

Data Path Software (DPS)

WINPATH™ ACCESS PACKET PROCESSORS

Product Highlights

- **Highly modular, production quality data path code is factory and customer verified**
- **All protocol software executes out of RAM and is included with the silicon with no royalties or NRE**
- **Flexible protocol software comes ready to use with modular packages of IP, ATM, PPP, Ethernet, TDM, interworking and switching**
- **Sustained performance of up to 2.7 Gbps of IP and ATM**
- **Source code included for feature rich Wintegra Device Driver Interface (WDDI) enables rapid time to market**
- **Data path code is supplied in binary form or optionally licensed as source with full development environment**
- **All WinPath I/O and software features are accessible via WDDI**
- **Control Path software executable on internal MIPS processor or external PPC device**
- **Reference implementations of ATM signalling, high layer routing protocols, PPP authentication services are available from numerous third parties as well as Wintegra**
- **WDDI support is RTOS independent with support available from Wintegra for VxWorks as well as Linux**
- **Hundreds of example routines are available to highlight specific functions or suggest possible system implementations**

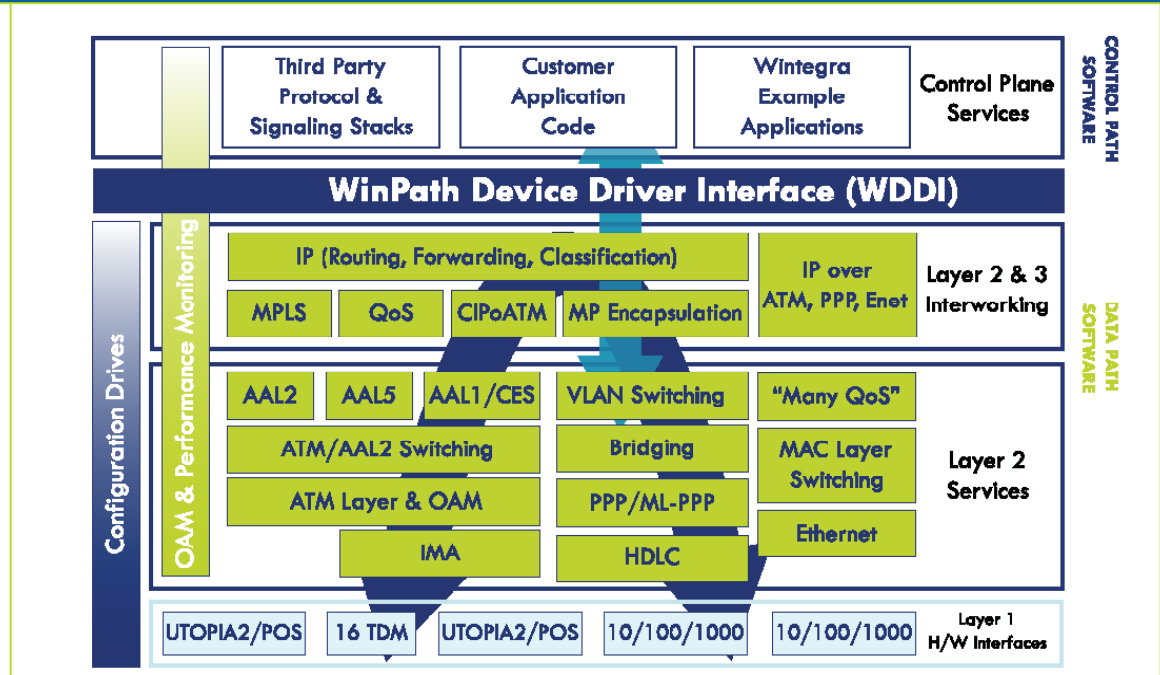
Any Protocol/Any Port

Wintegra-supplied data path software is factory verified, customer hardened, production quality code that enables quick customer integration and rapid system deployment. The WinPath integrated software architecture creates a robust, efficient environment for managing the extensive set of existing WinPath control and data path services, while also providing an intuitive platform for rapid development and the integration of new protocols. This combination of functionality and flexibility reduces product development cycles and increases field longevity by enabling field upgradeability.

