

Wireless Infrastructure

WinMax™ - Silicon and Software for WiMAX

WINPATH™ ACCESS PACKET PROCESSORS

Highlights

- **Increased Integration:** WinMax provides a **single-chip solution for WiMAX-MAC control and data path components.**
- **Software Suite:** Complete WiMAX-MAC software implementation integrated with Wintegra production quality code library.
- **Platform Scalability:** Features that require multiple devices and technologies can be collapsed into the fully programmable WinPath architecture. Platforms based on WinMax can utilize the same silicon and software architecture as original WinPath designs, and can quickly accommodate the evolving wireless infrastructure standards changes with a simple DPS software update.
- **Optimized Overall Data Path Performance:** The performance of the highly integrated system is optimized to the device required – so the overall cost of the system can be balanced to the performance throughput. WinMax processors have all the interfaces to PHYs on-chip (for both the 802.16d/e versions of the specifications) and incorporate all the required features for security processing.
- **Power consumption:** Power consumption of WinMax is very low (less than 3.5 Watts), well suited for power sensitive designs.

WinMax for WiMAX Systems

The growth of broadband wireless traffic using Wi-Fi has been evident over the last few years and with the continued growth of voice and data traffic services, a significant effort has been invested in developing technology to further support this evolution. In particular, WiMAX defined by the IEEE in the 802.16 standard helps to further develop an open standard for broadband wireless access.

The processing requirements in a WiMAX Base Station (BS) design are typically divided between two logical processing modules, the network card, and the access module. The network card is primarily responsible for the overall traffic aggregation and secured connectivity to the core network (either ATM and/or IP based backhaul) and for the BS management. Wintegra has a complete silicon and software offering for the network card with a production quality suite of data path software plus silicon with the



requisite interfaces and performance. This document focuses primarily on the access module. Additional information on network card designs is available from Wintegra.

The access module is a cluster of access cards which are responsible for the implementation of the Media Access Control Layer (MAC) and Physical Layer (PHY) of the wireless broadband access systems as annotated in the 802.16-2004 and 802.16e standards (fixed and mobile respectively).

This document introduces WinMax, a WinPath variant specifically designed for the WiMAX-MAC function. Use of WinMax for the WiMAX-MAC layer is explained, including a description of the data path and control services supplied plus the connectivity to PHY technology which implements the WiMAX PHY layer.

The Benefits of a WiMAX Implementation Approach Using WinPath

The main benefits of using the WinPath architecture for handling the WiMAX-MAC layer functions in a BS access card are as follows:

