WiMAX Forum Network Architecture

(Stage 2: Architecture Tenets, Reference Model and Reference Points)

[WiMAX Interworking with DSL]

Release 1.1.0

July 11, 2007

WiMAX Forum Proprietary

Copyright © 2005-2007 WiMAX Forum.   All Rights Reserved.

1 **Copyright Notice, Use Restrictions, Disclaimer, and Limitation of Liability.**

1 **TABLE OF CONTENTS**

10

11 **TABLE OF FIGURES**

16

1. Internetworking with DSL

Note: See §3.0 References in *WiMAX Forum Network Architecture [Part 1]* for references cited in this document.

1.1   DSL Reference Architecture

A simplified DSL reference model for the most common scenarios according to [62], [63], [64] and [75] of the DSL Forum is depicted in Figure 1. At the bottom of the picture the protocol layering is shown for the PPP over Ethernet as well as for the IP over Ethernet case.
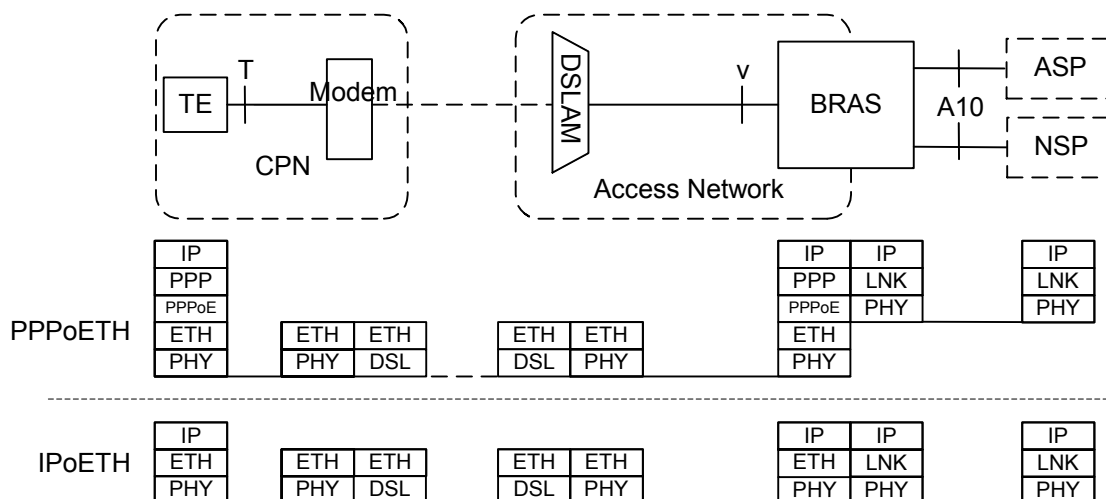
Figure 1 - DSL Reference Architecture

Figure 1 denotes the following reference points:

T: Interface between terminal equipment and DSL modem in the customer premises network (CPN)

V: Ethernet aggregation in the access network

A10:   Interface between the access network and service providers. This interface connects either an Application Service Provider (ASP) to the Network Service Provider (NSP) owning the access network or in sharing scenarios the NSP with the access network.

Current DSL deployments for pure data services are mostly based on PPP over Ethernet as link protocol between BRAS and TE for the IP configuration of the terminal and the control and management of the IP link to the terminal. Regarding DSL deployments allowing QoS provisioning (typically used for delivering Data + voice + video service), they are mostly based on IP over Ethernet model.

1.1.1   DSL Service Based on PPPoETH

Widely used as protocol for commercial dial-up access to the Internet, PPP provides all the control functions operators require also for providing broadband access. With the evolution from ATM towards Ethernet as universal link layer protocol, PPP has to be encapsulated into PPPoE frames to emulate on top of Ethernet the point-to-point connectivity, for which PPP is designed for. With the application of PPPoE, just a plain Ethernet network is required between BRAS and TE.

1.1.2   DSL Service based on IPoETH

IP over Ethernet fully relies on DHCP for identification and for the configuration of the customer premises equipment. Additionally, IEEE 802.1x security framework may be used if deemed necessary by the DSL operator.

