Project	**IEEE 802.16 Broadband Wireless Access Working Group** <http://ieee802.org/16>	
Title	**Proposal for IEEE 802.16m System Architecture and Protocol Structure**	
Date Submitted	**2008-01-16**	
Source(s)	Jeff Bonta, Mike Baker, George Calcev, Benedito Fonseca, Nitin Mangalvedhe, Nathan Smith, Mark Cudak, Steve Emeott Motorola	E-mail: jeff.bonta@motorola.com mark.cudak@motorola.com steve.emeott@motorola.com *<http://standards.ieee.org/faqs/affiliationFAQ.html>
Re:	IEEE 802.16m-07/047. Contribution pertains to: Proposed IEEE 802.16m Reference Model and potential System Architectures Proposed 802.16m Protocol Architecture and main functionalities per protocol layer	
Abstract	This contribution proposes that the group adopt simple and concise reference architecture identifying all the air interface links the group will be developing—a BS to MS, RS to MS and RS to MS links—along with only the essential outline of the remaining network architecture. Moreover, this contribution proposed the group adopt a protocol architecture that describes only the fundamental components of IEEE 802.16m protocol stacks. Finally, this contribution further suggests that the IEEE 802.16m include Peer-to-Peer link consistent with proposed IMT-ADVANCED network topologies.	
Purpose	To adopt the proposed IEEE 802.16m network and protocol architectures as working assumptions	
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 System Architecture and Protocol Structure

Jeff Bonta, Mike Baker, George Calcev, Benedito Fonseca,
Nitin Mangalvedhe, Nathan Smith, Mark Cudak, Steve Emeott
Motorola

1 Overview

IEEE 802 LMSC has been charted by the IEEE Standards Association to develop MAC/PHY solutions for local area and metropolitan area networks. The IEEE 802.16m PAR has authorized the IEEE 802.16 working group to develop "advanced air interface for operation in licensed bands." The reference architecture and protocol structure adopted by TGm should remain within scope of the PAR authorization and focus on the air-interface components. In particular, the reference architecture should capture the MS to BS interface as has been captured by 16e; the BS to RS interface as is being developed by 16j and RS to MS interface that is uniquely within the charter of 16m. The details of the network interfaces are not within the scope of IEEE 802.

This contribution proposes that the group adopt a simple and concise reference architecture identifying all the air interface links the group will be developing. Contribution IEEE C802.16m-07/297, page 6, includes such an architecture defining the BS to MS, RS to MS and RS to MS links along with essential outline of the remaining network architecture. Similarly, contribution IEEE C802.16m-07/297, page 11, provides a protocol architecture that describes the fundamental components of IEEE 802.16m protocol stacks. These two diagrams alone are sufficient to meet the objectives of the task group and provide base from which to construct a harmonize solution.

This contribution further proposes modifications to the overall system architecture to enable multi-hop and peer-to-peer communications through utilizing IEEE 802.16m mobile station relays (MS). The IMT-Advanced Network Topology requirement has proposed multi-hop, mesh and P2P (peer-to-peer) modes. As such, the 802.16m operational requirements call for multi-hop relay support. A system that supports multi-hop relay with mobile relay stations (MS) will open tremendous opportunities for low cost scalable network architectures.

2 Overall Network Architecture (informative)

The Network Reference Model (NRM) is a logical representation of the network architecture. The NRM identifies functional entities and reference points over which interoperability is achieved between functional entities. The following figure illustrates the NRM, consisting of the following logical entities: MS, Access Service Network (ASN), and Connectivity Service Network (CSN).

Figure 1 depicts the overall network architecture as captured in contribution IEEE 802.16m-07/297. The figured has been modified to include the following

- Names suitable for reference for the various air-interface links to be captured by the IEEE 802.16m amendment: BS to MS, BS to RS and RS to MS. (i.e. R1.0, R1.1, R1.2)
- The addition of a MS to MS ad-hoc link consistent with P2P modes included in the IMT-Advanced Network Topology (i.e. R1.3).

