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Minimizing IP Connectivity Delay During Network (Re)Entry

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1 Introduction

A number of contributions related to a) providing hints on neighbor BS advertisements to indicate whether a Target BS HO will incur an IP subnet/prefix/mobility agent switch and b) minimizing the delay introduced by IP connectivity acquisition following network (re)entry have been proposed so far (see references below). The HO adhoc group has recently agreed on a revision to MOB-NBR-ADV message by adding a HO optimization flag to indicate if HO to a neighbor BS would incur an IP subnet/prefix/mobility agent switch.

In this contribution, we propose a solution enabling a HO target BS in a WiMAX RAN (in one of many possible RAN configurations) to attempt to reacquire the same IP connectivity context as in with its previous serving BS based on information provided by the MSS. This mechanism is independent of the HO Optimization Flags proposal which will only work if backbone connectivity is implemented and functioning. The mechanism avoids lengthy Network Address re-acquisition negotiation process. The extensions recommended in the contribution are optional and equally applicable to Normal Operation and Idle mode operation.

2 References

[1] IEEE P802.16e/D3 draft working document.
[2] IEEE C802.16e-04/51r1, Minimization of Handoff Interruption Time Optimizing IP Address Assignment Procedure, Dongkie Lee et al.
[3] IEEE C802.16e-04/68r2, Subnet Zone ID Support, Y. Chang et al.
[4] IEEE C802.16e-04/76r2, Handover – Data Forwarding and deferring IP re-establishment, Yong-Ho Kim.
[5] IEEE C802.16e-04/90r2, Minimizing IP Connectivity Establishment Procedure, Yong-Ho Kim.
[6] IEEE C802.16e-03/NNr0, Minimization of IP Connection Re-establishment Procedure, Sungjin Lee et al.

3 Problem definition

IEEE 802.16e has currently no provision as part of network (re)entry MAC messaging for an MSS to determine if its IP connectivity context would change and skip IP context acquisition procedures it this were not to be the case. An MSS may acquire an IP address and related connectivity context information such as the DNS server address, default gateway, subnet mask and so using a variety of mechanisms such as DHCP, PPP/IPCP, router prefix advertisements, mobility agent advertisements and so on. Without reliable indications during the network (re)entry procedure, an MSS will incur delay in attempting to reacquire its IP connectivity context – and in many instances, ends up acquiring the same context as with the previous base station. Previous proposals to solve this problem have introduced concepts like Network ID, Subnet Zone ID, Access Router ID and so on, which introduce administrative overhead.

4 Overview of Proposed Harmonization

The HO Adhoc group has adopted a new HO optimization flag (bit #3) in MOB-NBR-ADV which may be set by a serving BS to indicate (a hint) if HO to the corresponding target BS may in fact incur an IP connectivity context change.

In this contribution we propose a solution that would enable a WiMAX HO Target base station to reacquire an MSS's IP connection context thereby speeding up the network entry procedure and minimizing impact of an IP address change to active applications and services on the MSS at the time of HO. The solution does not introduce any new administrative requirements and is independent of the RAN architecture which may use VLANs, PPP switching, MPLS, IP routing (v4 or v6), IP tunneling, or something else. The 2 steps involved are as follows:

1. When the MSS initially obtains an IP address either statically, through DHCP, or auto-configuration, it also obtains the Fully Qualified Domain Name (FQDN) of the Gateway Access Router (GAR). For example using DHCP, the DHCP server could be configured to offer the FQDN as follows:
   OPTION GAR-FQDN CODE 197 = text
   and then communicate the FQDN of the GAR to the MSS as
   OPTION GAR-FQDN "ar1.operator-xyz.com"
2. The MSS provides the FQDN of the previous GAR and its own (the MSSs) last IP address as an optional TLV in the REG-REQ message to a target BS as part of HO/network (re)entry procedure. This allows the target BS to find out what type of connectivity it can facilitate to the AR identified by the FQDN and inform the MSS whether it needs to re-establish its IP address or not in the REG-RSP message.

This mechanism is independent of the HO Optimization Flags proposal which will only work if backbone connectivity is implemented and functioning. The mechanism avoids lengthy Network Address re-acquisition negotiation process. If HO Omit Network Address Acquisition Flag is set, the backbone transfer of MSS service and operational context have been completed, and the MSS will omit REG-REQ/RSP.

The essential idea of the proposal is illustrated in the Figure below:

