Response (ABS-addition-Response) Message

If the system support active BS set the active BS sends the message to serving BS in Table 85n in order to response to the ABS-addition-request message.

Table 85n— Active BS Addition Response (ABS-addition-Response) Message Format

Field	Size	Notes
Message Type	8 bits	
Sender BS-ID	48 bits	
Target BS-ID	48 bits	
Time Stamp	32 bits	
Num Records	48 bits	
For (j=0; j<Num Records; j++) {		
MSS unique identifier	48 bits	
basic CID	16 bits	
primary CID	16 bits	
N_NSIE	8 bits	
For (k=0; k<N_NSIE; k++) {		
Transport CID substitution	32 bits	(old transport CID, new transport CID)
Field Size	16 bits	
TLV encoded information	Var.	This field shall contain only TLV values which are different from the Serving BS corresponding values.
}		
N_SAIE	8 bits	
For (k=0; k<N_SAIE; k++) {		
SAID substitution	32 bits	(old SAID, new SAID)
Field Size	16 bits	
TLV encoded information	Var.	This field shall contain only TLV values which are different from the Serving BS corresponding values.
}		
TLV encoded SBC information	Var.	This field shall contain only TLV values which are different from the Serving BS corresponding values.
TLV encoded REG information	Var.	This field shall contain only TLV values which are different from the Serving BS corresponding values.
}		
Security field	TBD	
CRC field	32 bits	

6.4.2.3.55 Active BS Addition (ABS-ADD)Message

If the system support active BS set the serving BS sends the message to MSS in Table 85o in reception of ABS Addtion Response message.

Table 85o— Active BS Addition (ABS-ADD) Message Format

Syntax	Size	Notes
MOB_ABS-ADD_Message_Format () {		
Message Type	8 bits	
BS ID	48 bits	
basic CID	16 bits	
primary CID	16 bits	
N_NSIE	8 bits	
For (k=0; k<N_NSIE; k++) {		

Transport CID substitution	32 bits	(old transport CID, new transport CID)
Field Size	16 bits	
TLV encoded information	Var.	This field shall contain only TLV values which are different from the Serving BS corresponding values.
}		
N_SAIE	8 bits	
For (k=0; k<N_SAIE; k++) {		
SAID substitution	32 bits	(old SAID, new SAID)
Field Size	16 bits	
TLV encoded information	Var.	This field shall contain only TLV values which are different from the Serving BS corresponding values.
}		
TLV encoded SBC information	Var.	This field shall contain only TLV values which are different from the Serving BS corresponding values.
TLV encoded REG information	Var.	This field shall contain only TLV values which are different from the Serving BS corresponding values.
HMAC Tuple	168 bits	
}		

C.2.8 Enhanced EHC-MSS-info-response message

If the system support active BS set and the serving BS sends this message to active BSs in Table C9 after reception of MSS-info-request message..

Table C9—EHC-EHC-MSS-info-response Message

Syntax	Size	Notes
Global Header	152 bits	
for(j=1; j<=Num Records; j++) {		
MSS unique identifier	48 bits	48-bit unique identifier used by MSS (as provided by the MSS or by the *I-am-host-of* message)
N_NSIE		Number of Network Service Information Elements
For (k=0; k<N_NSIE; k++) {		
SFID	32 bits	Service flow ID, Added in this proposal
Field Size	16 bits	Size of TLV encoded information field below
TLV encoded information	Variable	TLV information as allowed on a DSA-REQ MAC message
}		
N_SAIE		Number of Security Association Information Elements
For (k=0; k<N_SAIE; k++) {		
Field Size	16 bits	Size of TLV encoded information field below
TLV encoded information	Variable	TLV information as allowed on a PKM-xxx MAC messages
}		
N_MSS_CBS		Number of MSS Capabilities
For (k=0; k< N_MSS_CBS; k++) {		
Field Size	16 bits	Size of TLV encoded information field below

TLV encoded information	Variable	TLV information as allowed on a SBC-REQ MAC messages
}		
TLV encoded information	Variable	TLV information as allowed on a REG-REQ MAC message
}		
Security field	TBD	A means to authenticate this message
CRC field	32 bits	IEEE CRC-32

C.2.9 MSS-info-confirm message

If the system support active BS set and the active BS sends this message to serving BS in Table C10 after reception of EHC-MSS-info-response message..

