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Title	System Reference Model and Protocol Stack for Broadband Wireless Access		
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Re:	This document responds to the "call for contributions" of 802.16sc-99/12, published on 20 May 1999 for a System protocol and a reference architecture for broadband wireless access.		
Abstract	In this contribution, we propose an improved system architecture focusing on system reference and protocol stack for broadband wireless access networks. The proposal aims to construct an open packetized platform for wireless access and wireless networks. This solution can greatly increase the spectrum utilization rate while providing good quality of service in broadband wireless multimedia communications.		
Purpose	Contribution to IEEE P802.16 for the proposal of broadband wireless access system architecture		
Notice	This document has been prepared to assist the IEEE P802.16. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) reserve(s) the right to add, amend or withdraw material contained herein.		
Release	The contributor acknowledges and accepts that this contribution may be made publicly available by 802.16.		

System Reference Model and Protocol Stack for Broadband Wireless Access

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Introduction

Broadband Wireless Access (BWA) systems have gained an increased interest during the last two years. This has been fuelled by a large demand on high frequency utilization resulting in a crowded spectrum as well as a large number of users requiring simultaneous multi-dimensional high data rate access. BWA uses a new network architectures to deliver broadband services in a fixed point-to-point or point-to-multipoint configuration to residential and business customers and supports voice, data, video distribution services and emerging interactive multimedia communications. Large bandwidth, lower installation cost and ease of deployment coupled with recent advancements in semiconductor technologies for wireless applications make BWA an attractive solution for broadband service delivery.

However, most of the current wireless access architectures are based on channelized circuit switching, which becomes an obstacle in raising the spectrum utilization for wireless multimedia services. Also, the connection-oriented networks and services result in fixed bandwidth allocation which restricts the service environment as well as the network infrastructure.

The future wireless network should be an open platform supporting multi-carrier, multi-bandwidth and multi-standard air interfaces, and content-oriented bandwidth-on-demand (BoD) services will dominate throughout the whole network. In this way, the packetized transmission will go all the way from one wireless end terminal to another directly.

In this contribution, we propose an improved system architecture focusing on the system reference model and protocol stack for broadband wireless access systems. This proposed system differs from conventional BWA and offers many technological and operational advantages. The major benefits are that we greatly simplify the network design and reduce the system cost. The BWA base station is now a smart open platform with a basic broadband hardware pipe embedded with a CAI BIOS (Common Air Interface, Basic Input/Output System). Most functional modules of the system are software definable and re-configurable.

System Reference Model

As mentioned in the previous section, the future wireless access system will be packet oriented instead of circuit switching. This evolution includes [1]:

Today: *Circuit*	**Tomorrow: *Packet***
• Channelized	• Packetized
• Connection-oriented services	• Content-oriented services
• Connection-oriented networks	• Connectionless networks
• Fixed bandwidth	• Bandwidth on Demand
• Proprietary network infrastructure	• Open network infrastructure
• Closed service environment	• Open service environment
• Dumb terminal	• Smart terminal
• Separate systems	• Harmonized systems

