Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Minimization of Handoff interruption time optimizing IP Address Assignment Procedure**
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Re:	Response to IEEE 802.16-04/19 (Recirculation Ballot #14a Announcement)
Abstract	To minimize the handoff interruption time, Packet Zone ID concept is introduced. Packet Zone ID is broadcasted by BS. When BS receives previous PZID in the RNG-REQ by the MSS, BS decides whether new IP address assignment/Mobile IP registration is required or not. Then BS notifies MSS whether DHCP or Mobile IP procedure may be skipped in the RNG-RSP message. The basic assumption behind this is that decision on IP address change in BS-side is cheaper than in MSS-side, which necessitates at least 1 message exchanges over air interface.
Purpose	Discuss and Adopt as the enhanced handoff authentication procedure
Notice	
Release	
Patent Policy and Procedures	

Minimization of Handoff interruption time optimizing IP Address Assignment procedure

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1. Problem Statements

According to current 802.16 standard, post-handoff new IP address assignment procedure is required. And decision on IP Address renewal is, whether DHCP or Mobile IP, solely performed by MSS and IP address renewal requires at least 2 message exchange between target BS and MSS. During the IP address change/renewal, all the TCP/IP connections are suspended and it leads to handoff latency.

Table 1 DHCP message exchange

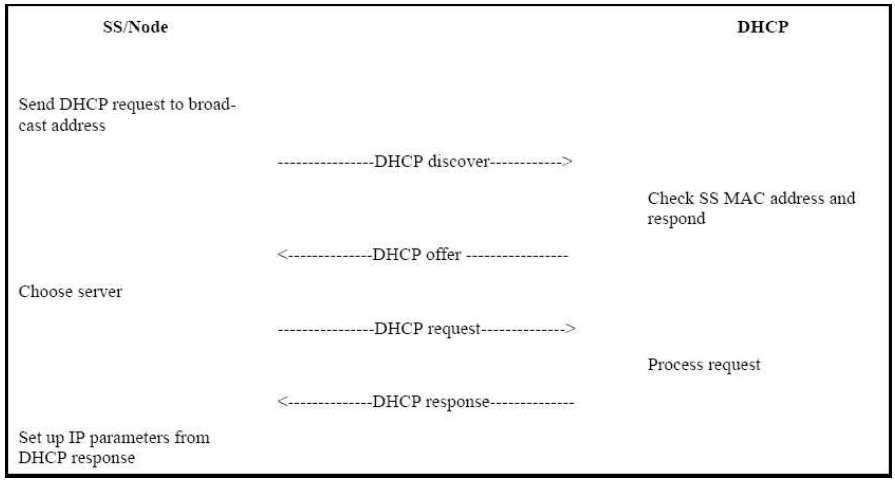
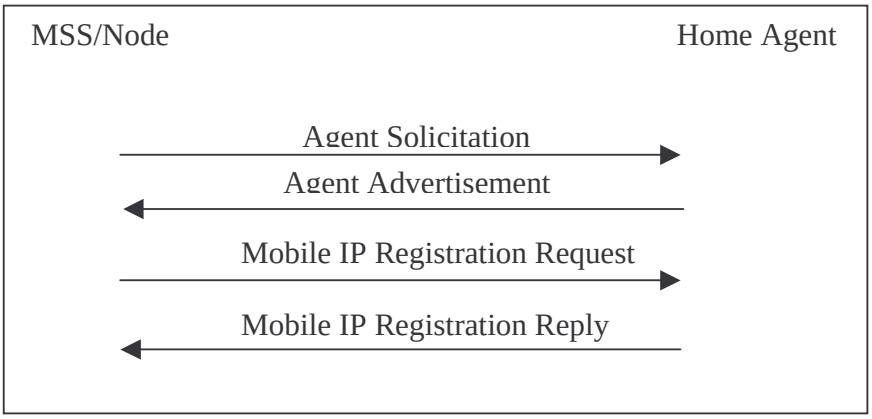


Table 2 Mobile IP message exchange



2. Overview of Proposed Solutions

To minimize the handoff interruption time due to IP address change, PZID(Packet Zone ID) concept is introduced. Packet Zone ID, which is shared by several BS and means same subnet area and area managed by the same Foreign Agent, is broadcasted by BS. And MSS sends previous PZID in the RNG-REQ after

handoff. When BS receives previous PZID in the RNG-REQ, target BS decides whether IP address renewal is required or not based on the previous PZID and current PZID. Then BS notifies MSS with the RNG-RSP message, whether DHCP or Mobile IP procedure may be skipped.

The BS's are divided into logical groups called Packet Zone which is in the same subnet for DHCP case and/or is managed by the same Foreign Agent. A BS belongs to one and only one Packet Zone ID.