Table C10—MSS-info-confirm Message

Syntax	Size	Notes
Global Header	152 bits	
Confirmation Code	8 bits	
TLV encoded information	Variable	The TLV encoded information is a compound TLV value that have changed for the service. All the rules and settings that apply to the parameters when used in the DSA-RSP, DSC-RSP, DSD-RSP messages apply to the contents encapsulated in this TLV.
Security field	TBD	A means to authenticate this message
CRC field	32 bits	IEEE CRC-32

11.14 DSA-RSP management message

The encodings are specific to the DSA-RSP message (**6.4.2.3.11**).

This encodings shall be used in TLV field of DSA-REQ message if enhanced handover mechanism is supported.

Table —DSA-RSP message encodings

Syntax	Type (1 byte)	Size	Notes
NumActiveBSs	1	4 bits	Number of active BSs
for(i=1; i<=NumActiveBSs; i++) {			
BS ID	2	48 bits	Active Cell ID
Confirmation Code	3	8 bits	
if (BS ID=”serving BS ID”)	4		
Connection_Info	5	Variable	The Connection_Info is a compound TLV value that has created for the service flow. All the rules and settings that apply to the parameters when used in the DSA-RSP

			message apply to the contents encapsulated in this TLV.
Else			
Connection_settings	6	Variable	

Connection_settings

The Connection_settings is a compound TLV value that encapsulates Connection_Info fields. This information is intended to reduce the information that is transmitted to the MSS. The Connection_settings fields shall contain only the BS's Connection_Info which are different from the Serving BS's corresponding values. For values that are not included, the MSS shall assume they are identical to the Serving BS's corresponding values.

11.15 DSC-RSP management message

The encodings are specific to the DSC-RSP message (**6.4.2.3.14**).

This encodings shall be used in TLV field of DSC-REQ message if enhanced handover mechanism is supported.

Table — DSC-RSP message encodings

Syntax	Size	Notes
NumActiveBSs	4 bits	Number of active BSs
for(i=1; i<=NumActiveBSs; i++) {		
BS ID	48 bits	Active Cell ID
Confirmation Code	8 bits	
if (BS ID=”serving BS ID”)		
Connection_Info	Variable	The Connection_Info is a compound TLV value that have created for the service. All the rules and settings that apply to the parameters when used in the DSA-RSP message apply to the contents encapsulated in this TLV.
Else		
Connection_settings	Variable	

D.3 Enhanced Hand-over MSCs(Support Active BS set)

D.3.1 Service flow procedures

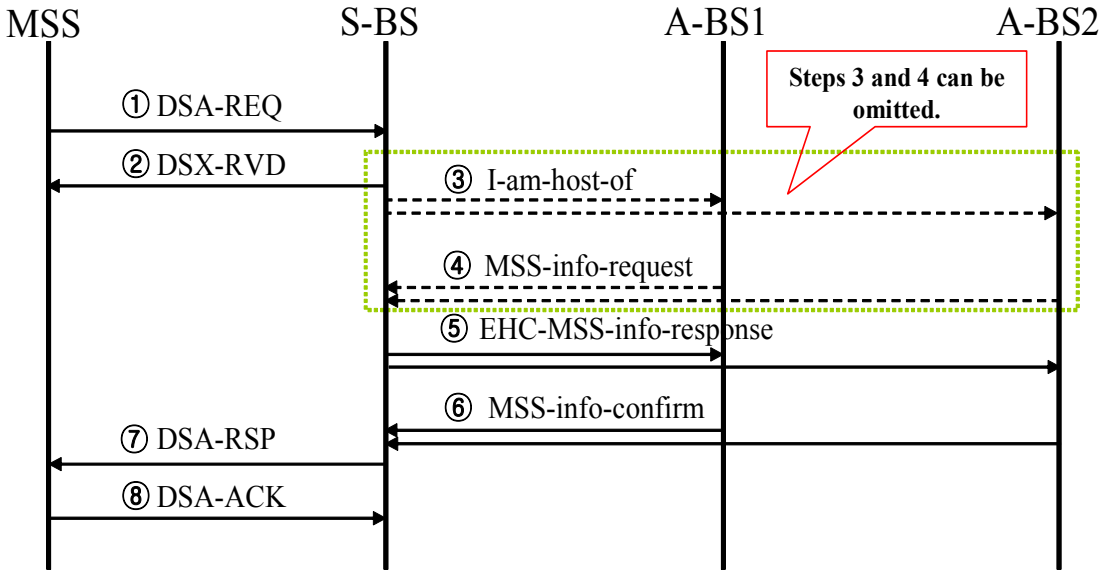

Figure D.14. Example of service flow addition procedures in active BS set containing three active BSs