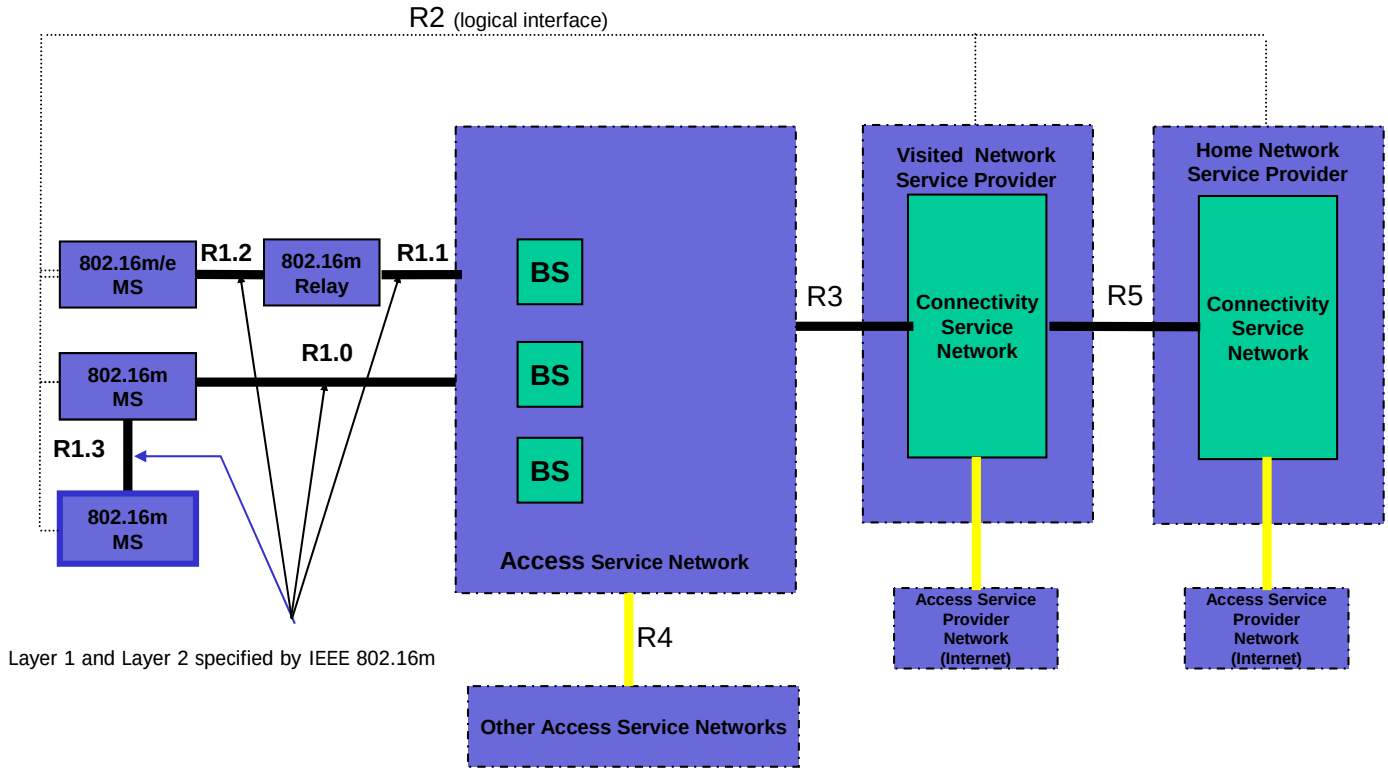

Figure 1 - Overall Network Architecture

The functions of the ASN and CSN are well known and described in section 6 of the "WiMAX Forum Network Architecture" – Stage 2 Part 1 - Release 1.1.0. In addition to the described functions for the ASN, an ASN must further support the following multi-hop relay functions for peer-to-peer communications:

- IEEE 802.16m Layer-1 (L1) and Layer-2 (L2) peer-to-peer connectivity of a remote IEEE 802.16m MS and an intermediate IEEE 802.16m MS relay utilizing an R1.3 interface via an R1.0 interface.
- Relay functionality for establishing Layer-3 (L3) connectivity of a remote IEEE 802.16m MS and an intermediate IEEE 802.16m MS relay utilizing an R1.3 interface via an R1.0 interface.
- IEEE 802.16m MS connectivity with a peer IEEE 802.16m MS via an R1.3 interface. Peer connectivity provided with supervised control via the R1.0 interface.