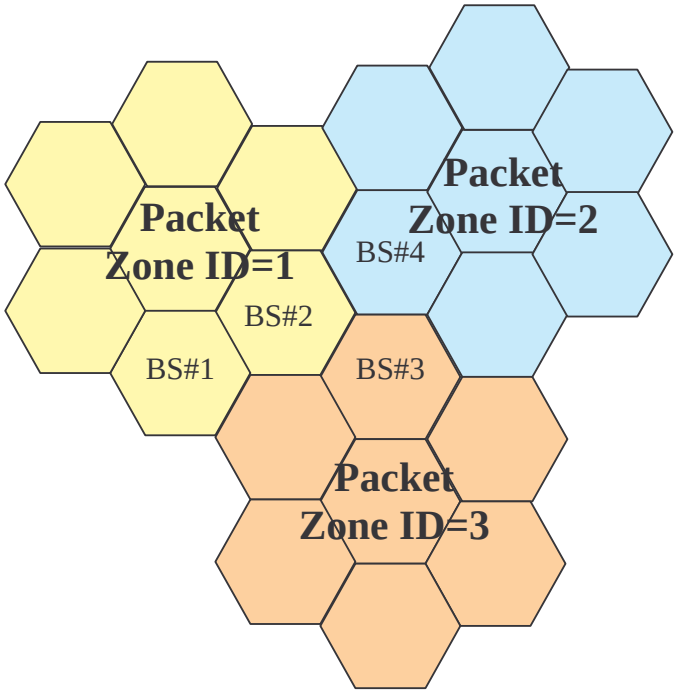


Figure 1 Packet Zone ID Grouping example

Handoff Direction(Serving BS →Target BS)		IP Address Refresh
BS#1	BS#2	Not Required
BS#2	BS#3	Required
BS#3	BS#4	Required
BS#4	BS#2	Required

The basic assumption behind this is that performing decision on IP address change in BS-side is better than in MSS-side, which necessitates at least 2 message exchanges over air interface.

With this approach in the same subnet area, for DHCP case 2 messages exchange may possibly be skipped and 1 Mobile IP message(Agent Solicitation, Agent Advertisement) exchange may be skipped.

3. Proposed Changes to IEEE 802.16e/D2

3. Definitions

[Add the following text to section 3:]

3.75 Packet Zone ID

The Packet Zone Identification is a unique number which identifies the coverage area with the same subnet or managed by the same Foreign Agent.

[Add the following text to section 4:]

4. Abbreviations and acronyms

PZID Packet Zone Identification

[Change the following text to section 4:]

6.3.2.3.2 Downlink Map (DL-MAP) message

The DL-MAP message defines the access to the downlink information. If the length of the DL-MAP message is a non-integral number of bytes, the LEN field in the MAC header is rounded up to the next integral number of bytes. The message shall be padded to match this length, but the SS shall disregard the 4 pad bits.

A BS shall generate DL-MAP messages in the format shown in Table 16, including all of the following parameters:

PHY Synchronization
The PHY synchronization field is dependent on the PHY specification used. The encoding of this field is given in each PHY specification separately.

DCD Count
Matches the value of the configuration change count of the DCD, which describes the downlink burst profiles that apply to this map.

Base Station ID
The Base Station ID is a 48-bit long field identifying the BS. The Base Station ID shall be programmable. The most significant 24 bits shall be used as the operator ID. This is a network management hook that can be combined with the Downlink Channel ID of the DCD message for handling edge-of-sector and edge-of-cell situations.

Packet Zone ID
The Packet Zone ID is a 8-bit long field identifying the Packet Zone where the BS belongs to. A BS belongs to one and only one Packet Zone ID.

The encoding of the remaining portions of the DL-MAP message is PHY-specification dependent and may be absent. Refer to the appropriate PHY specification.

Table 16—DL-MAP message format

Syntax	Size	Notes
DL-MAP_Message_Format() {		
Management Message Type = 2	8 bits	
PHY Synchronization Field	*variable*	See appropriate PHY specification.
DCD Count	8 bits	
Base Station ID	48 bits	
Packet Zone ID	***8 bits***	
Begin PHY Specific Section {		See applicable PHY section.
for (*i* = 1; *i* <= *n*; *i*++) {		For each DL-MAP element 1 to *n*.
DL-MAP_IE()	*variable*	See corresponding PHY specification.
}		

}		
if !(byte boundary) {		
Padding Nibble	4 bits	Padding to reach byte boundary.
}		
}		

6.3.2.3.5 Ranging Request (RNG_REQ) message

The following parameters shall be included in the RNG-REQ message when the MSS is attempting to perform re-entry, association or hand-over:

Serving BS ID
The BS ID of the BS to which the MSS is currently connected (has completed the registration cycle and is in Normal Operation). Serving BS ID shall not be included if interval timer is timed-out (Serving BS ID AGINGTIMER, see Table 264a). Inclusion of Serving BS ID in the RNG-REQ message signals to the Target BS that the MSS is currently connected to the network through the serving BS and is performing association or is in the process of either hand-over or network re-entry.

PZID(Packet Zone ID)
The PZID is the PZID of the serving BS. Target BS may use PZID of serving BS, it's PZID to decide whether IP address renewal is required for MSS or not.