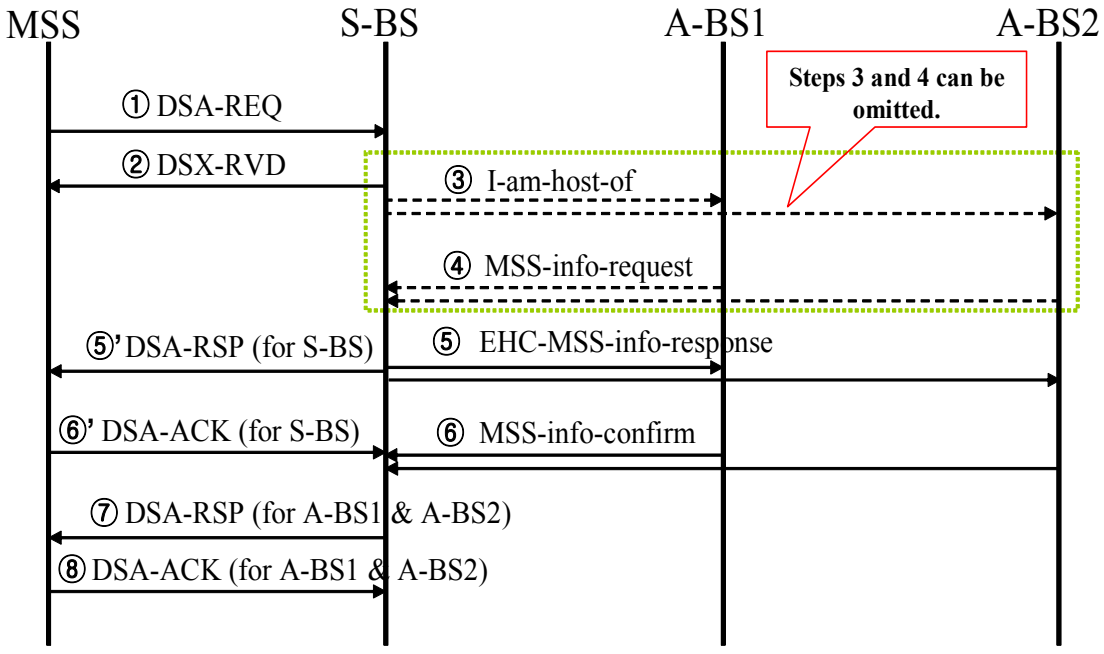

Figure D.15. Another example of service flow addition procedures in active BS set containing three active BSs

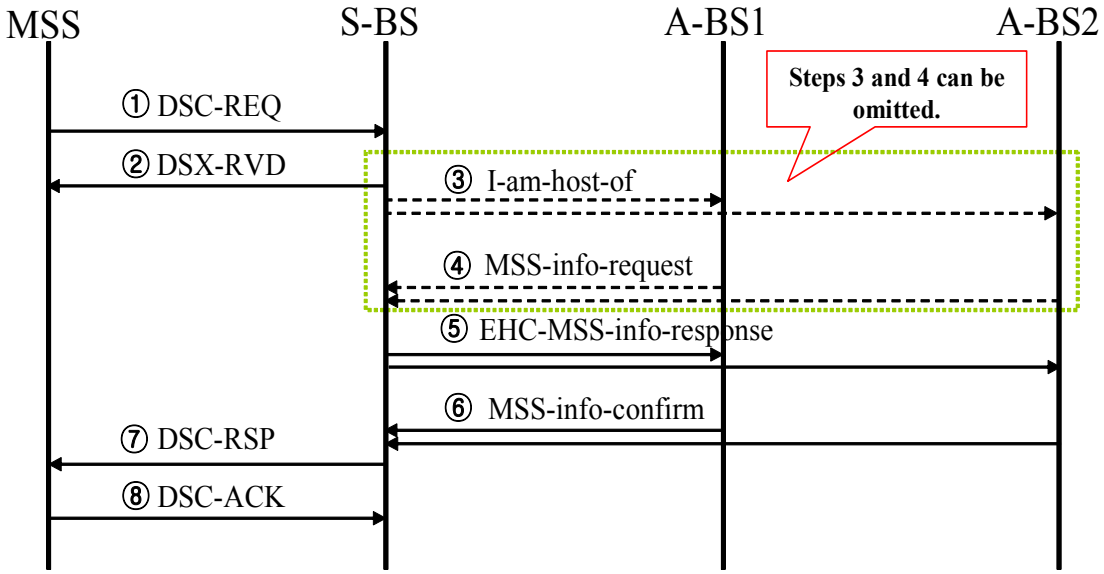

Figure D.16. Example of service flow change procedures in active BS set containing three active BSs