3 IEEE 802.16m Protocol Structure

The following figure shows the protocol architecture of IEEE 802.16e/m which will be used as a reference system. The MAC layer is composed of two sub-layers: Convergence Sublayer (CS) and MAC Common Part Sublayer (MAC CPS).

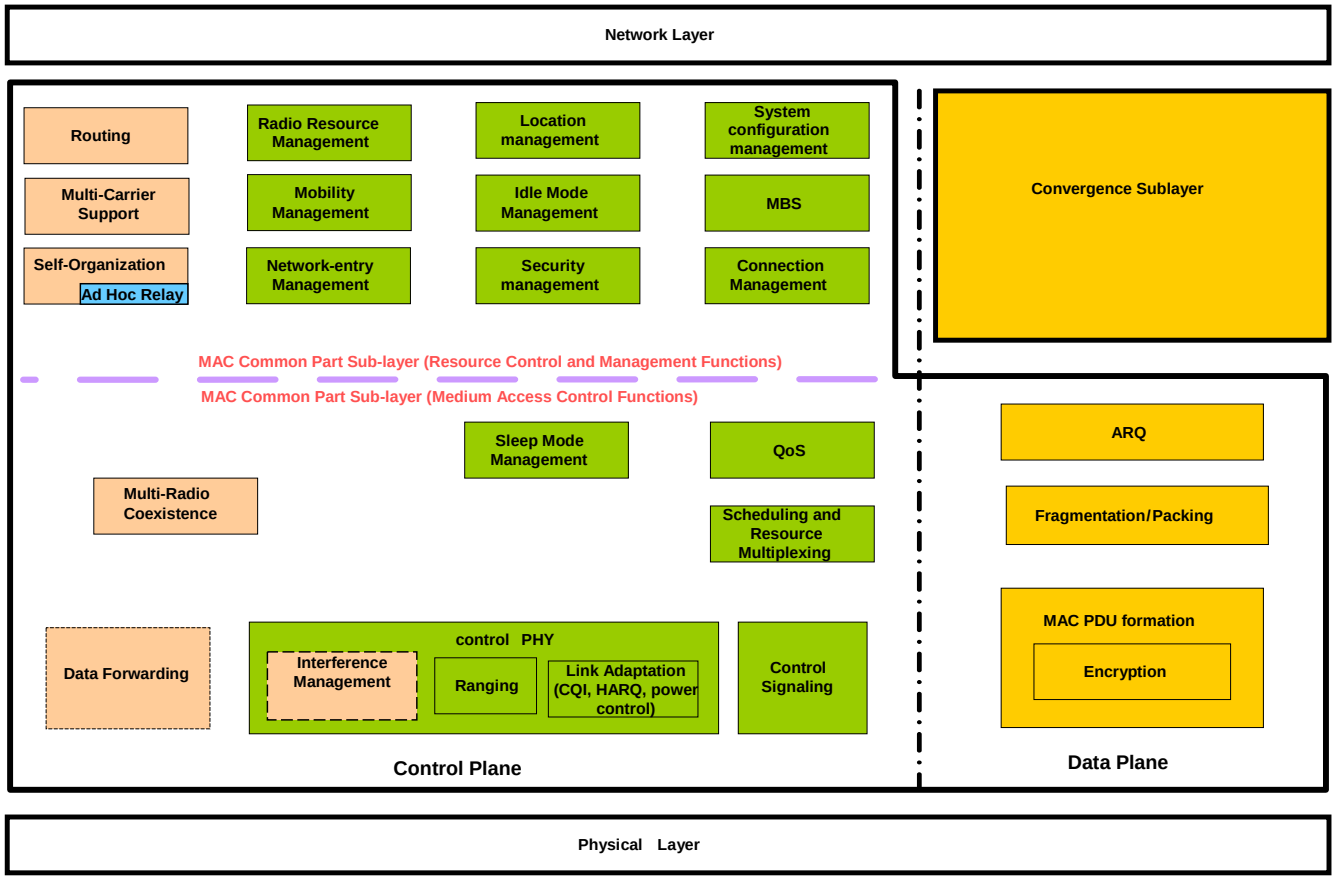

Figure 2 - IEEE 802.16m Air-Interface Protocol Structure

This figure is a modified version of the IEEE 802.16m Protocol Structure found in contribution C802_16m-07/297. The additions to this figure have been shown in blue and are further discussed with in the sections below. For convenience, the MAC CPS functions are logically classified into two groups based on their characteristics. The upper group is named resource control and management functions, and the lower group is named medium access control functions. The control plane functions and data plane functions are also separately classified.

3.1 Resource Control and Management Functions

The IEEE 802.16e resource control and management functional group includes several related functional blocks such as:

- Radio Resource Management
- Mobility Management
- Network-entry Management
- Location Management
- Idle Mode Management
- Security Management
- System Configuration Management

- MBS
- Connection Management

IEEE 802.16m builds on the MAC architecture of current IEEE 802.16e. In our proposed MAC architecture for IEEE 802.16m, we include additional functional blocks for newly proposed features, identified as:

- Routing
- Multi-Carrier Support
- Self-Organization

3.2 Medium Access Control Functions

The IEEE 802.16e/m medium access control functional group includes several related functional blocks such as:

- PHY Control (including signaling for ranging and link adaptation)
- Control Signaling
- Sleep Mode Management
- QoS
- Scheduling and Resource and Multiplexing
- ARQ
- Fragmentation/Packing
- MAC PDU formation

IEEE 802.16m builds on the MAC architecture of current IEEE 802.16e. In our proposed MAC architecture for IEEE 802.16m, we include additional functional blocks for newly proposed features, identified as:

