Project	**IEEE 802.16 Broadband Wireless Access Working Group <**http://ieee802.org/16**>**
Title	**Proposal for IEEE 802.16m Inter RAT Handovers**
Date Submitted	2008-07-10
Source(s)	Vivek Gupta (vivekggupta@ieee.org) Intel Corporation
Re:	Call for Contributions on Project 802.16m System Description Document (SDD) IEEE 802.16m Inter RAT Handovers
Abstract	Proposal for IEEE 802.16m Inter RAT Handovers
Purpose	Discussion and Approval
Notice	*This document does not represent the agreed views of the IEEE 802.16 Working Group or any of its subgroups*. It represents only the views of the participants listed in the "Source(s)" field above. It is offered as a basis for discussion. It is not binding on the contributor(s), who 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	The contributor is familiar with the IEEE-SA Patent Policy and Procedures: <http://standards.ieee.org/guides/bylaws/sect6-7.html#6> and <http://standards.ieee.org/guides/opman/sect6.html#6.3>. Further information is located at <http://standards.ieee.org/board/pat/pat-material.html> and <http://standards.ieee.org/board/pat>.

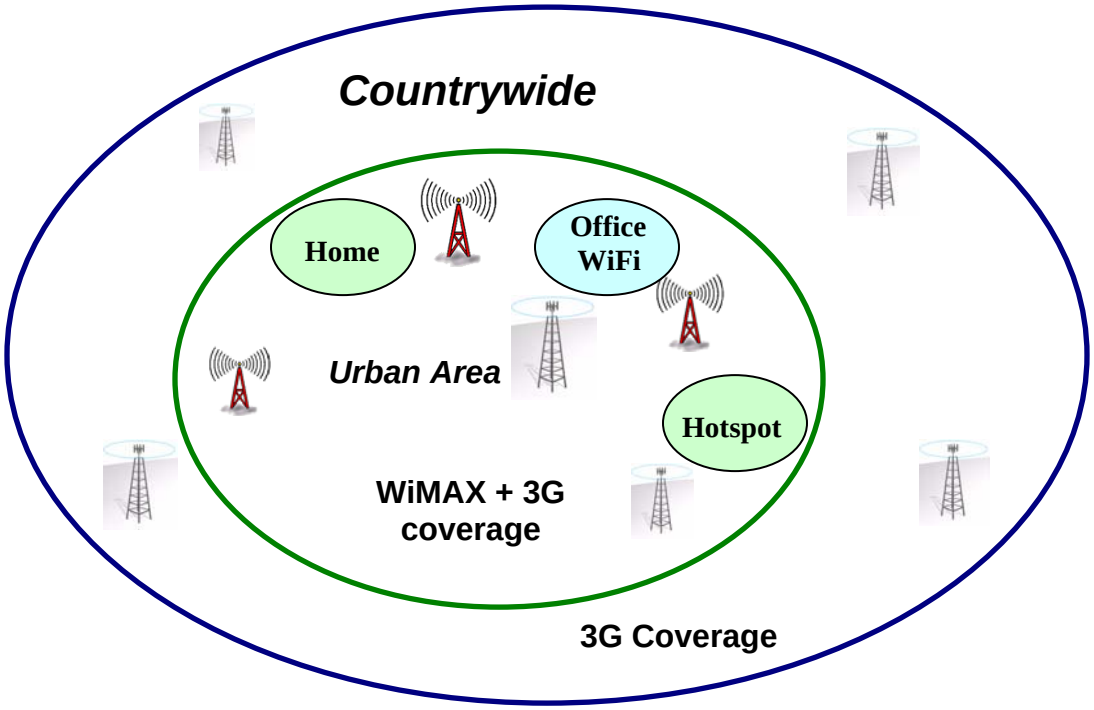
Proposal for IEEE 802.16m Inter RAT Handovers

Vivek Gupta

1. Introduction and Background

IEEE 802.16m systems need to support mobility between IEEE 802.11, 3GPP and 3GPP2 networks. There is a need to support Mobile initiated handovers wherein the handover decision is made by the MS as well as Network initiated handovers wherein the handover decision is made by the network operator. Further there is a need for 802.16m systems to support both dual radio and single radio operation.

- **Dual-Radio operation**: In this mode a dual radio device can receive and transmit simultaneously on both the radio modules. Since both the radios can be active simultaneously in these types of devices, the target radio directly connects to the target network to prepare radio resources while maintaining the connection with source network during handover.
- **Single-Radio operation**: In this mode a dual radio device can receive and transmit on only one radio at a time. This is usually the mode of operation when radio frequencies are close to each other (e.g. IMT 2000 bands). Since only one radio can be active at a time in these types of devices, the source radio and the back-end connection between the source and target network is used to prepare the target network for handover.