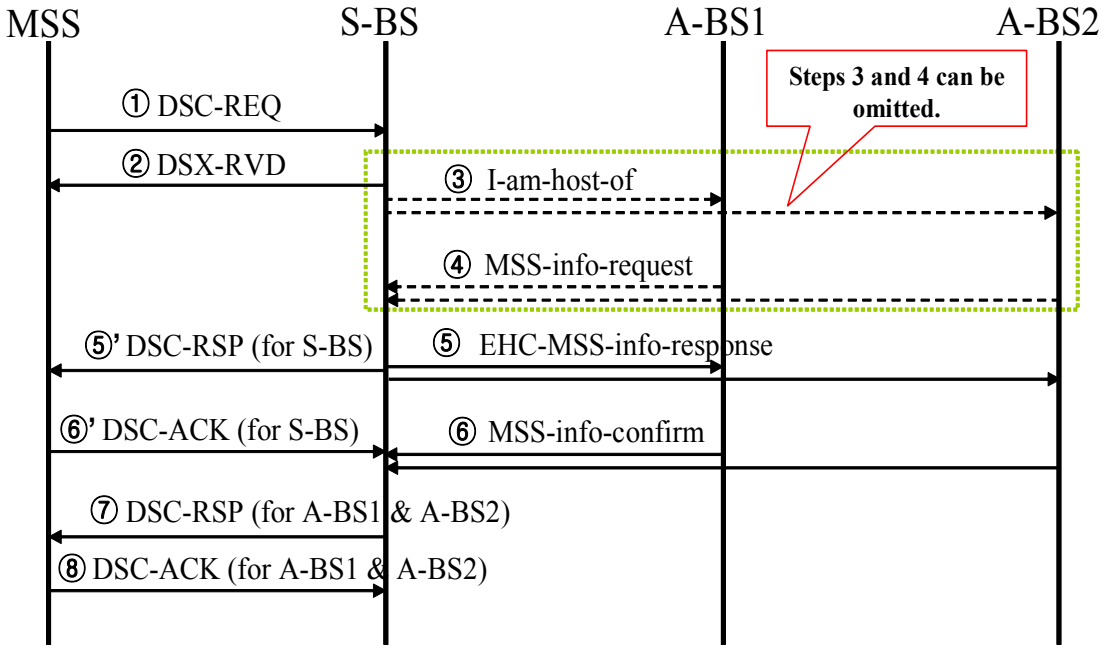

Figure D.17. Another xample of service flow change procedures in active BS set containing three

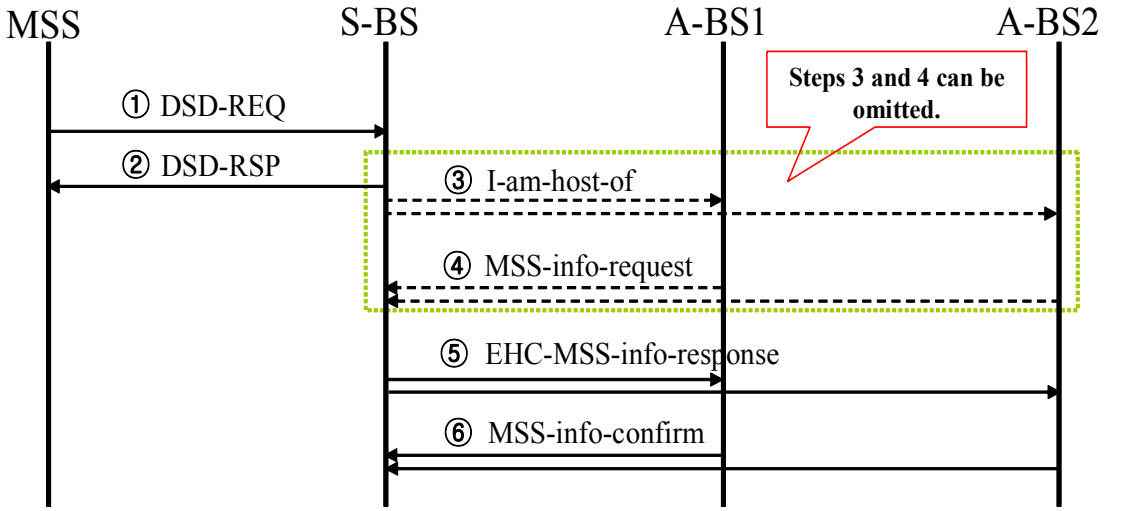

Figure D.18. Example of service flow deletion procedures in active BS set containing three active BSs