- Multi-Radio Coexistence
- Data Forwarding
- Interference Management

3.3 Functional Block Descriptions

A detailed description of the functional blocks for the Resource Control and Management functions and the Medium Access Control functions are not provide here. However, a number of these functional blocks will require additional capabilities to control multi-hop relay between peer IEEE 802.16m MSs via an R1.3 interface. Multi-hop relay control also includes relay through an MS to a remote MS that is out of the coverage of the IEEE 802.16m BS. The details of these capabilities will be addressed in future MAC contributions. As noted earlier, new functional blocks are proposed. Of particular significance to multi-hop relay are the proposed Routing and Self-Organization functions.

The Self-Organization block includes ad hoc relay support for network synchronization procedures related to the configuration and control of IEEE 802.16m MSs that are out of the coverage of the IEEE 802.16m BS via an R1.3 interface.

The Routing block manages the discovery and maintenance of multi-hop relay connections through IEEE

802.16m MSs and intermediate IEEE 802.16m MS relay utilizing an R1.3 interface.

4 Suggested Changes

This document proposes the adoption of additional interfaces between 802.16m mobile stations in the 802.16m system architecture, inclusion of self-organization and routing functional blocks in the 802.16m protocol structure. This also has implications on the required sections of the System Description Document. Specifically, it is proposed that the SDD be modified as follows:

In the section titled “Overall Network Architecture (informative)”, include Figure 1 from this contribution inclusive of the R1.3 interface and optionally include the supporting text from section 1 of this contribution

In the section titled “IEEE 802.16m Air-Interface Protocol Structure”, include Figure 2 from this contribution and optionally include the supporting text for the functional block definitions found in section 3 of this contribution.