1.1.3 DSL Internetworking Scenarios

According to the DSL reference architecture the end-to-end DSL network consists of several providers. The role of the Application Service Provider, the Network Service Provider and the Access Service Provider in the DSL reference architecture is similar to the role of the ASP, NSP and NAP in the WiMAX reference architecture.

Aligned to the provider structure of the DSL reference architecture, internetworking between a mobile WiMAX network and a DSL network can be established at different stages of the end-to-end DSL network.

Internetworking Between a Mobile WiMAX Network and a DSL Access Network

Internetworking Between a Mobile WiMAX Network and a DSL NSP Network

The migration of DSL access networks towards Ethernet based aggregation introduces a V reference point in the architecture which allows the combination of a mobile WiMAX network with a DSL access network based on Ethernet bridging. The details of this reference point are defined in WT-101 of the DSL Forum.

A WiMAX network providing plain Ethernet bridging capabilities can be used to extend the reach of a DSL access network over wireless links.

Details of this kind of internetworking are described in Section 1.2 for WiMAX systems based on IEEE802.16-2004 and in Section 1.4 for the mobile WiMAX network.

This internetworking scenario usually requires support of the Ethernet CS in the base station. Under special conditions (only IPoETH DSL service, only single host CPE) also the use of the IP CS is possible.

Internetworking Between a Mobile WiMAX Network and a DSL NSP Network

TR-059 defines the interface between the DSL access network and the DSL NSP network. This interface is denoted A10-NSP and exists in two different flavors. One version is based on forwarding of layer 2 PPP connections over L2TP; the other version describes a layer 3 IP routed interface similar to the R5 interface in the WiMAX architecture used for the roaming case. By use of an appropriate interworking unit it is feasible to convert WiMAX R5 to the IP routed version of the A10-NSP. This kind of internetworking is further detailed in Section 1.3.

It is not possible to provide internetworking between mobile WiMAX and a DSL NSP based on the L2TP version of A10-NSP because the mobile WiMAX network does not handle PPP connections.

Internetworking Between a Mobile WiMAX Network and a DSL ASP Network

[64] also defines the interface A10-ASP between the DSL access network and the DSL ASP network. Internetworking between a mobile WiMAX network, which includes mobile WiMAX Terminals and a DSL ASP network can be achieved by the use of an interworking unit between WiMAX R5 (non-roaming case) and the A10-ASP.. Further details about this kind of internetworking are also provided in Section 1.3.

1.2 Integration of IEEE Std 802.16

Requiring only plain Ethernet bridging behavior between BRAS and TE for both cases, the PPPoETH as well as the IPoETH, allows the replacement of the DSL link by another transmission technology without any impact in the higher layer network architecture. As shown in Figure 2 the first generation WiMAX technology according to [1] is easily deployable in a DSL network by just replacing the DSL link by a wireless WiMAX link providing Ethernet bridging behavior.