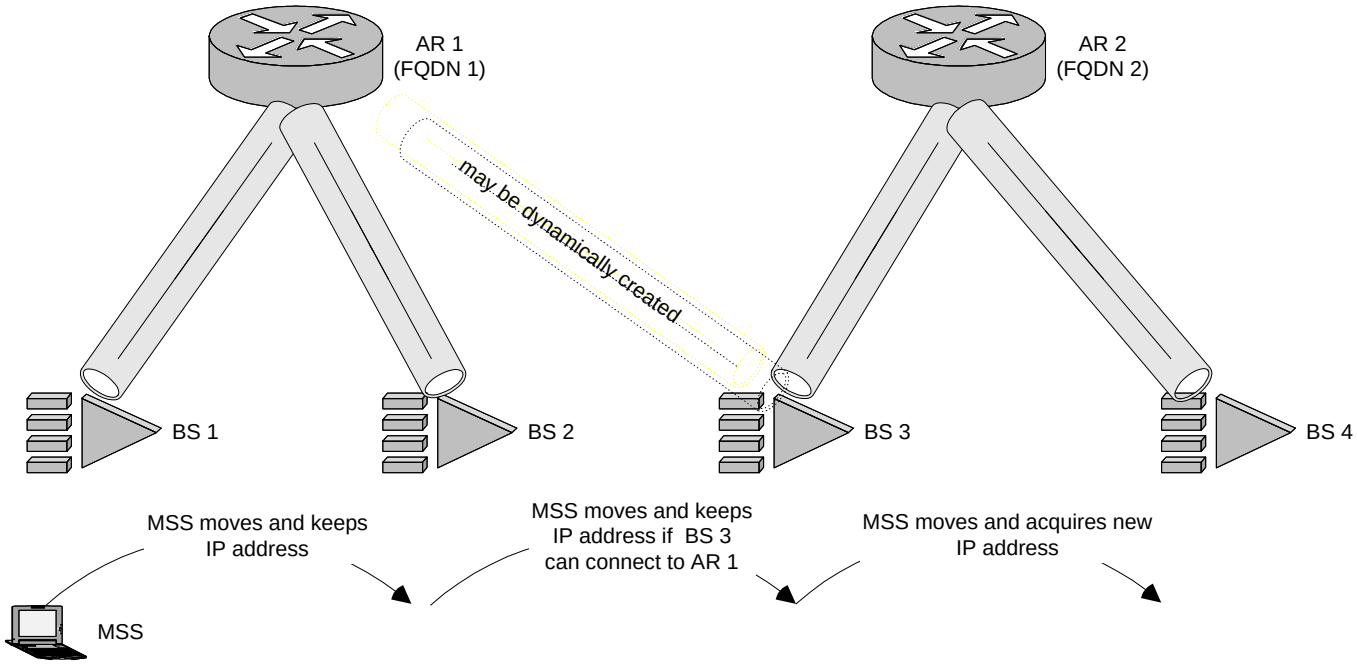

Figure 1 MSS is handed over and keeps IP address when it connects to BS 3

5 Proposed Changes to 802.16e/D3 draft:

Remedy 1:
Replace following text on page 7, starting line 54:

Finally, the Secondary Management Connection is used by the BS and MSS to transfer delay tolerant, standards-
based [Dynamic Host Configuration Protocol (DHCP), router prefix advertisements, Mobile IP, Trivial File Transfer Protocol (TFTP), SNMP, etc.] management messages. These management messages are terminated at the MSS.

with

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based [Dynamic Host Configuration Protocol (DHCP), router prefix advertisements, Mobile IP, Trivial File Transfer Protocol (TFTP), SNMP, etc.] management messages. These management messages are terminated at the MSS.

An MSS supporting the optional GAR-FQDN and MSS-PREV-IP-ADDR TLV parameters in REG-REQ message, shall store the Fully Qualified Domain Name (FQDN) of the Gateway Access Router (GAR) as part

of the standard IP host configuration procedure as the first name server (e.g. in resolv.conf on many systems). In systems using DHCP, the DHCP server shall be configured to offer the FQDN as follows:

OPTION GAR-FQDN CODE 197 = text
and then communicate the FQDN of the GAR to the MSS as
OPTION GAR-FQDN "*ar1.operator-xyz.com*"

Remedy 2:
Add the following text to the end of section 6.3.20.4

An MSS may include the GAR-FQDN and GAR-PREV-IP-ADDR TLV parameters in the REG-REQ message to a Target BS. A Target BS may return XXX in REG-RSP to indicate to the MSS if IP address (and related connection context) acquisition may be skipped for Normal Operation.

Remedy 3:
Add the following section before section 11.8, page 108, line 18:
11.7.9 GAR-FQDN
The GAR-FQDN parameter specifies the Fully Qualified Domain Name of a gateway access router (GAR). A fully qualified domain name consists of a host and domain name, including top-level domain. A FQDN always starts with a host name and continues all the way up to the top-level domain name, so www.parc.xerox.com is also a FQDN.

Type	Length	Value	Scope
9	variable	string	REG-REQ

This will be a bit string
11.7.10 MSS-PREV-IP-ADDR
The MSS-PREV-IP-ADDR parameter specifies the IP address that the MSS was assigned based on an association with its last Serving BS. An IPv4 address shall be specified in conventional dotted format; e.g. '134.234.2.3'. An IPv6 address may be expressed in abridged or unabridged form; however the form chosen shall be consistent with RFC 2373.

Type	Length	Value	Scope
10	variable	string	REG-REQ

11.7.11 SKIP-ADDR-ACQUISITION
The SKIP-ADDR-ACQUISITION parameter indicates to an MSS whether it should reacquire its IP address and related context or reuse its prior context.

Type	Length	Value	Scope
11	1	0 – No IP address change 1 – Reacquire IP address	REG-RSP