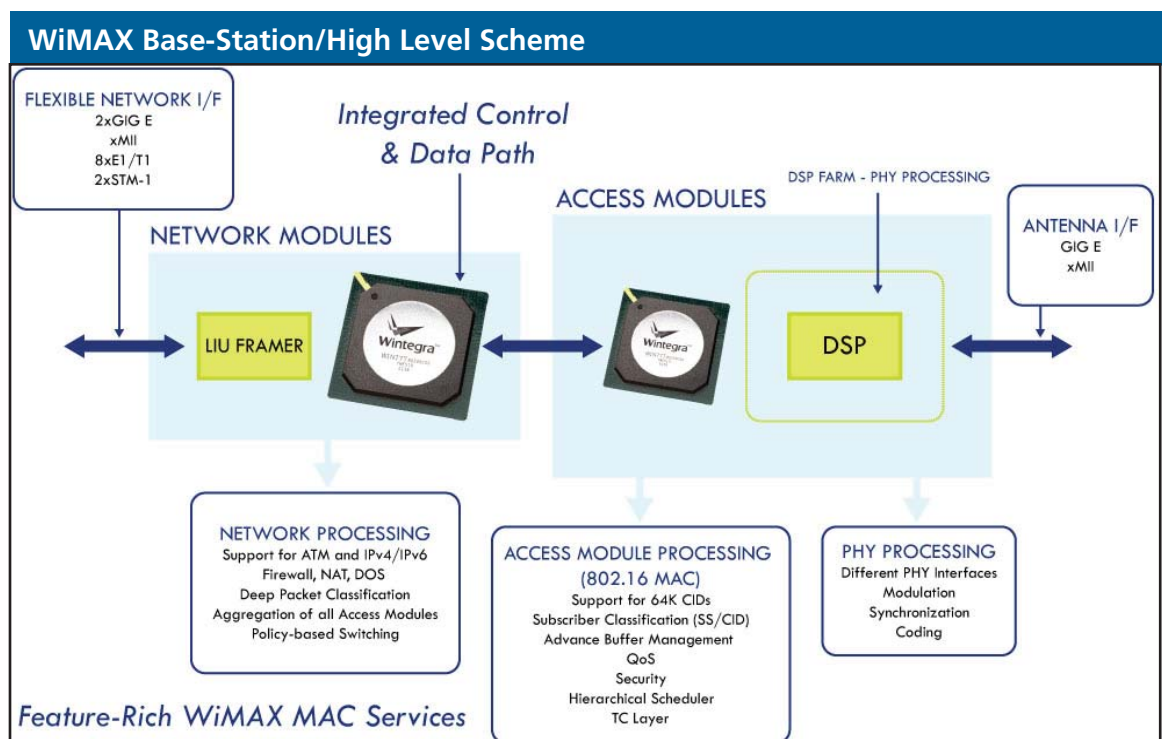
- Platform Scalability and Technology Re-Use:** Wintegra has become one of the main players in providing solutions for key wireless infrastructure designs. Recently Wintegra announced that WinPath is now being used by 9 of the 10 top infrastructure manufacturers in a variety of their designs. The aggressive combination of a more advanced architecture, increased programmability and performance, together with optimal cost and power consumption over that of other Network Processors, FPGAs and Communications Processors, has led to WinPath being selected for many different applications (including Pico and Micro/Macro BTS transport, BSC transport and RBB channel card aggregation and Multi-Service Access designs). Utilizing Wintegra's straightforward Application Program Interface (WDDI) and supplied data path software, designers of WiMAX equipment can quickly benefit from this solution to meet aggressive cost targets and as well as project timelines required for both the network and access modules.
- Increased Integration:** WinMax provides a single-chip solution for WiMAX-MAC control and data path components. This allows features that require multiple devices and technologies to be collapsed into the fully programmable WinPath architecture. The on-chip MIPS control processor handles the resource allocation and management tasks while the communications engines (WinGines) are responsible for the data path portion of the MAC layer and DSP aggregation. This allows for significant savings in cost, board space, power consumption and resources required for development and maintenance of different architectures.
- Scalability in Designs:** Like systems based on WinPath, WinMax based platforms can leverage Wintegra's wide base of data path software and system architectures. The data path processing engines are RAM based, so changes in wireless standards can be accommodated with simple DPS software updates. Additionally, the modular approach of the Wintegra data path software architecture allows for easy integration of customer proprietary features.
- Aggressive Silicon Roadmap:** WinMax is the newest addition to the original WinPath 7xx series (e.g. 717, 747, 787, etc.) of single, dual and four WinGine packet processors. With this new device comes higher performance (up to six WinGines at 300 MHz), plus newly integrated hardware and software acceleration features optimized for the WiMAX Access Module (AM).
- Technology Re-use:** A Common architecture (software and silicon) that is based on the same technology can be used for the WiMAX BS Network Module (NM) and the WiMAX BS Access module. This allows a glue-less interface (SW and HW) between the two logical elements - an argument that significantly speeds up the overall system deployment and the time to market. Note that the same concept has already been proven valuable in various 2G/2.5G and 3G RAN components (such as RNC, NodeB transport cards).