At the bottom of the Figure 2 the protocol layering is drawn for both cases, the PPP over Ethernet as well as IP over Ethernet, and highlights the replacement of just the DSL link by a wireless link according to [1].
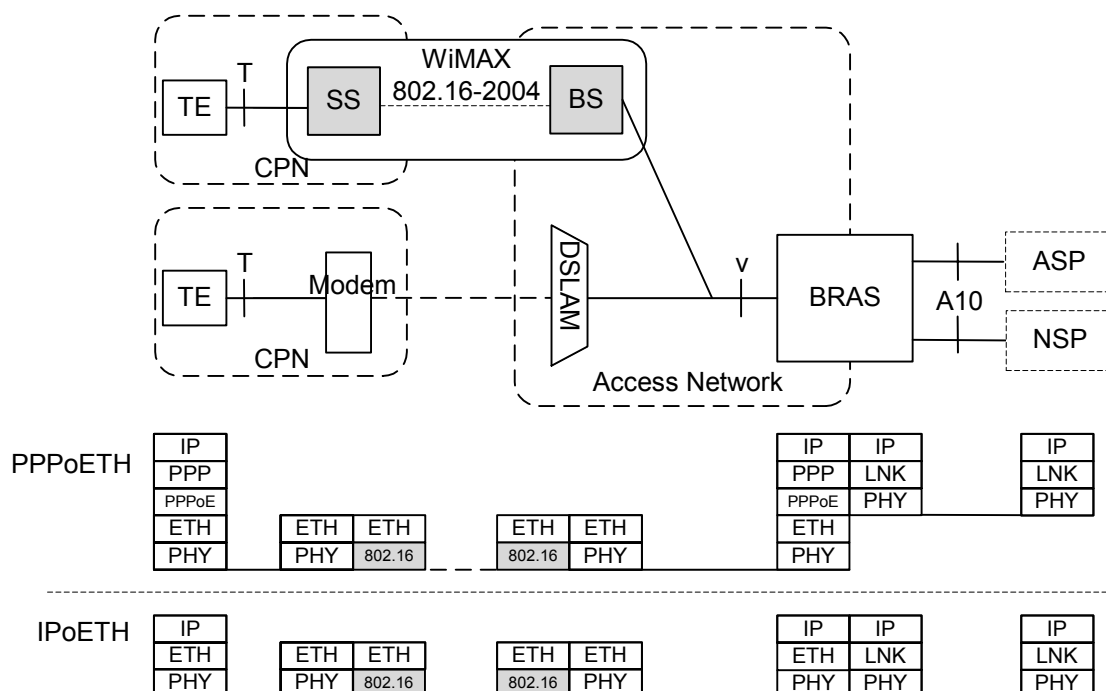
Figure 2 - WiMAX IEEE 802.16 FWA Deployment in a DSL Network

While [1] nicely fits into DSL architectures, [2] and its mobile WiMAX network architecture introduces a number of new network functions.

1.3   Interworking of Mobile WiMAX with DSL Services (A10 Interworking)

The mobile WiMAX network architecture describes a whole network with a two-layer mobility management structure and additional network elements to control mobility and enhanced security of terminals moving in a large area wireless network. Instead of PPP the enhanced 802.16 security sub layer PKMv2 and DHCP are used for terminal configuration and link control and management.

For mobile applications requiring MIP based mobility management provided by R3 between ASN and CSN the WiMAX network is assumed to integrate with the services provides by a DSL core via an IP interface between the CSN and the DSL core. The IWU as shown in the Figure 3 below mediates the R5 interface of WiMAX to an A10 conformant interface for integration with the services provided by the DSL core. The IWU may also co-locate a DHCP relay to access a DHCP server in the regional broadband network.