D.3.2 Enhanced handover procedures

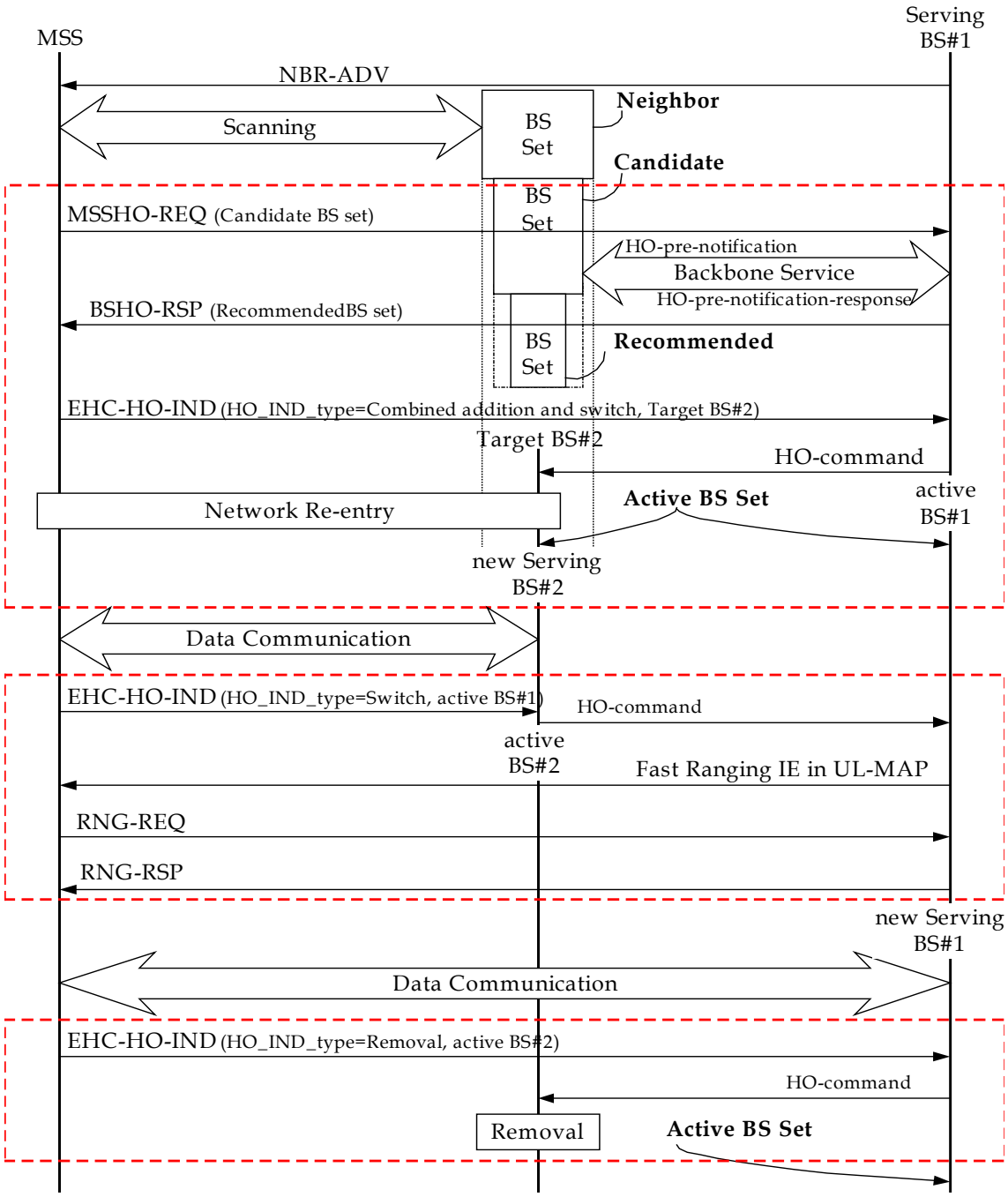

Figure D.18. An example of MSS-initiated handover procedures by 'combined addition and switch', 'switch', and 'removal'

