Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Handover - Serving BS Release with Data Forwarding**
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Re:	Response to IEEE 802.16-04/19 (Recirculation Ballot #14a)
Abstract	Handover option of Serving BS release with Data Forwarding
Purpose	Enhance the handover performance during handover
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Handover - Serving BS Release with Data Forwarding

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1. Problem Statement

When handover is performed, the serving BS may either discard MAC SDUs associated with the MSS or forward MAC SDUs for service continuation.

However in case of data forwarding, if the MSS re-establishes IP connectivity after handover, forwarded data are useless due to IP address change. Therefore, it is required for MSS to defer IP re-establishment if there are forwarded data from the serving BS.

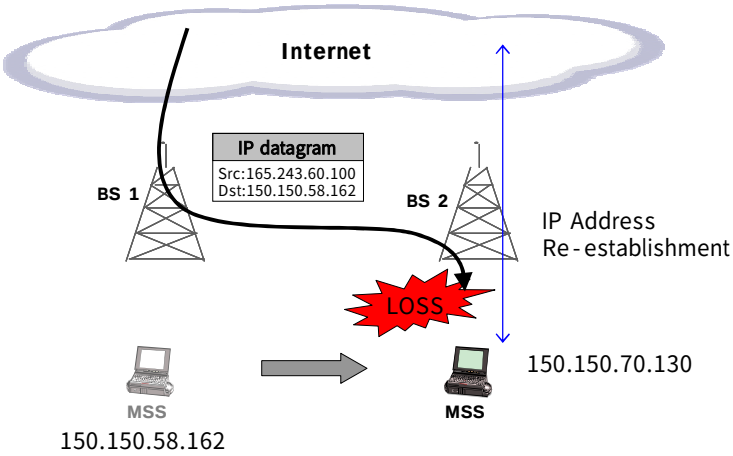

Figure 1. Data forwarding vs IP address re-establishment

In this contribution, we propose possible solutions for MSS to defer IP re-establishment if there are forwarded data from the serving BS after HO.

2. Overview of Proposed Solution

2.1 BS decides whether or not to forward the data

In case the BS decides whether or not to forward the data and the MSS doesn't know the BS's decision, the MSS requests Serving BS release by sending a MOB-HO-IND MAC Management message with the HO_IND_type value indicating serving BS release and the BS decides whether forwards the MSS's data to the target BS or not.

Because the MSS doesn't know whether the serving BS decides to forward MSS's data to the target BS, the MSS waits forwarded data for some pre-defined time after handover. If data are received from the new BS within pre-defined time and the destination is an old IP address, the MSS may choose to defer the IP address re-establishment until the session ends. If the MSS chooses to finish the session, it re-establishes IP connectivity to acquire new IP address.

The new BS may send Stop-Data-Forwarding backbone message to the old BS when the MSS re-established IP connectivity. When the serving BS receives the Stop-Data-Forwarding, the BS may close all connections and discard state machines and MAC SDUs associated with the MSS.