The use of EAP over RADIUS is presumed for AAA over R5 to enable authentication of mobile WiMAX users accessing DSL services.
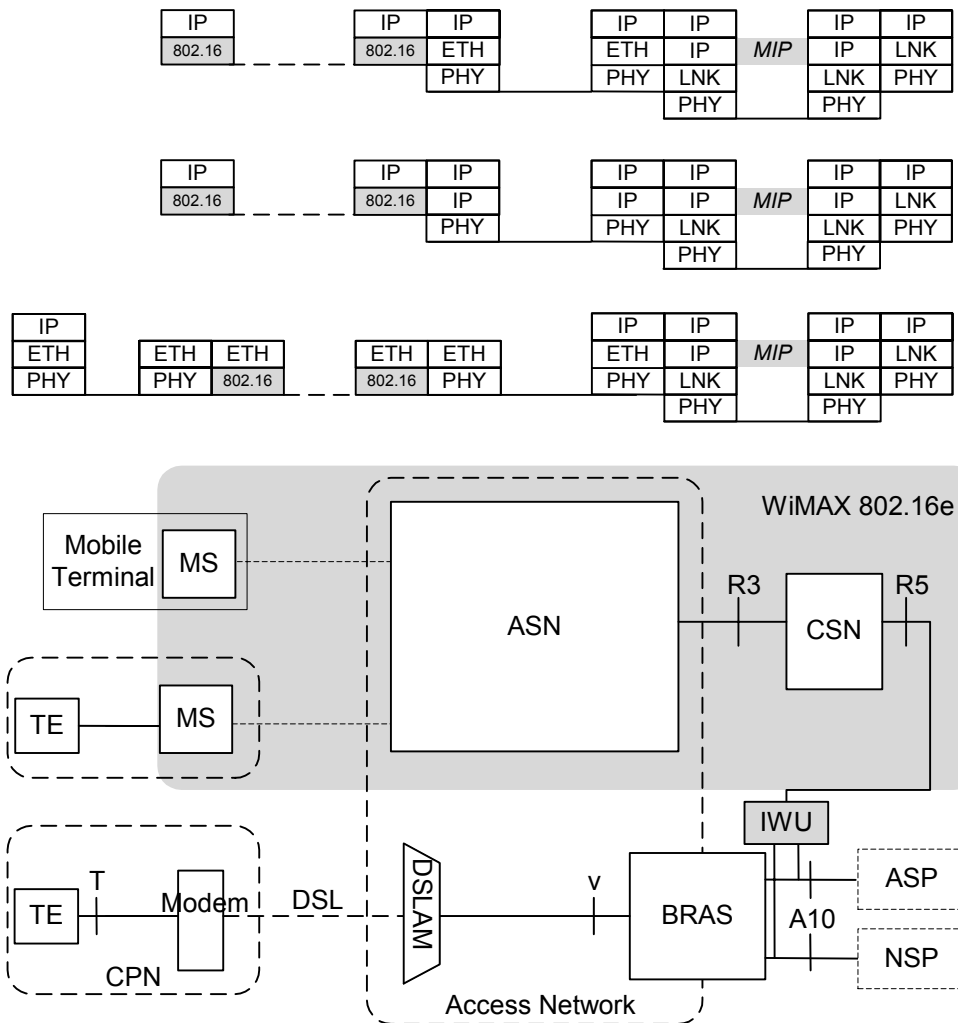
Figure 3 - WiMAX Integration with DSL Services

1.4   Interworking of Mobile WiMAX with DSL Access Networks (V Interworking)

For mainly fixed and nomadic WiMAX applications exposing the T reference point of the DSL architecture to the customers, the solution presented above is not suitable due to the unavailability of Ethernet bridging over R3 towards CSN.