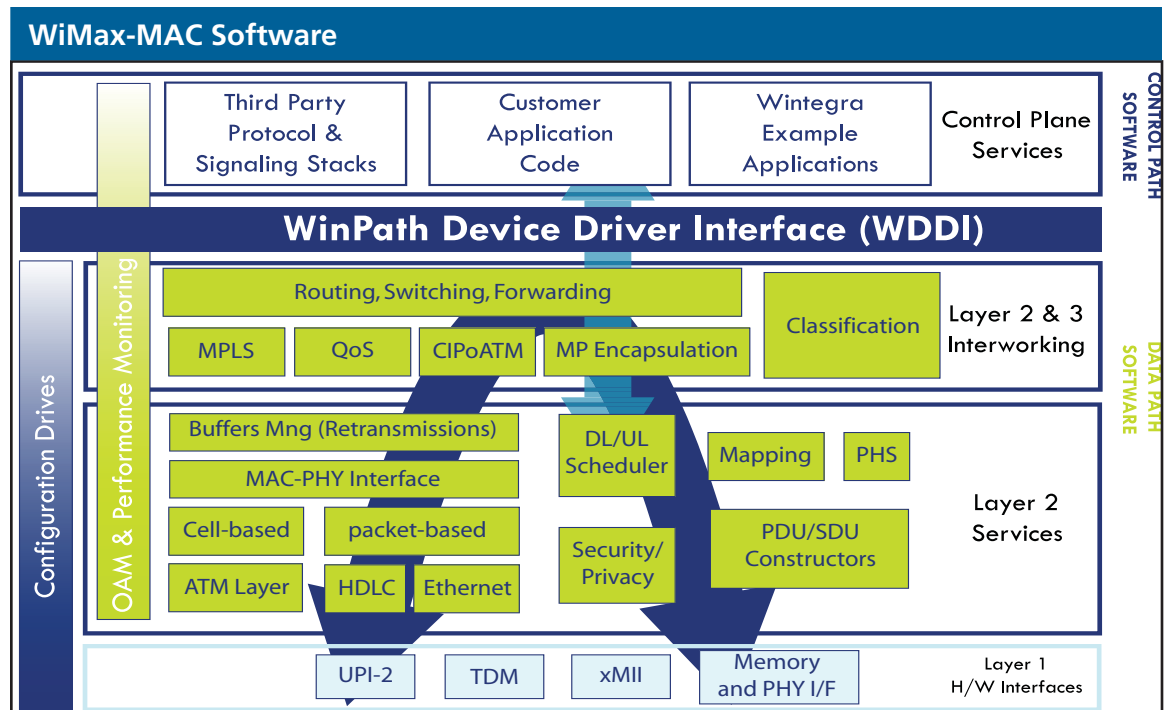
- Data Path and Control Path software implementation:** Where most silicon vendors offer only example “device drivers”, which must then be adapted and modified by each customer, Wintegra provides an extensive WinPath Device Driver Interface (WDDI) for all of its devices. WDDI provides a simple interface for every configurable feature of the silicon and data path software. Implementation of WiMAX-MAC functions using WinMax, means that the MAC itself (as well as other DPS components) are implemented as a set of buildings blocks that can be tuned and modified by the user in order to meet any advanced or optional scheduling features like adaptive antenna, MIMO and sub-channel diversity requirements.
- Programming Tool-kit:** The Wintegra Data-Path Development Kit for WiMAX (WDDK-MAC) offers a highly integrated and user friendly GUI environment. In the case of the WiMAX data path implementation, this allows the designer the ability to add/remove and modify data-path functionality. For example, the designer can take the reference implementation provided from Wintegra and make changes to the scheduler architecture dependant on particular operator requirements.
- Cost Optimization and Performance Scalability:** The data path software, and hence the WiMAX-MAC implementation is completely transparent to the number of WinGines or Processing Entities in the WinComm architecture. With this ability, similar software can run on any WinMax device providing totally transparent upward and downward system performance migrations.

WinMax Used in WiMAX BTS Designs

A WiMAX Base Station (BS) is composed of 2 main components: The network module and access modules.

The **network module** implements the BS interface to the core network, and serves as an aggregation device for the multiple access modules. A WinPath based network module provides a flexible network interface for different network connectivity options, such as Gigabit Ethernet, ATM, or multiple TDM interfaces on the same device. Security is another important aspect of the network interface. NAT, Firewall, DOS protection and dedicated IPsec Hardware are all part of the standard WinPath offering. In addition, the WinPath ready to use classification modules make it a simple to program aggregation device. The network





card WinPath can be connected to the access modules using any standard backplane interface, such as density xMII, UTOPIA/POS multi-PHY or memory interface.

The **access modules** include the PHY functionality implemented on the DSP farm, and the MAC functionality implemented on the WinMax. The same interfaces mentioned in the network card description are also applicable in the case of the access module WinMax, allowing flexible backplane and DSP connectivity, including Ethernet, UTOPIA, and memory mapped interface. WinMax provides a highly programmable advanced feature WiMAX-MAC implementation, based on the existing WinPath DPS/WDDI building blocks, such as interworking classification and QoS, buffer management and packet/ATM scheduler, as well as new WiMAX specific features.

WinPath Data Path and Control Path Software

The WiMAX-MAC software implementation (shown above) is divided into two main sections, data path processing and control path processing.