2. Design Principles of Handover

The following high level principles will be supported:

- It shall be possible for the operator to provide the MS with access network information pertaining to supported access technologies. The access network information may also include operator preferences based on available access technologies. The information may be restricted to the access technologies, based on the MS's current location and preferences
- The IEEE 802.16m system shall support bidirectional service continuity with other radio access technologies.

3. Analysis

The following mechanisms comprise the essential components of an effective inter-RAT handover solution.

3.1 Inter-RAT Advertisements

The following radio access technology specific parameters may be broadcast to help with Network Discovery and Selection:

1. RAT specific center carrier frequency which identifies the center frequency of neighboring cells
2. Operator Identifier: Operator identifier for the radio access network
3. PLMN ID: The identifier for the RAT specific PLMN provider
4. Version: This may be the MAC version, system version or the release version for the specific RAT.

Other access network specific information elements may be included as well. Please refer to [4] and [7].

3.2 Mobile/Network initiated Network Discovery and Selection

The 802.16m system (WiMAX network) may provide the MS with assistance/data policies about available accesses to allow the MS to scan for access networks and select an access network. The system may allow the home and visited operator to influence the access network that the MS may handover to. The WiMAX network may do this through an Information Server. The Information Server shall be able to provide:

- Access Network discovery information
- Inter-system mobility policy

IEEE 802.16m systems shall support a mechanism to retrieve this information for access network discovery and selection before authentication and after authentication. The MS should be able to query this information and obtain suitable response. Please refer to [5] and [6] for further details.

3.3 Inter-RAT Measurement Reporting

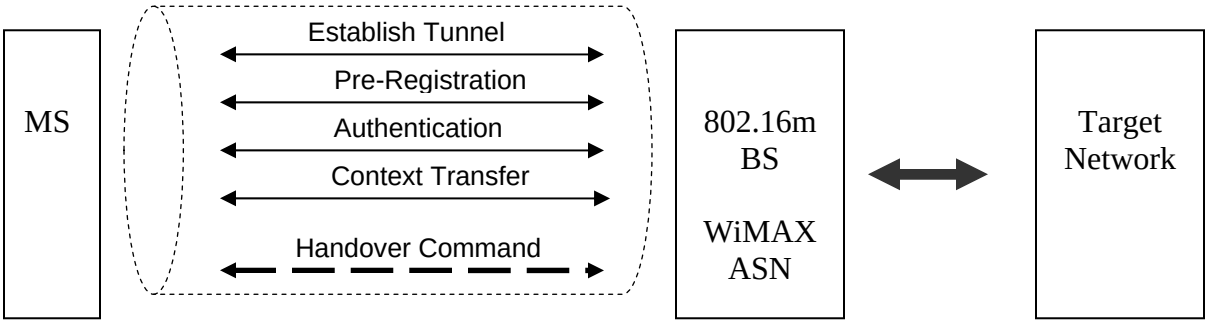
While the MS is attached to the IEEE 802.16m network and is in active mode, the MS may need to perform radio measurements on other RATs when directed by the IEEE 802.16m network. The IEEE 802.16m network will provide the MS required neighbor cell list information and measurement controls. When needed the IEEE 802.16m BS will be responsible for configuring and activating the measurements on the MS via dedicated signaling message with appropriately defined IEs.

For single-radio MSs, measurement gaps are needed to allow the MS to switch to the other RAT and do radio measurements. These measurement gaps may be MS network-controlled. In case of network-controlled scenarios the IEEE 802.16m BS is responsible for configuring the gap pattern and providing it to the MS through dedicated signaling. MSs with a dual receiver can perform measurements on other RATs neighbor cells without tuning away from the IEEE 802.16m network.