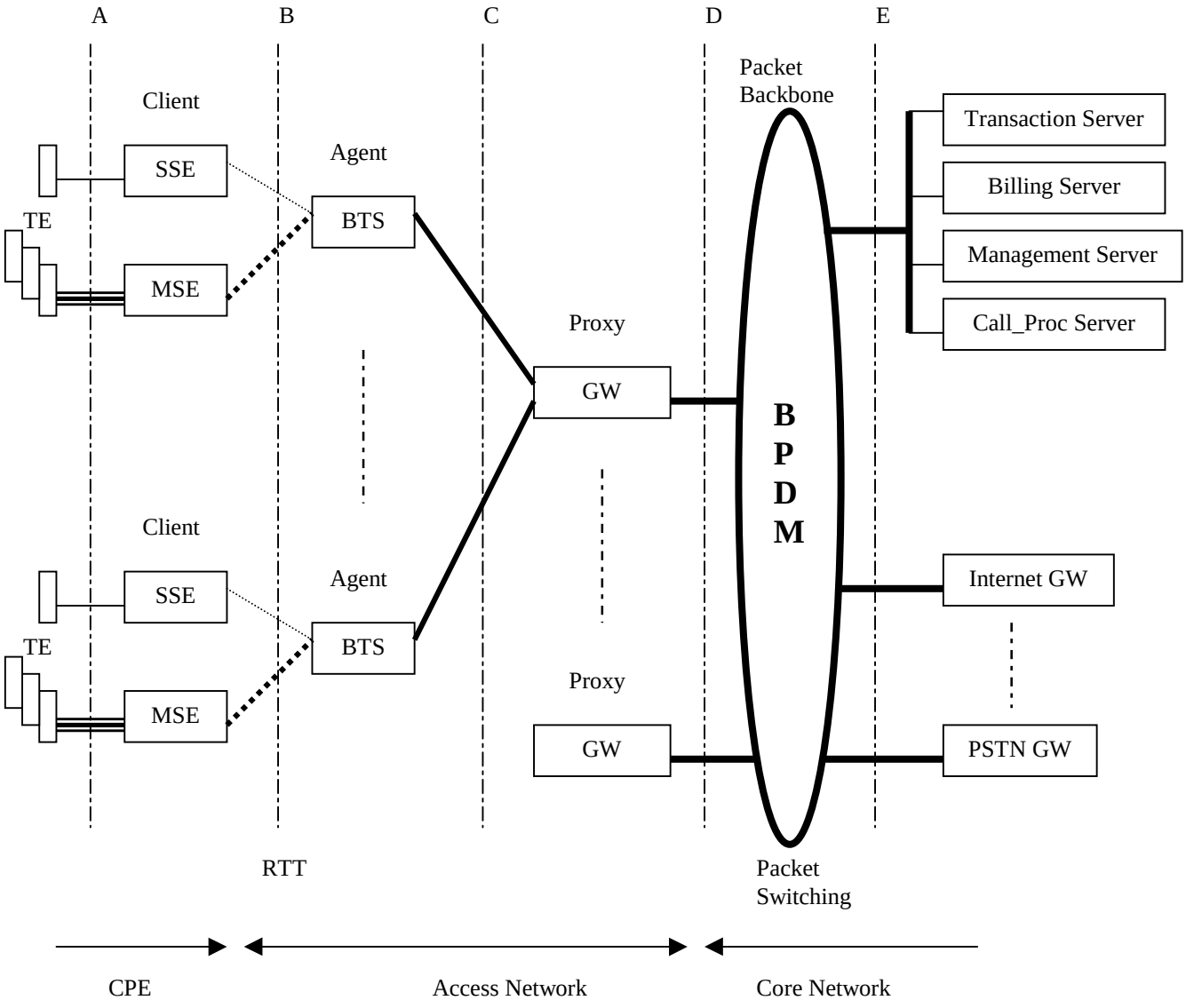
The proposed reference model is shown in Figure 1, where the packet switching is distributed in the broadband packet backbone (or core network). The wireless call processing, as well as other console processing, is handled in this network. The Gateway (GW) acts as proxy for the Core Network and deals with any issues for the Base Transceiver Station (BTS). The BTS contains a basic broadband hardware pipe with embedded Common Air Interface (CAI) and Basic Input/Output System (BIOS) control software. In this way, the BTS is an open platform supporting various standards and optimized for full harmonization.

The Radio Transmission Technology (RTT) of BWA employs several generic solutions. First, the broadband wireless transceiver is composed of a multi-frequency converter (Analog to Digital, Digital Down-Converter, and vice versa), filter and amplifier. Secondly, an adaptive antenna array with digital beam forming technology can be adopted to improve the wireless transmission performance. Thirdly, a packetized wireless link ensures dynamic channel allocation in the shared wireless medium, and therefore increases the spectrum utilization. The physical air interface is also open for different options. For example, wATM (wireless ATM) [2] technology can be deployed to support variable rate services with guaranteed QoS (Quality of Services).

To make the BTS operable in various modes or upgradable, most of the functional modules are software definable, and located in the backbone core network. Therefore, the link between BTS and the Core Network through the Gateway needs enough bandwidth. This can be easily done by using currently available network transmission technologies, i.e. ATM AAL2 and AAL5.

The proposed BWA network can also flexibly interoperate with other networks (e.g. PSTN), terminated at the Core Network access point through different GW modules. But, if the communicating parties are within the same packet network (either wireless or wireline), the signaling occurs directly between these two end terminals. In this way, from the transmission point of view, the core network is transparent for this kind of packet link.