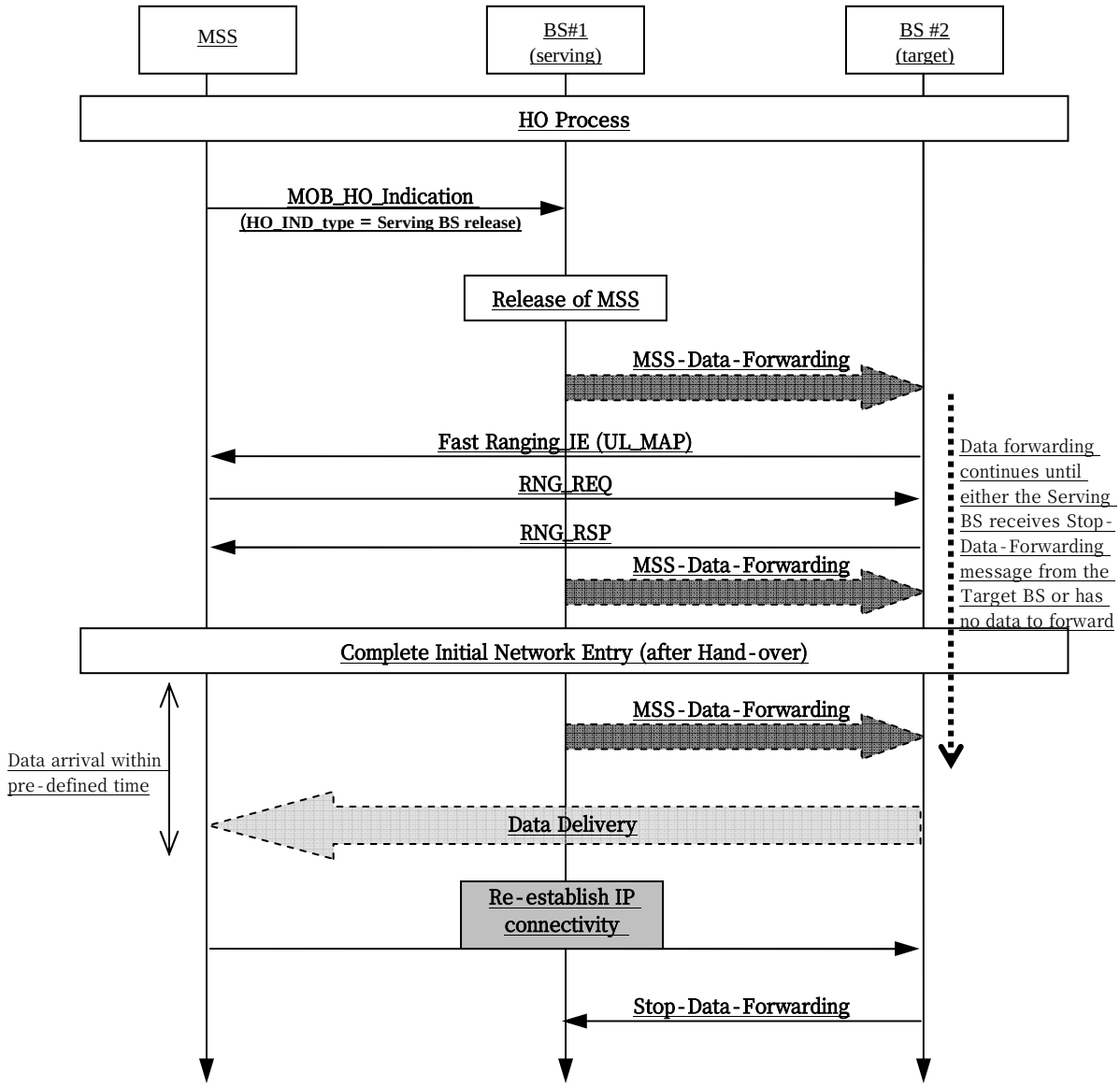

Figure 2. Data forwarding without an indication to the MSS

2.2 MSS has capability to request the BS of the serving BS release with data forwarding

If MSS can request the serving BS release with data forwarding explicitly, the MSS does not need to wait for pre-defined time to check whether there are forwarded data to receive after HO. In this case, the BS should indicate the MSS with its capability of data forwarding. If the MSS received the indication of Data forwarding supported, MSS defer re-establishment of IP connectivity, and if the MSS received the indication of Data forwarding not supported, MSS re-establishes the IP connectivity without waiting for the pre-defined time after handoff.

The new BS may send Stop-Data-Forwarding backbone message to the old BS when the MSS re-established IP connectivity. When the serving BS receives the Stop-Data-Forwarding, the BS may close all connections and discard state machines and MAC SDUs associated with the MSS.

If the MSS, which can request data forwarding explicitly, requests the Serving BS release by sending a MOB-HO-IND MAC Management message with the HO_IND_type value indicating serving BS

release, the MSS does not care whether the data is forwarded to the target BS or not. This MSS initiates IP re-establishment as soon as handover is finished and registers with the new BS.