The primary elements of Wintegra's software offering are the WinPath Device Driver Interface (WDDI) and numerous code examples.



WinPath Software Model



Software Protocols: Data Path Software (DPS)

At the heart of WinPath are symmetric, programmable protocol engines (WinGines) that provide exceptionally cost-effective and power-efficient data path performance. A powerful feature of WinPath is the ability of the device to dynamically load the appropriate Interworking engines according to the real-time characteristics of the application. This means that the data path software developer does not have to undertake the arduous task of partitioning code or managing coherency between engines; it is handled internally by the architecture. The Data Path Software (DPS) packages provide an extensive set of real-time networking services optimized for the WinPath architecture. The software comes "ready to use" in standard ELF/DWARF2 executable format.

Unlike traditional micro-coded solutions, where protocol software is located in ROM or partitioned into small, segmented microengine memories, the WinPath DPS runs from a shared address space in internal RAM, adding a great deal of flexibility and performance.

All WinPath DPS code is written in C-like software-not assembly code- which provides substantial

time to market advantages. This advantage was demonstrated by Wintegra having over 18 protocols available at first product announcement. Today there are over 50 supported protocols and more constantly being developed. The flexibility of the WinPath DPS architecture extends to the development environment, where optional source licensing permits system designers to customize and extend the data path software to meet specific application requirements.

Software Protocols: WinPath Device Driver Interface (WDDI)

While the WinPath DPS sets a whole new standard for breadth, price/performance and extensibility in network and packet processor software, it represents only a piece of the overall Wintegra software solution.

The Wintegra software architecture extends beyond the data plane and into the control plane and host processor environment, where system developers must integrate WinPath into their overall system architecture. It is this integration stage that has historically been an obstacle to widespread adoption of traditional network processors. To simplify and expedite this effort, Wintegra provides a modular,

object-oriented Application Programming Interface (API)

Whereas typical drivers often implement only the most basic functionality and serve primarily as examples for developers, Wintegra provides a WinPath Device Driver Interface (WDDI) that consists of over 100,000 lines of ANSI C source code. This code is provided free of charge to all WinPath system developers

WDDI is a host-based software architecture that permits all configurable WinPath features to be accessed and managed via an ANSI-C interface. It treats hardware parameters and DPS parameters in a uniform manner. With WDDI, there is no loss of generality, simplifying configuration and management by providing visibility only to user-definable fields. With WDDI, WinPath users can also control all of WinPath interfaces such as UTOPIA and 10/100/1000s, etc. WDDI's object-oriented design permits one or more WinPath chips to be configured from the "bottom up" and managed from the "top down". Furthermore, WDDI is a portable implementation, where ANSI C, Real-Time Operating Systems and BSP dependencies have been isolated. WDDI is divided into layers, where the upper layer exports all user accessible services, data structures and constants. The lower layer implements the mapping of upper layer parameters to HW registers and DPS tables in a