The data path processing along with the transport interfaces, handles all the frame based real time

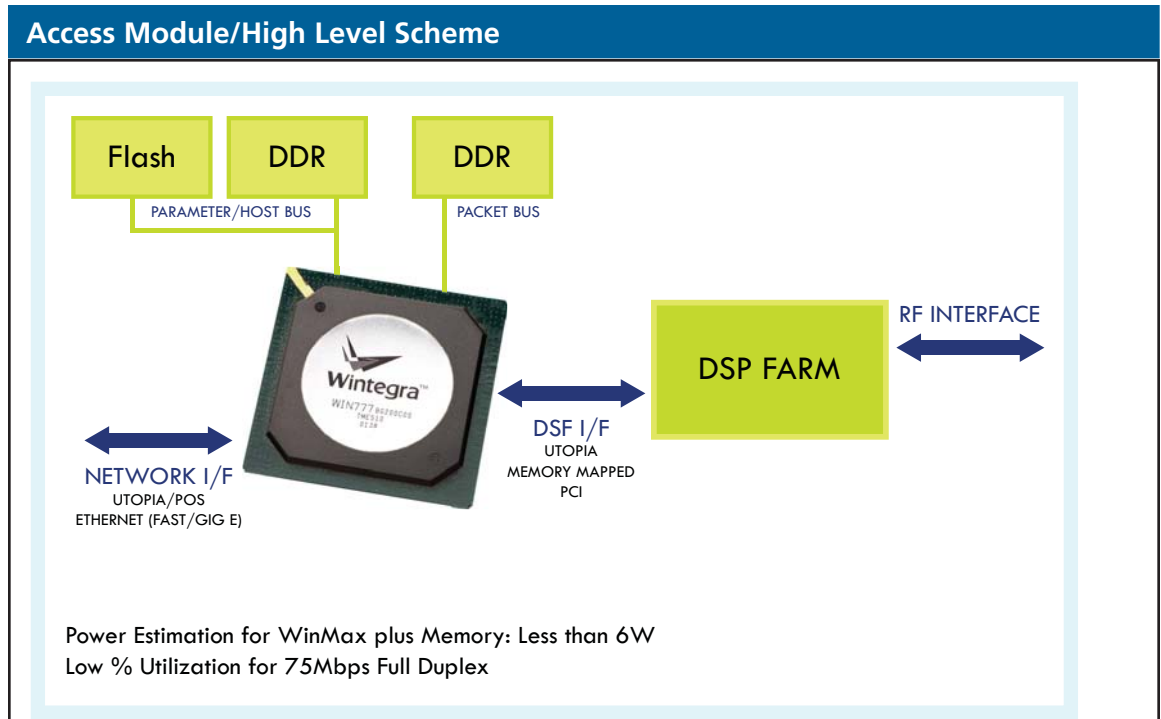
WiMAX-MAC events such as packet classification, QoS, frame packing, fragmentation and scheduling. These tasks are executed on the WinMax engines (i.e. WinGines) and integrated within the standard Data Path Software (DPS). The control path processing handles the less time sensitive events of WiMAX-MAC. Those events include the resource management, signaling, connection set-up and configuration. The majority of these tasks are implemented as part of the Wintegra Device Driver Interface (WDDI) which is executed on the internal MIPS processor.

WiMAX-MAC Access Module Overview

An Access Module using WinMax and DSPs is shown on the following page.

The WinMax connection to the network card is any standard backplane interface, such as UTOPIA or Ethernet, while for the DSP connectivity a memory mapped interface can be implemented as well as using any of the standard communication interfaces.

Data flowing into the WinMax is handled by the communication modules, and passed as packets to the WinGines executing the DPS SW. The DPS uses the parameter memory to read per connection configuration parameters as well as read and write state variables associated with the data processing.



Packets are stored in the packet memory, and handled by an efficient DMA and buffer management hardware accelerator, providing a fast buffer allocation, fast priority queue selection and various free buffer pool operation. The WinMax memory management scheme allows a very flexible data-structure allocation in which classification, scheduling and other databases can be located on either of the memories, enabling efficient memory allocation and optimized bus load balancing.

The estimated power consumption of WinMax will be less than 3.5W.

WinMax Key Features

Features, collateral and details of the Wintegra's WinMAX device and WiMAX reference design are available under NDA.

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