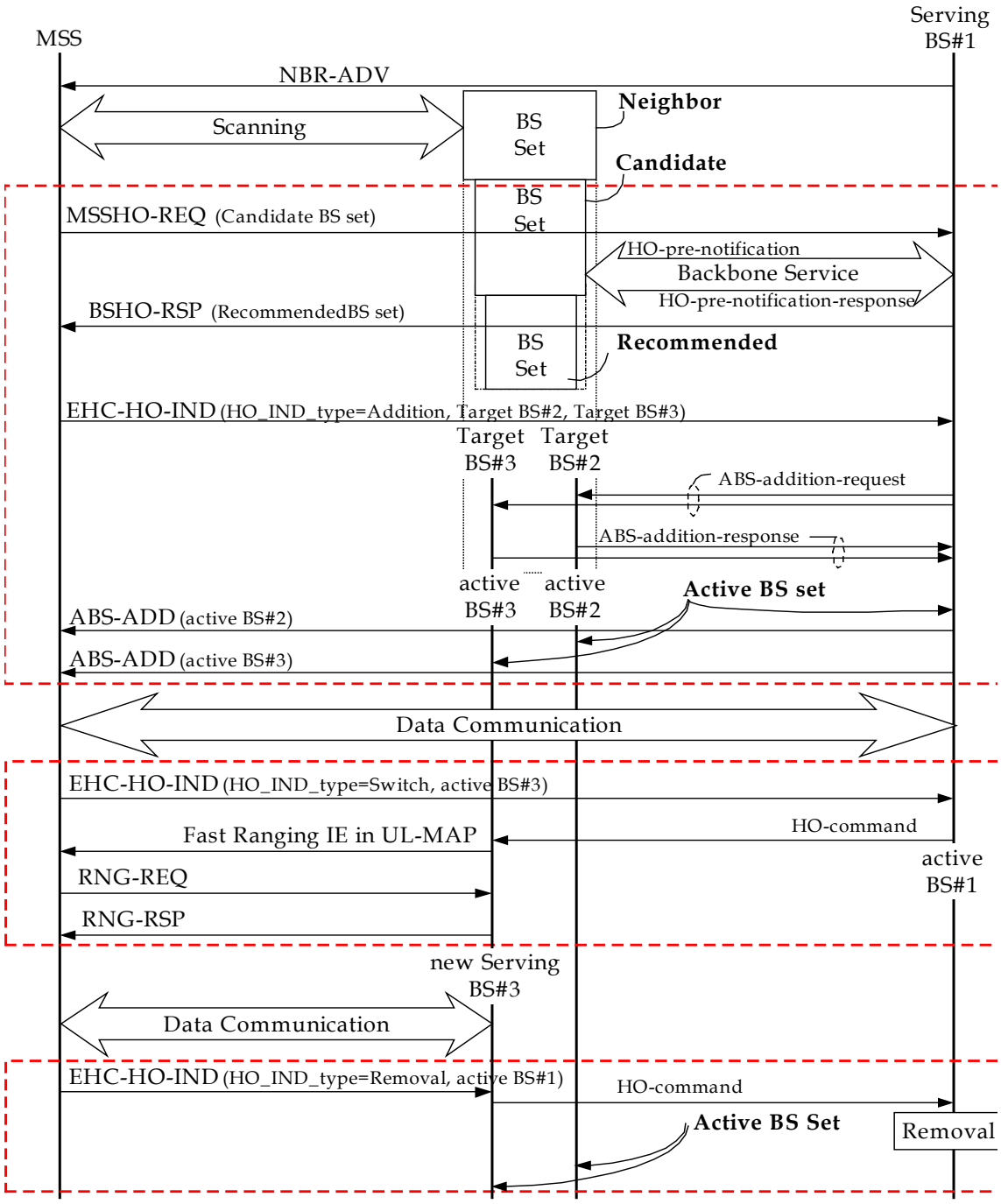

Figure D.19. An example of MSS-initiated handover procedures by 'addition', 'switch', and 'removal'

Reference

[1] IEEE C802.16e-03/20r1 "IEEE 802.16e Handoff Draft"