Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**IP re-establishment Optimization (HO&Forwarding)**
Date Submitted	**2004-06-20**
Source(s)	Ronny (Yong-Ho) Kim Voice: 82-31-450-4387 LG Electronics,Inc. Fax: 82-31-450-7912 533,Hogye-1dong,Dongan-gu, mailto: ronnykim@lge.com Anyang-shi,Kyongki-do,Korea
Re:	Response to HO Ad-Hoc Call for Contributions on IEEE 80.16e/D3
Abstract	IP re-establishment Optimization
Purpose	Provide mechanism to optimize IP re-establishment handover when MSS is in receiving data or when MSS is not receiving data.
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 that the draft publication will be approved for publication. Please notify the Chair <mailto:chair@wirelessman.org> as early as possible, in written or electronic form, if patented technology (or technology under patent application) might be incorporated into a draft standard being developed within the IEEE 802.16 Working Group. The Chair will disclose this notification via the IEEE 802.16 web site <http://ieee802.org/16/ipr/patents/notices>.

IP re-establishment Optimization
Ronny (Yong-Ho) Kim
LG Electronics

1. Problem Statement

We can think two handover scenarios, one is handover during an MSS is not receiving data and the other is handover during an MSS is receiving data.

i.   HO while an MSS is not receiving data

IEEE 802.16e uses DHCP, and Mobile IP in order to allocate IP addresses to MSSs and after MSS handover to the target BS or entering network from Idle mode, re-establishment of IP connectivity is required. However in case the same subnet can be used or same Foreign Agent is connected in the new BS, re-establishment of IP connectivity procedure can be skipped and MSS can use the same IP address. Therefore, some mechanism between BSs to determine the subnet change or Foreign Agent change for moving MSS is required. When an MSS moves to a new BS, if an old BS can provide a new BS with network ID (NetID) through backbone message for a new BS to decide MSS's subnet change or Foreign Agent change, the new BS can provide an MSS with indication of IP re-establishment. Network ID can represent Subnet, Prefix, Access Router, or Foreign Agent. One BS can have more than one NetID depending on the network configuration.

Currently IEEE 802.16e doesn't provide MSS with instruction of IP re-establishment. In this document, we propose a possible solution to give MSSs instruction of IP re-establishment whether it needs to re-establish IP connectivity.

ii.   HO while an MSS is receiving data

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.
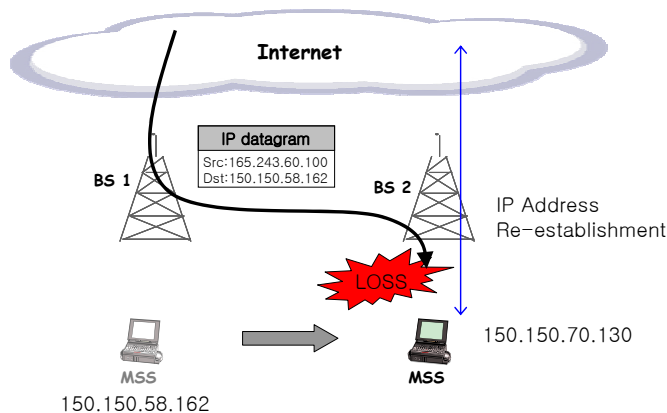

Figure 1. Data forwarding vs IP address re-establishment

2. Overview of Proposed Solution

i.   HO while an MSS is not receiving data

By giving MSS's Network ID (NetID) to the target BS over a backbone, the target BS can provide a moving MSS with instruction of IP re-establishment.

In DHCP case, currently after MSS's handover, new IP allocation procedure is required regardless of subnet change. However, if network subnet is not changed in the new BS, MSS can use old IP address which was used in the previous BS. In Mobile IPv4 case, when an MSS moves to the new BS, it takes some time for the MSS to re-establish IP connectivity using Mobile IPv4. However, if same foreign agent is connected to the new BS, MSS can skip mobile IP procedure and reduce delay.

The new BS needs information to decide whether subnet or Foreign Agent is different from the previous BS. When an MSS is moving to the new BS, the old BS sends MSS's NetID through a backbone to the new BS and the new BS can compare received NetID with its own NetIDs. If one of NetIDs in the new BS is same as the received NetID from the previous BS, the new BS instructs the MSS with **"*Network Address Acquisition management messages re-entry omit during current re-entry processing*"** flag in **HO Process Optimization flags to RNG-RSP TLV table.**

ii.   HO while an MSS is receiving data

If the serving BS decides to forward data to the target BS for moving MSS's service continuation, the serving BS will forward data through backbone and the target BS will receive them. At this time, the target BS notices the MSS of data to receive after HO. The MSS will register with the target BS, and the target BS will notify the MSS of forwarded data existence with **"*Deferred Network Address Acquisition Recommended due to forwarded data*"** flag in **HO Process Optimization flags to RNG-RSP TLV table.**

Now MSS can decide when IP re-establishment should be performed. The MSS may defer re-establishment of IP connectivity to receive data or may re-establish IP connectivity. During data is being forwarded to the target BS, if the MSS re-establishes IP connectivity then the target BS may send a backbone message (Stop-Data-Forwarding) to stop data forwarding to the serving BS. 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.