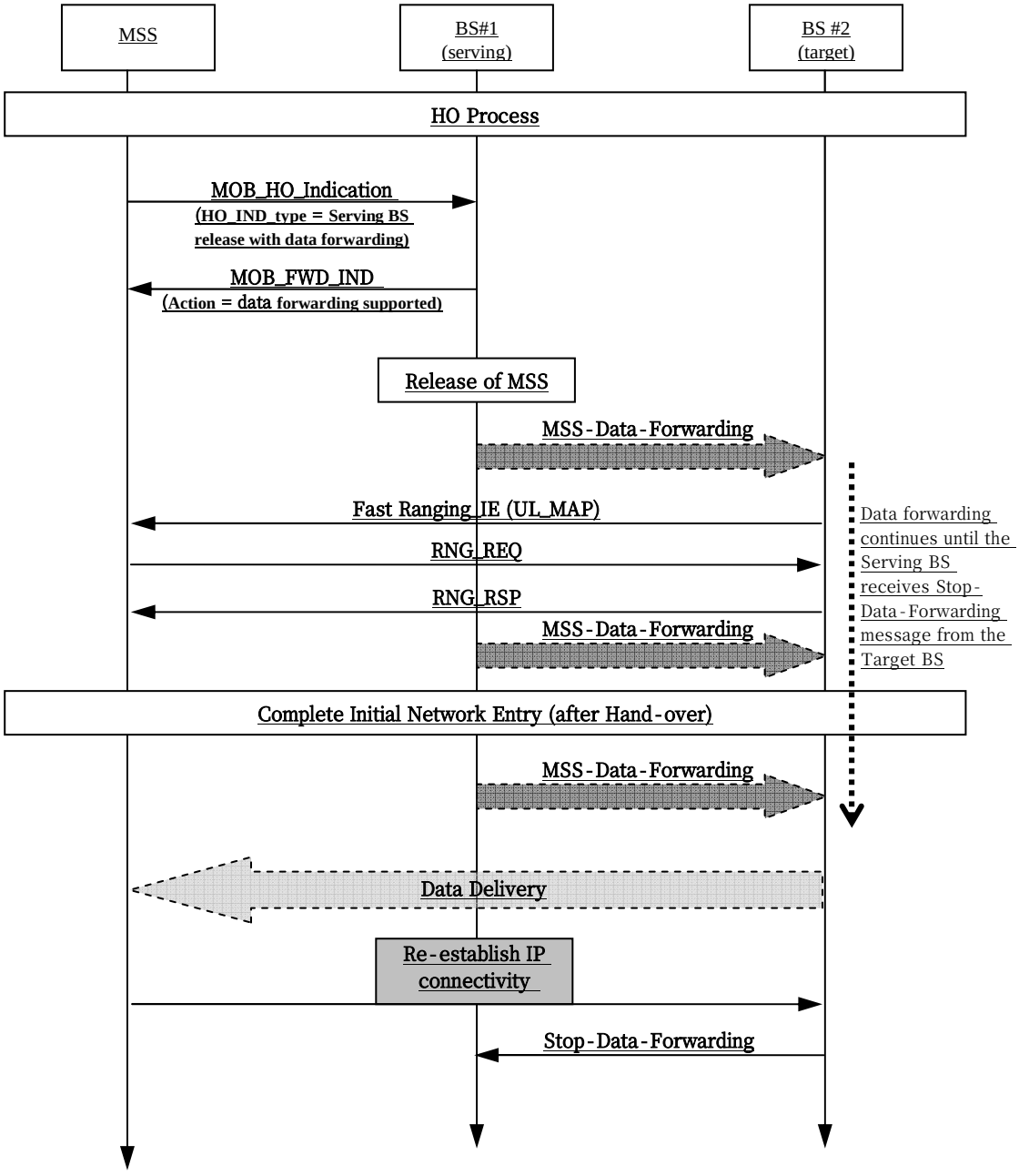

Figure 3. Data forwarding with an indication to the MSS

3. Proposed Changes in Document

Remedy:

Add one HO_IND_type in MOB-HO-IND to indicate to the serving BS that decision of data forwarding shall be indicated back to the MSS. Add one MOB-FWD-IND message for indication of BS's decision. Insert paragraph describing BS's and MSS's actions of data forwarding. Add backbone messages for data forwarding and stop data forwarding over a backbone.

Remedy 1:

[Insert a sentence to 6.3.20.2.5 in page 47as follows]

6.3.20.2.5 Termination with the Serving BS

After the hand-over request/response handshake has completed, the MSS may begin the actual HO. At some stage during the HO process, the MSS terminates service with the serving BS. This is accomplished by sending a MOB-HO-IND MAC Management message with the HO_IND_type value indicating serving BS release.