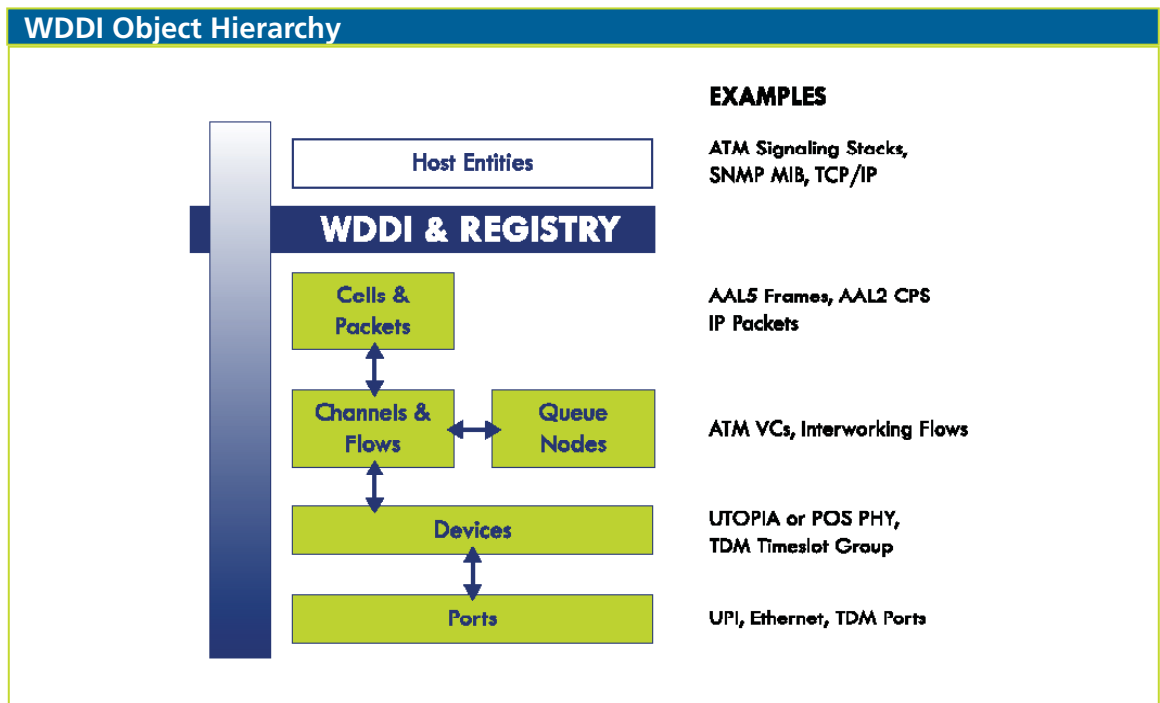
manner that is transparent to users.

Real Time Operating System (RTOS) Support: As the software model indicates, the WDDI has been partitioned into OS dependent and OS Independent sections for efficient porting of various Board Support Packages.

WDDI Object Hierarchy

WDDI is architected with various objects. As the drawing indicates, there are hierarchical objects like ports, devices, and flows plus data units, like cells and packets. There are also shared objects. Among these shared objects are system resources like clocks and scheduling units and memory resources like buffer pools and queues. Additional shared resources include OAM, statistics, and policing tables, plus interworking resources like aggregation and priority queues.

A key feature of WDDI is a Registry that serves as a database for maintaining configuration details for one or more WinPath processors. The Registry provides a means of storing data required by third party software suppliers such as control plane code and network management services. The Registry also assists in the set-up and management of WinPath hardware and DPS through generating reports, traces and revision information.



DPS Modules

Wintegra offers a series of pre-developed, optimized software modules, providing the protocol processing capability of WinPath. All of these production quality modules are available from Wintegra with no NRE or royalty payments. These DPS modules run on the internal WinComm Architecture. The modules are developed in Data Path Language using industry standard object and debug formats (ELF/DWARF2). The modules that compose the Integrated Software Architecture have been subjected to rigorous Conformance and Interoperability testing during development to ensure that developers can be confident of interoperable product and need not fear having to 'de-debug' modules during their product design. These modules have been subjected to testing on the silicon using traffic generators and existing customer equipment to prove operation before production release.

Standards tested include many of the ITU standards

for ATM (like I.363.2, I.363.5 in the DPS and Q.2931 in the CPS stacks) the IETF standards that focus on Interworking and IP capabilities, the IEEE standards for Ethernet and the ATM Forum control specifications

Software Protocols: Wintegra's Standard Software Offering

Wintegra supplies a broad range of factory verified and validated protocols as part of WinPath standard software support. Currently there are over 50 protocols available, a number that is growing rapidly due to the rich tool support and architecture of WinPath. Wintegra supplies these software modules free, and they are delivered as a binary code load which is downloaded into on-board RAM in WinPath. Current modules are listed below, but for the latest information, customers should contact Wintegra. Most customers will utilize these verified modules "as is" accessing these through WDDI. These modules set the standard by being production quality, requiring no changes prior to system deployment. By utilizing WDDI and Control Path software, complete system software configurations are possible.