6.3.2.3.6 Ranging Response (RNG-RSP) message

[Add the following to section 6.4.2.4.6:]
When a BS sends a RNG-RSP message in response to a RNG-REQ message containing Serving BS ID, the BS may include the following TLV parameter in the RNG-RSP message:

Service Level Prediction — This value indicates the level of service the MSS can expect from this BS. The following encodings apply:

0 = No service possible for this MSS.
1 = Some service is available for one or several Service Flow authorized for the MSS.
2 = For each authorized Service Flow, a MAC connection can be established with QoS specified by the AuthorizedQoSParamSet.
3 = No service level prediction available.

Service Level prediction may be accompanied by a number of Service Flow Encodings as specified in 11.4.913 sufficient to uniquely identify the AuthorizedQoSParamSet associated with the predicting SLP. If Service Flow Encodings are included, then the SLP response is specific to the presented AuthorizedQoSParamSet defined by the associated encodings. Included Service Flow Encodings are restricted to the following parameters only:

— Global Service Class Name
— Service Flow QoS parameter set encodings as defined in 11.13 such that the combination of Global Service Class Name and any Service Flow modifying parameters fully defines an AuthorizedQoSParamSet profile being assessed
— Service Flow Identifier

If individual AuthorizedQoSParamSet profiles are provided for multiple Service Level Predictions, then each Service Level Prediction is specific to its associated AuthorizedQoSParamSet profile and shall include only response options '0' or '2'.

IP Address Renewal Required
Target BS compares PZID of serving BS and it's own and notifies to MSS whether IP address renewal is required for DHCP case, Mobile IP registration is required or not with this field.

11.5 RNG-REQ message encodings

[Add the following rows to table 318:]

Table 318a-RNG-REQ Message Encodings

Name	Type(1 byte)	Length	Value
Serving BS ID	4	6	The unique identifier of the former Serving BS
Basic CID	6	2	Basic CID allocated from the formar Serving BS
PZID	8	1	Previous PZID

11.5 RNG-RSP TLV for re-establishment of Service Flows

[Add the following rows to table 320:]

Table 318a-RNG-RSP Message Encodings

Name	Type(1 byte)	Length	Value
QoS Parameters	[145/146].Variable	Variable	Compound TLV incorporating one or more 11.13 QoS Paramater Set definition encodings
SFID	[145/146].1	4	
Resource Retain Flag	20		This value indicates whether the former Serving BS retains the connection information of the MSS. 0 = the connection information for the MSS is deleted 1 = the connection information fo the MSS is r
IP address Renewal Required	22	1	This indicates whether IP address renewal for DHCP case, Mobile IP registration is required due to subnet change, Foreign Agent change or not.

6.3.20.4 Network entry/re-entry

Unless otherwise indicated in this section, MSS mobile network entry/re-entry is processed according to 6.4.9. For purposes of this process, MSS network re-entry and hand-over are synonymous.

MSS and Target BS shall conduct Ranging per 6.4.9.5 to begin network entry/re-entry except as MSS may take advantage of a non-contention based MSS Initial Ranging opportunity if present. If MSS RNG-REQ includes an Serving BS ID and Target BS had not previously received MSS information over the backbone (see section Backbone network HO procedures), then Target BS may make an MSS information request of Serving BS over the backbone network and Serving BS may respond. Regardless of having received MSS
information from Serving BS, Target BS may request MSS information from another network management entity via the backbone network. Network re-entry proceeds per 6.4.9.5 except as may be shortened by Target BS possession of MSS information obtained from Serving BS over the backbone network.

If MSS RNG-REQ included an Serving BS ID, HMAC-Digest and Target BS had previously received an backbone message (see section Backbone network HO procedures) containing MSS information and security context information, Target BS shall skip use the embedded TLV PKM-REQ information and the re-authorization process as defined in 7.2 and authenticates MSS using HMAC-Digest which is calculated with the AK of the serving BS. But Target BS may request MSS to re-authorize setting Authorization Required field in RNG-RSP.

If Target BS had previously received an backbone message (see section Backbone network HO procedures), Target BS may use the embedded TLV REG-REQ & DSA-REQ information to build and send an unsolicited REG-RSP message. The REG-RSP message may include New_CID, Old_CID and Connection_Info TLVs. Target BS may ignore only the first REG-REQ message received if it sends an unsolicited REG_RSP message. MSS is not required to send an REG-REQ if it receives an unsolicited REG-RSP prior to MSS attempt to send REG-REQ.

If MSS RNG-REQ included an Serving BS ID, MSS and Target BS may skip Time of day process.

If MSS RNG-REQ included an Serving BS ID, MSS may skip the MSS configuration file download procedure.

If MSS received a REG-RSP message that included New_CID, Old_CID, and Connection_Info TLVs, MSS and Target BS may skip the establish connections procedure.

Network entry/re-entry process completes with establishment of MSS Normal Operations.

Figure 141j-m

For a managed MSS, there is the possibility that entry at the new BS necessitates layer 3 protocol exchanges in order to retain IP connectivity. Such an MSS should take appropriate steps to detect and respond to the change of BS (eg. by performing Mobile IPv4 move detection and re-registration [RFC 3344], or Mobile IPv6 Binding Update [draft-ietf-mobileip-ipv6-24.txt]).In order to minimize the handoff latency due to IP address update, if the MSS RNG-REQ included a PZID, MSS may skip the DHCP procedure or Mobile IP registration procedure.