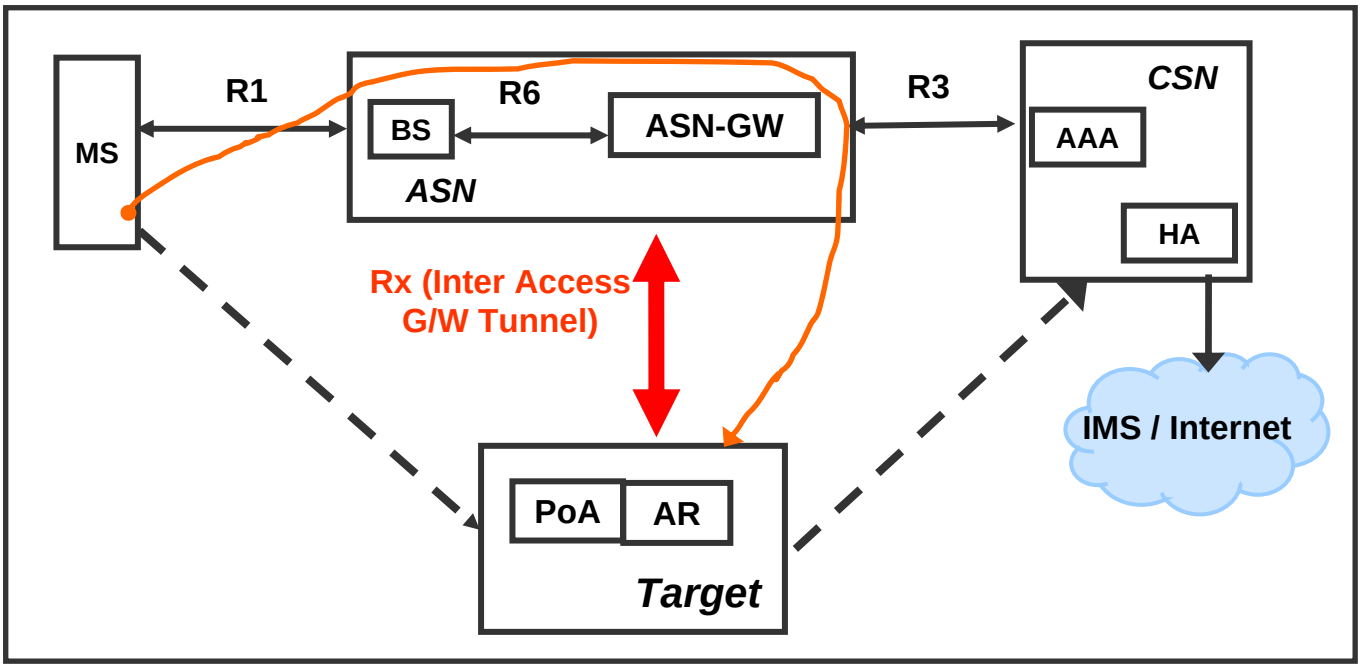
In order to assist the IEEE 802.16m BS, the MS shall inform the system of its gap-related capabilities. This capability needs to be transferred along with other MS capabilities. The MS needs to indicate if it has a dual receiver. In cases that the measurement gaps are not required, the IEEE 802.16m BS can configure measurements on cells of other RATs without the need to configure measurement gaps. No DL gap patterns will be required for MSs which are capable of simultaneous reception on the involved frequency bands. No UL gap patterns will be required for MSs which are capable of simultaneous transmission in one access and conducting measurements on another access. Please refer to [3] and [4] for further details.