The Broadband Packet Division Multiplex (BPDM) Core Network can be any packet network, e.g. IP over ATM. The BWA packet switching is distributed and executed in this BPDM backbone. Therefore, we do not have to implement a separate Wireless Switching Center (WSC), thus greatly reducing the system cost. In addition, the Base Station Controller (BSC) is also omitted since the call processing and wireless network management are now centrally done in the core network, and the wireless access control function (per different air interface) becomes the software definable module uploadable through Core Network Proxy - GW.



SSE: Single Subscriber Equipment

MSE: Multiple Subscriber Equipment

BTS: Base Transceiver Station

CPE: Customer Premise Equipment

GW: Gateway

TE: Terminal Equipment
RTT: Radio Transmission Technology
BPDM: Broadband Packet Division Multiplex

Figure 1: Proposed System Reference Model for BWA

Protocol Stack

Considering the protocol stack of this proposed BWA system, the client-server model is established between a wireless terminal and the core network. The BTS becomes the agent in both directions. Figure 2 shows an example of the protocol stack for the proposed BWA system [3].

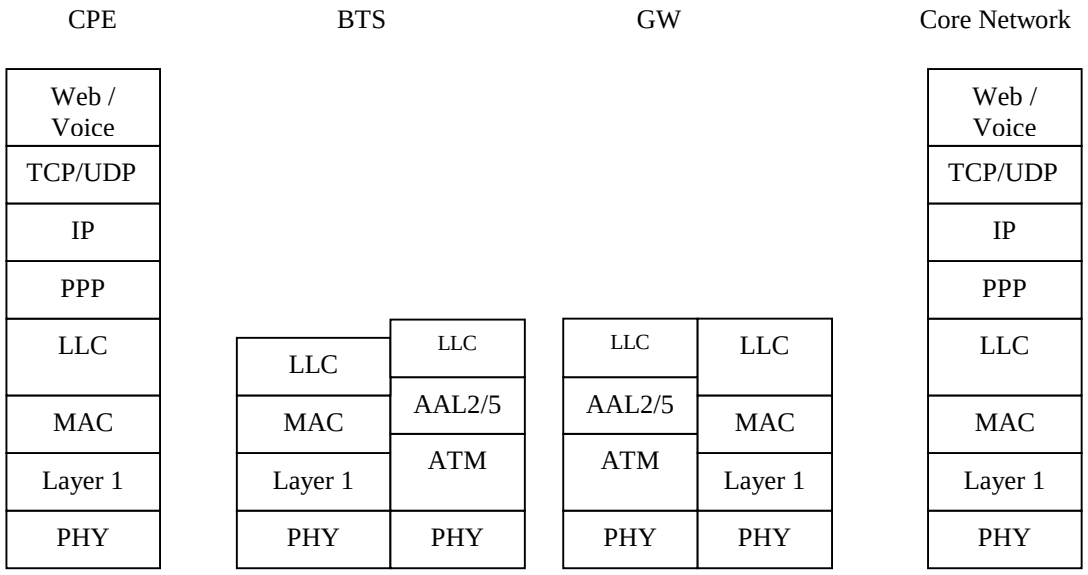


Figure 2: Example of Protocol Stack for BWA System

On the Core Network side, any packet network can be utilized, e.g. IP over ATM. In the wireless link, IEEE 802.16 will cover the issues on MAC (Medium Access Control) and LLC (Logic Link Control). "PPP" is used to establish a direct connection between the communicating parties. If the connection is not terminated at the core network, the "PPP" stack is not necessary.

Conclusion

In this contribution, we introduce and describe an improved system architecture focusing on the system reference model and the protocol stack for the broadband wireless access networks. The proposed solution reflects the newest advancements in wireless communications and greatly increases the spectrum utilization efficiency.

Reference

[1] Proc. Of 1999 IMT-2000 3rd Generation Wireless Technology Conference. Feb 10-12, 1999. New Orleans, USA.

[2] Lou Dellaverson, Evolution of a Global Standard on WATM. ATM Forum, 1999.

[3] Proc. Of 1999 Wireless Symposium. Feb. 22-26, 1999. San Jose, USA.