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WiMAX MBS Architecture

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1 Introduction and Scope

The rapid deployment of broadband wireless networks is raising expectation of new applications over the air interface especially in mobile environments. One of killer applications will be multimedia streaming. When many users want to receive the same multimedia service (e.g. news, live sports) at the same time, even high bandwidth wireless link resources might run into shortage if we use a point-to-point for each user.

Recently, a new kind of broadband wireless networks is emerging, IEEE 802.16 and IEEE 802.16e standards [1], [2]. The former defines the fixed broadband wireless access network and the latter augments the former for mobile communications by introducing handoff, sleep/idle mode, and multicast/broadcast service (MBS). As these specifications deal with only the air interface, another industrial forum is launched to facilitate service environments and to promote interoperability, Worldwide Interoperability for Microwave Access (WiMAX) [4].

This document describes the architecture reference model, reference points and protocols and procedures for WiMAX MBS.

2 Abbreviations and Acronyms

The following table lists several abbreviations and acronyms used throughout this document.

Table 2-1 Abbreviations and Acronyms

ABBREVIATION	EXPANSION
3GPP	Third Generation Partnership Project
3GPP2	Third Generation Partnership Project 2
ACR	Access Control Router
ASN	Access Service Network (WiMAX)
ASN-GW	Access Service Network Gateway (WiMAX)
BCAST	Mobile Broadcast Service (OMA)
BCMCS	Broadcast/Multicast Service (3GPP2)
BS	Base Station
CID	Connection Identifier
CSN	Connectivity Service Network (WiMAX)
DSA	Dynamic Service Addition
DSD	Dynamic Service Deletion
HO	Handoff
IEEE	Institute of Electrical and Electronics Engineers
IGMP	Internet Group Management Protocol
IPv4	Internet Protocol Version 4
IPv6	Internet Protocol Version 6
MAC	Medium Access Control
MBMS	Multimedia Broadcast/Multicast Service (3GPP)
MBS	Multicast Broadcast Service
MBSC	Multicast Broadcast Service Controller

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MCBCS	Multicast and Broadcast Service (WiMAX)
MCID	Multicast Connection Identifier
MS	Mobile Station
NSP	Network Service Provider
OAM	Operations and Maintenance
OMA	Open Mobile Alliance
PIM-SM	Protocol Independent Multicast Sparse Mode
PIM-SSM	Protocol Independent Multicast Source Specific Multicast
PSS	Portable Subscriber Station
RAS	Radio Access Station
SFA	Service Flow Authorization
WiBro	Wireless Broadband network
WiMAX	Worldwide Interoperability for Microwave Access Forum

3 References

[1] "IEEE Standard for Local and Metropolitan Area Networks", (*IEEE Std. 802.16-2004*).

[2] "IEEE Standard for Local and Metropolitan Area Networks", (*IEEE Std. 802.16e-2005*).

[3] "Specifications for 2.3GHz band Portable Internet Service," (*TTAS.KO-06.0082*), TTA, June 2005.

[4] "WiMAX End-to-End Network Systems Architecture (Stage 2: Architecture Tenets, Reference Model and Reference Points)," WiMax Forum Network Working Group (NWG), under revision, *www.wimaxforum.org/technology/documents/*, April 2006.

[5] "WiMAX End-to-End Network Systems Architecture (Stage 3: Detailed Protocols and Procedures)," WiMax Forum Network Working Group (NWG), under revision, *www.wimaxforum.org/technology/documents/*, August 2006.

[6] "Multimedia Broadcast/Multicast Service (MBMS); Architecture and functional description (Release 6)," (*3GPP TS 23.246 v6.9.0*), December 2005.

[7] "Interoperability Specification (IOS) for Broadcast Multicast Services (BCMCS)," (*A.S0019-0 v2.0*), 3GPP2, January 2006.

[8] "Broadcast/Multicast Services – Stage 1 Revision A," (*S.R0030-A v1.0*), 3GPP2, January 2004.

[9] "Broadcast-Multicast Service Security Framework," (*S.S0083-A v1.0*), 3GPP2, August 2004.

[10] "Mobile Broadcast Service Architecture," (*OMA-AD-BCAST-V1_0-20060329-D*), Open Mobile Alliance, March 2006.

[11] "Proposed Stage 1 Requirements for MCBCS Requirements," (*060404_SPWG_MCBCS_Requirements for Rel1dot5_r1*) Service Provider Working Group, WiMAX Forum, April 2006.

[12] B. Cain, S. Deering, I. Kouvelas, B. Fenner, and A. Thyagarajan, "Internet Group Management Protocol, Version 3," *RFC 3376*, Oct. 2002.

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[13] B. Fenner, M. Handley, H. Holbrook, and I. Kouvelas, “Protocol Independent Multicast - Sparse Mode (PIM-SM): Protocol Specification (Revised),” *RFC 4601*, Aug 2006.

[14] S. Bhattacharyya, “An Overview of Source-Specific Multicast (SSM),” *RFC 3569*, July 2003.

[15] http://www.antd.nist.gov/seamlessandsecure/toolsuite.html, IEEE 802.16 model for NS-2, NIST, Oct 2006.

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