3. Proposed Changes in Document

Remedy:

Add **"*Network Address Acquisition management messages re-entry omit during current re-entry processing*"** flag in **HO Process Optimization flags to RNG-RSP TLV table,** which are used to instruct MSS whether it shall perform IP address re-establishment procedure, add NetID in HO-Confirm and Paging-announce backbone messages. Add **"*Deferred Network Address Acquisition Recommended due to forwarded data*"** flag in **HO Process Optimization flags to RNG-RSP TLV table** to indicate the MSS of forwarded data existence. 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:

[Modify the Table D6 in D.2.5 HO-confirm Message Format in page 101]

Field	Size	Notes
Global Header	152-bit	
For (j=0; j<Num Records; j++) {		
MSS unique identifier	48-bit	48 bit unique identifier used by MSS (as provided to the BS on the RNG-REQ message)
BW Estimated	8-bit	Bandwidth which is provided by BS (to guarantee minimum packet data transmission) TBD how to set this field
QoS Estimated	8-bit	Quality of Service level - Unsolicited Grant Service (UGS) - Real-time Polling Service (rtPS) - Non-real-time Polling Service (nrtPS) - Best Effort Service (BE)
}		
NetID	8bit	Network ID of MSS
Security field	TBD	A means to authenticate this message

*[Modify the Table in **D.2.95 Paging-announce message** in page 102]*

Field	Size	Notes
Message Type=?	8-bit	
Sender BS-ID	48-bit	Base station unique identifier (Same number as that broadcast on the DL-MAP message)
Target BS-ID	48-bit	Set to 0xffffff to indicate broadcast
Time Stamp	32-bit	Number of milliseconds since midnight GMT (set to 0xffffff to ignore)
Num MSS	8-bit	Number of MSSs to page
For (j=0; j<Num MSS; j++) {		
MSS MAC address	48-bit	48 bit unique identifier used by MSS (as provided to the BS on the RNG-REQ message)
NetID	8bit	Network ID of MSS
PAGING CYCLE	16-bit	Bandwidth which is provided by BS (to guarantee minimum packet data transmission) TBD how to set this field
PAGING OFFSET	8-bit	Quality of Service level - Unsolicited Grant Service (UGS) - Real-time Polling Service (rtPS) - Non-real-time Polling Service (nrtPS) - Best Effort Service (BE)
}		
Security field	TBD	A means to authenticate this message
CRC field	32-bit	

Remedy 2:

*[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

*[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

Remedy 3:

[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 4:

Add HO Process Optimization flags language to RNG-RSP section.

[In 6.3.2.3.6 Ranging Response (RNG-RSP) message, page 10, line 22, append to end of section]:

The following TLV parameter shall be included in the RNG-RSP message when the MSS is attempting to perform network re-entry or hand-over and the Target BS wishes to identify re-entry process management messages that may be omitted during the current HO attempt:

HO Process Optimization—identifies re-entry process management messages that may be omitted **or deferred** during the current HO attempt due to the availability of MSS service and operational context information obtained over the backbone network. The Target BS shall not direct the omission of any re-entry process management messages that would abridge the security or integrity of Normal Operation of the communications as established through an unabridged Initial Entry.

Remedy 5:

Add HO Process Optimization flags to RNG-RSP TLV table.

[In 11.6 RNG-RSP TLVs for re-establishment of Service Flows, page 106, line 13, append to Table 320a—RNG-RSP Message Encodings; editor will make appropriate allocation of numbering nn for Type]:

Name	Type	Length	Value
HO Process Optimization	nn	1	For each Bit location, a value of '0' indicates the associated re-entry management messages shall be required processing, a value of '1' indicates the re-entry management message may be obmitted Bit #0: SBC-REQ/RSP management messages re-entry omit during current re-entry processing Bit #1: PKM-REQ/RSP management message re-entry omit during current re-entry processing **Bit #3: Network Address Acquisition management messages re-entry omit during current re-entry processing** Bit #4: Time of Day Acquisition management messages re-entry omit during current re-entry processing Bit #5: TFTP management messages re-entry omit during current re-entry processing **Bit #6: Deferred Network Address Acquisition Recommended due to forwarded data**