The Most Complete Networking Software Portfolio

WLS (Wintegra Linux Services)

SNMP Agent	User CLI	TCP/IP
DHCP Server	Tunneling Driver	IGMP host
IGMP Snooping	VLAN Tagging	LLC Encapsulation
HTTP Server	Fast Path Multicast	ICMP

Packet

Ethernet	FR-Switching	GRE
HDLC	MFRoTDM	GTP
PWE3-CESoPSN	HDLC/PPPoTDM	MC-PPP
PWE3-SATOP	ML-PPP	PPP-Mux

Interworking/Routing

MPLS	Bridging	VLAN Stacking
IPv4	Packet Switching	Dynamic Field Classifier

Other

Packet Policing	WRED	Weighted Fair Queuing
L2/L3 Multicast	802.1Q	QOS

ATM

AAL1/CESoTDM	AAL5	OAM
AAL2/CPS	ATM Switching	OAM-FM/PM
AAL2-SSSAR/SSTED	IMA	Multiple Queues per VC

Supported Protocols*

Wintegra packages DPS modules into code images optimized for various vertical markets. These load images include combinations of the following protocols/modules:

- ATM Adaptation layers AAL0, AAL1, AAL2 and AAL5.
- TM-4.1 compatible ATM traffic shaping
- Up to 64K simultaneous ATM channels
- ATM cell switching up to 622 Mbps full duplex.
- AAL5 — Two full duplex ports up to 622 Mbps.
- AAL2 — Two Full-Duplex AAL2 ports at 155 Mbps with up to 11 CPS packets per cell
- AAL2 switching — Two Full-Duplex AAL2 ports at 155 Mbps.
- AAL1 — Supports structured and unstructured Circuit Emulation.
- IMA — Inverse Multiplexing over ATM in one or more IMA groups.
- OAM Support
- IP Termination — Support for IPv4, IPv6 (early 2007)
- IP Routing and interworking
- IP Classification — Supports Multi-field classification and Differentiated Services.
- IP Address Resolution

- L2 Ethernet switching using MAC address
- VLAN stacking
- Bridging – Ethernet to Ethernet or Ethernet to ATM
- Direct Mapping – from ATM VC to Ethernet port or PPP port
- PPP and ML-PPP
- MPLS — Tagging and detagging
- Statistics — Extensive collection at the channel and flow.
- Frame Relay .5 and .8 over UNI
- Multilink Frame Relay
- IP Header Compression
- IP Multicast
- IP fragmentation
- Multi-channel HDLC
- PPPoE, PPPoA
- NAT/Firewall Support
- SS7 FISU and LSSU Filtering Support
- 802.3ad Trunking
- PWE3 - CESoPSN, SAToP over TDM
- 6RE, 6Tp
- WT101 support
- G. Bond

Software Protocols: Example Code

Wintegra has hundreds of example programs to demonstrate the available protocols on WinPath. Wintegra also provides a reference board for customers. This board known as the WDS (Wintegra Development System) uses a WinPath device and has support for various physical connections such as T1/E1, UTOPIA, Gigabit Ethernet and 10/100 Ethernet. Wintegra-supplied examples run on the WDS and are supplied in source code form to customers. More details on the WDS are provided at the end of this document. Using these examples, demonstrations of interworking and other functions can be performed, plus they are an excellent starting point for customer developed software. These examples are an excellent way to demonstrate how quickly WinPath can be reconfigured for different applications as the WDS/WinPath combination can be set up to demonstrate ATM to Ethernet or ATM switching, all within minutes.

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*Please contact Wintegra for a full list of available protocols.