When Ethernet bridging is available over the air (ETH CS) and within the ASN, Ethernet packets can be forwarded to the V aggregation point at the BRAS by a direct link between the ASN and the Ethernet aggregation point in the DSL access network. In this case the Ethernet-enabled ASN can be reused to bridge PPPoE packets across a single ASN bypassing the functions of the R3 reference point .While user data is carried directly to the V aggregation point, there is still a need for a mobile WiMAX network compliant control plane for establishing the bridging connectivity across the air. As user authentication is performed within PPPoE, device authentication and the PKMv2 security framework should be applied for the bridging MS to establish the 802.16e link. The appropriate forwarding configuration inside the ASN is established during the service discovery phase of PPPoE when the client detects the MAC address of the BRAS offering the wanted service.
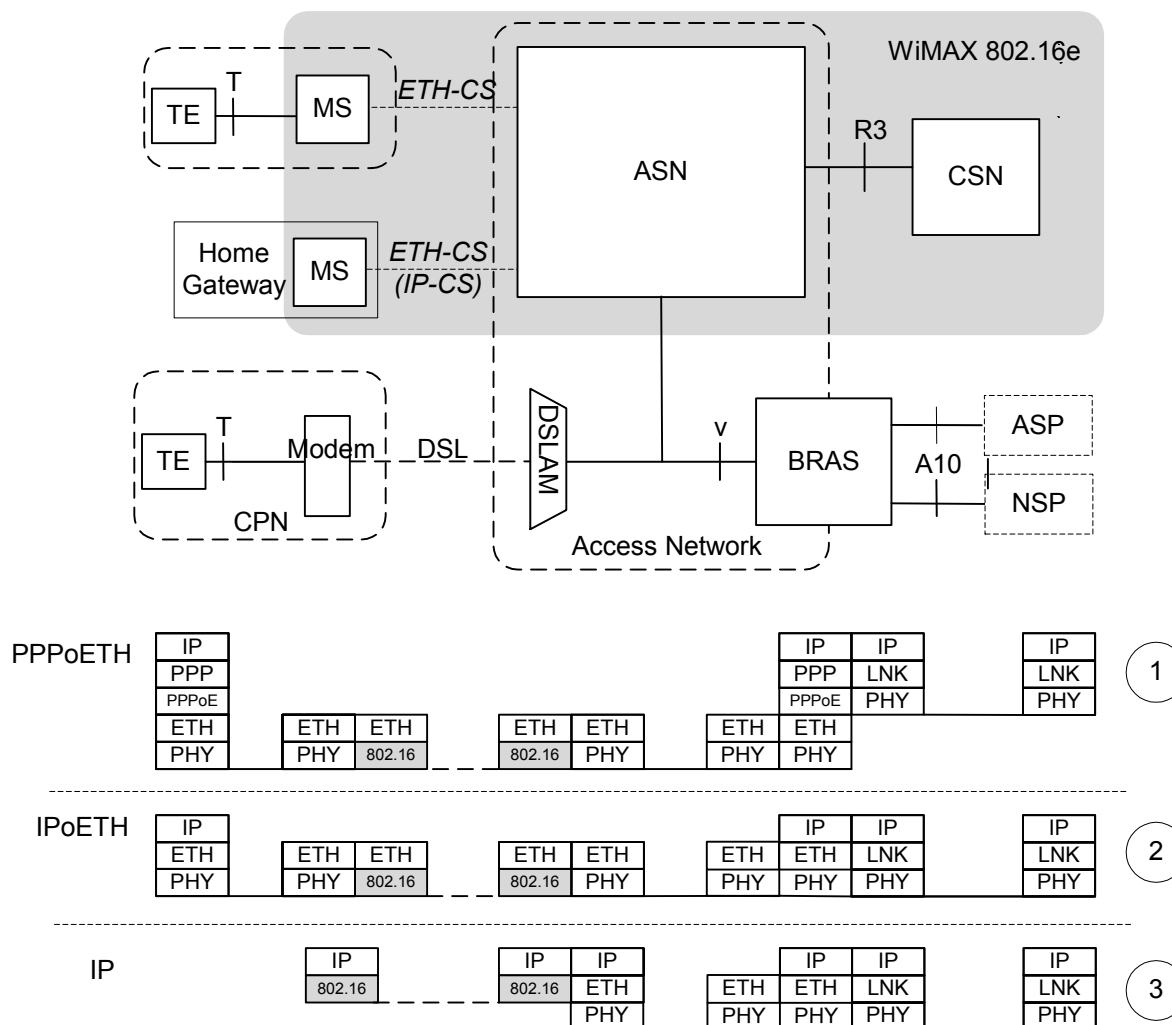
Figure 4 - WiMAX Integration with DSL Access Networks

3   This allows the integration of a mobile WiMAX network with a DSL network for offering DSL-like network
4   interfaces for cases when WiMAX mainly replaces the wire usually required for DSL services. Option 1 in the
5   protocol layering drawing at the bottom of Figure 4 shows the case for PPPoE.

6   While this kind of integration lacks the wide-area mobility management service it still remains the enhanced radio
7   resource management, load balancing and security features of [2].

8   Also the IP over Ethernet DSL case can be integrated with an Ethernet based implementation of a mobile WiMAX
9   network as shown for option 2 in the protocol layering drawing in the Figure 4 above. In that case, applying the
10   PKMv2 security framework ensures security.

11   When Ethernet binding is available in the ASN but not over the air, as IP CS is used, uplink IP packets over 802.16
12   frames can be encapsulated at the BS in Ethernet frames and forwarded northbound to the V aggregation point at the
13   BRAS by a direct link between the ASN and the Ethernet aggregation point in the DSL access network. This is
14   depicted by the option 3 in the protocol layering drawing in the picture below. In this case, the user plane in the
15   ASN allows for forwarding of Ethernet frames. As in the previous case, applying the PKMv2 security framework
16   ensures the security.