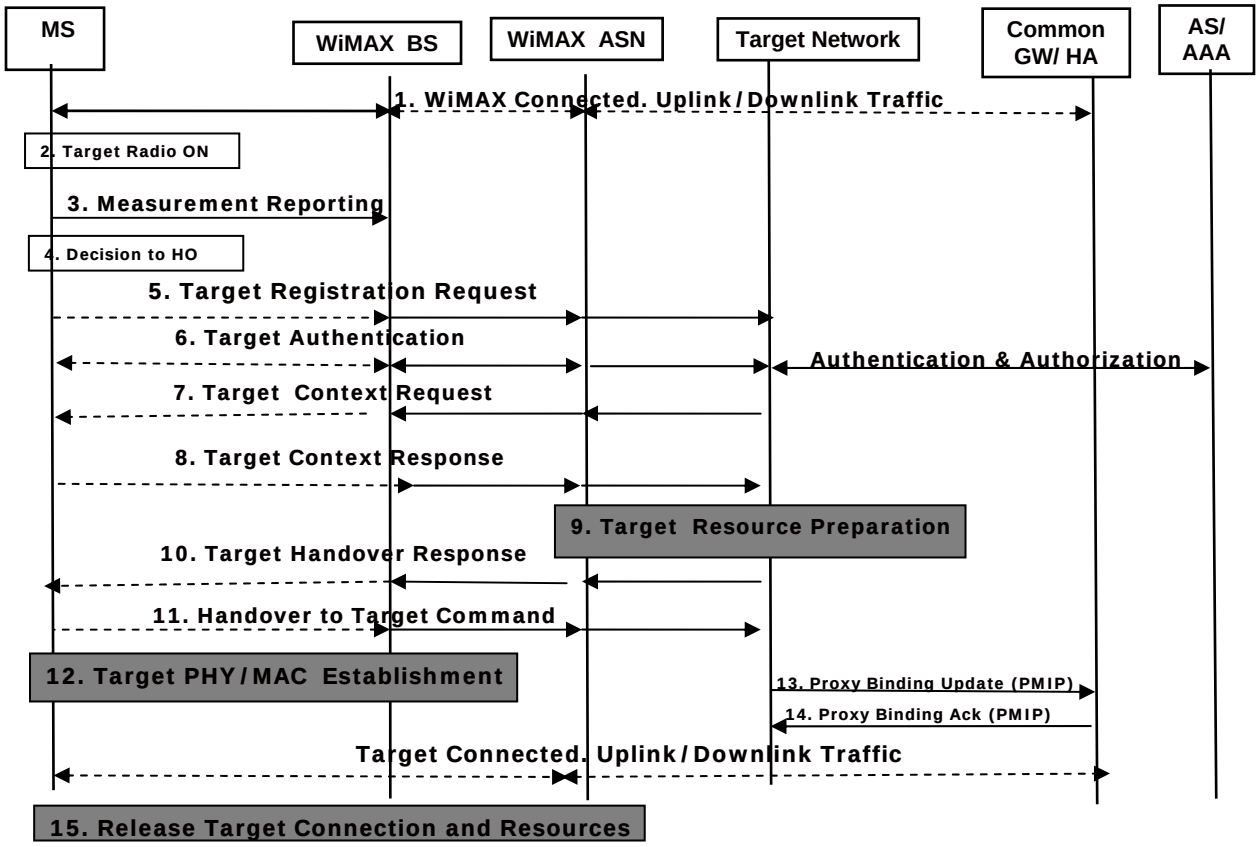
3.4 MAC Container for Handover messages

The figure below shows the main steps of single radio handover from IEEE 802.16m system to another target network. The target preparation will be done using the source network. An IEEE 802.16m MAC container will be used to tunnel all handover messages between MS and IEEE 802.16m BS.



Control Signaling through MAC Container


MS
R1
BS
R6
ASN-GW
ASN
R3
CSN
AAA
HA
Rx (Inter Access G/W Tunnel)
IMS / Internet
PoA
AR
Target


MS
WiMAX BS
WiMAX ASN
Target Network
Common GW/ HA
AS/ AAA
1. WiMAX Connected. Uplink/Downlink Traffic
2. Target Radio ON
3. Measurement Reporting
4. Decision to HO
5. Target Registration Request
6. Target Authentication
Authentication & Authorization
7. Target Context Request
8. Target Context Response
9. Target Resource Preparation
10. Target Handover Response
11. Handover to Target Command
12. Target PHY/MAC Establishment
13. Proxy Binding Update (PMIP)
14. Proxy Binding Ack (PMIP)
Target Connected. Uplink/Downlink Traffic
15. Release Target Connection and Resources

4. Proposed Text for SDD

Insert the following text in Chapter 13 Inter-Radio Access Technology Functions of the System Description Document [2]

---------- Text Start ----------

13 Inter-Radio Access Technology Functions

IEEE 802.16m systems advertise information about other RATs to help with Access Network Discovery and Selection. IEEE 802.16m systems provide a mechanism for MS to query information about other access networks in the vicinity of the MS from an information server. This mechanism can be used both before authentication and after authentication. IEEE 802.16m systems provide mechanisms for conducting inter-RAT measurements and reporting the measurement reports to network. Further, IEEE 802.16m systems specify a MAC container to support Single/Dual Radio Handover messages with other access technologies such as IEEE 802.11, 3GPP and 3GPP2. The specifics of these handover messages may be defined elsewhere.

---------- Text End ----------

5. References

[1] IEEE Std. 802.16e-2005, IEEE Standard for Local and metropolitan area networks, Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems, Amendment 2: Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands, and P802.16Rev2/D3 (February 2008).

[2] IEEE 802.16m-08/003r1, “The Draft IEEE 802.16m System Description Document”

[3] 3GPP TS 36.300: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description.

[4] 3GPP TR 36.938: “Improved Network Controlled Mobility between E-UTRAN and 3GPP2/Mobile WiMAX Radio Technologies”.

[5] 3GPP TS 23.402: "Architecture Enhancements for non-3GPP accesses".

[6] 3GPP TS 24.302: "Access to the 3GPP Evolved Packet Core (EPC) via non-3GPP access networks; Stage 3".

[7] IEEE P802.21/D12.0: “Draft IEEE Standard for Local and Metropolitan Area Networks: Media Independent Handover Services ", IEEE LAN/MAN Standards committee of IEEE Computer Society, June, 2008.