If the HO_IND_type field specifies Serving BS release, the BS may either close all connections and discard MAC state machines and MAC PDUs associated with the MSS, or it may retain the connections, MAC state machine and PDU associated with the MSS to be forwarded to the Target BS for service continuation, or to be discarded upon reception of a backbone message from the Target BS. After handover the MSS may defer IP connectivity re-establishment if there are data forwarded from the old BS. When MSS re-establishes IP connectivity during receiving forwarded data, BS may send a backbone message to request the old BS to stop forwarding data.

Remedy 2:

[Insert a paragraph to 6.3.20.2.5 after line 23 in page 47 as follows]

MSS may request the forwarding of currently receiving data by sending a MOB-HO-IND MAC Management message with the HO_IND_type value indicating serving BS release with data forwarding. This request is made if the MSS wants to receive the currently receiving data through the serving BS for service continuation and IP re-establishment is deferred after HO until currently receiving data finishes. Upon reception of HO_IND_type of Serving BS release with data forwarding, the serving BS shall send MOB_FWD_IND to the MSS on the basic CID indicating whether the BS can forward the data or not. If action code in MOB_FWD_IND is Data forwarding not supported, MSS re-establishes IP address as soon as HO finishes and if the action code is Data forwarding supported, the MSS defers IP re-establishment and receives the forwarded data. When MSS re-establishes IP connectivity during receiving forwarded data, BS may send a backbone message to request the old BS to stop forwarding data.

Remedy 3:

*[Modify the Table 92j in **6.3.2.3.56 MOB-HO-IND Message Format** in page 25]*

Syntax	Size	Notes
MOB_HO_IND_Message_Format() {		
Management Message Type=56	8 bits	
reserved	6 bits	Reserved; shall be set to zero
HO_IND_type	2 bits	00: Serving BS release 01: HO cancel 10: HO reject 11: ~~reserved~~ Serving BS release with data forwarding

Target_BS_ID	48 bits	Applicable only when HO_IND_type is set to 00 or 11
HMAC Tuple	21 bytes	See 11.4.11
}		

Remedy 4:

*[Add new **6.3.2.3.XX MOB-FWD-IND Message** after page 27]*

The BS sends this message to indicate its data forwarding capability when an MSS sends a MOB-HO-IND MAC Management message with the HO_IND_type value indicating serving BS release with data forwarding. Action code 00 is sent in order to indicate to MSS that the BS can forward data to the target BS and 01 is sent when the BS cannot support data forwarding.

Table NNN – MOB-FWD-IND Message Formate

Syntax	Size	Notes
MOB_FWD_IND_Message_Format() {		
Management Message Type=??	8 bits	
Action code	2 bits	00: Data forwarding supported 01: Data forwarding not supported 10: reserved 11: reserved
Reserved	6 bits	
}		

Remedy 5:

*[Add new Inter-base station message **"D.2.XX MSS-Data-Forwarding Message";** appropriate allocation of numbering is required.]*

This message is sent from the Serving BS to the Target BS to forward the MSS's MAC SDUs during HO. This message is typically used when MSS requests the Serving BS to releases the Serving BS with data forwarding. This message's transmission shall be stopped on reception of Stop-Data-Forwarding Message.

Table DX– MSS-Data-Forwarding Message

Field	Size	Notes
Global Header	152-bit	
Length	8-bit	The length in bytes of the MAC SDU including the Global Header, MSS unique identifier, and Security field.
MSS unique identifier	48-bit	48-bit unique identifier used by MSS on initial network entry
MAC SDU	Variable	
Security field	TBD	A means to authenticate this message

Remedy 6:

*[Add new Inter-base station message **"D.2.XX Stop-Data-Forwarding Message";** appropriate allocation of numbering is required.]*

This message is sent from the Target BS to the Serving BS in order to make the Serving BS stop forwarding the MSS's MAC SDUs.

Table DX– Stop-Data-Forwarding Message

Field	Size	Notes
Global Header	152-bit	
MSS unique identifier	48-bit	48-bit unique identifier used by MSS on initial network entry
Action	TBD	TBD
Security field	TBD	A means to authenticate this message