WIND RIVER

Wind River VxWorks 653 Platform 2.3

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Real-time operating systems form the core of many avionics systems. These operating systems not only must provide the real-time capabilities and high performance required by avionics, they must enable certification of commercial airborne systems to the stringent safety requirements of RTCA DO-178B and EUROCAE ED-12B, the "Software Considerations in Airborne Systems and Equipment Certification."

Wind River VxWorks has long been used in aerospace applications, forming the foundation for federated (distributed) avionics systems. Wind River VxWorks DO-178B Platform is the current market-leading software platform for federated avionics, providing real-time capabilities along with DO-178B Level A certification evidence that can be used in the certification efforts of airborne systems. Wind River VxWorks 653 Platform is a commercial off-the-shelf (COTS) platform for delivering safety-critical, integrated modular avionics (IMA) applications and provides DO-178B Level A certification evidence that can be used in the certification efforts of airborne systems.

ARINC Specification 653 has been developed as the standard for software capabilities enabling IMA for safety-critical avionics. IMA enables multiple functions (applications), often of different safety criticality levels, to execute safely on a shared hardware platform, thereby reducing the system's overall space, weight, and power (SWaP) requirements.

VxWorks 653 Platform fully complies with the Avionics Application Software Standard Interface, ARINC 653, Supplement 2, Part 1 Required Services, as tested by an independent third-party evaluator following the ARINC 653 Supplement 2, Part 3 Conformity Test Specification.

RTCA DO-178B Certification Evidence

To ensure that airborne systems meet the demands of a variety of safety criticality levels, the global aerospace community developed the RTCA DO-178B and EUROCAE ED-12B airborne avionics standards. These standards provide guidance on creating, certifying, and deploying airborne systems. They are now uniformly enforced by a wide range of commercial aviation control organizations, including the U.S. Federal Aviation Administration (FAA), the European Aviation Safety Agency (EASA), Transport Canada, and others. The aviation community reviewed input from aerospace manufacturers worldwide to create this standard that specifies 66 objectives, describing the recommended software life cycle and testing guidelines for the aviation industry.

Wind River VxWorks 653 and DO-178B platforms feature the DO-178B and ED-12B COTS Certification Evidence DVD, which provides comprehensive documentation, enabling airframe manufacturers to meet the stringent DO-178B objectives, thereby helping achieve faster time-to-market.

VxWorks 653 Platform Benefits

VxWorks 653 Platform 2.3 offers a range of benefits for avionics development teams, including the following:

- Run-time conformant to ARINC Specification 653, providing time and space partitioning
- Portability and reusability of existing ARINC 653 applications and VxWorks kernel-mode applications and drivers
- Powerful kernel-aware development and debugging tools: Wind River Workbench development environment, with VxWorks 653 project and build system
- Support for independent development teams on asynchronous application projects and system integration, thus simplifying complex team management
- Ease of system configuration and integration of software, spanning multiple safety criticalities, shortening integration periods, and reducing integration errors
- Wind River expertise in safety-certified systems in the form of professional services, customer education, and customer support services

VxWorks 653 Run-Time Components

VxWorks 653 Platform includes run-time components that provide the time- and space-partitioning foundation and ARINC 653-conformant capabilities for IMA systems, as well as tools for developing and integrating ARINC 653-based systems efficiently.

VxWorks 653 Module OS

The VxWorks 653 module OS forms the supervisor-mode OS that enforces time and space partitioning on the user-mode application components. This provides fault isolation to make sure that any damage is limited to the faulty application's partition. The user-mode partitions are virtualized run-time environments where user components, such as applications and middleware components, execute.

VxWorks 653 Platform supports complete separation between applications and between applications and the module OS. As a result, applications can interact with each other only through explicit mechanisms that the module OS controls. Applications cannot affect the operation of the ARINC 653 system except in a controlled manner through resources that the module OS explicitly allocates to them.

Development Suite

Wind River Workbench

Software Partner Technologies

Ada Support	COBRA
DDS	File Systems
Graphics	I/O
Java	SDR

Middleware

Wind River DO-178B File System*	Wind River DO-178B Network Stack*

Operating System

VxWorks 653

Hardware Partner Technologies

Reference Designs	Semiconductor Architectures

Services

Education Services and Installation	Platform Customization
System Design	Hardware/Software Integration

**Optional add-on product*

Figure 1: Wind River VxWorks 653 Platform

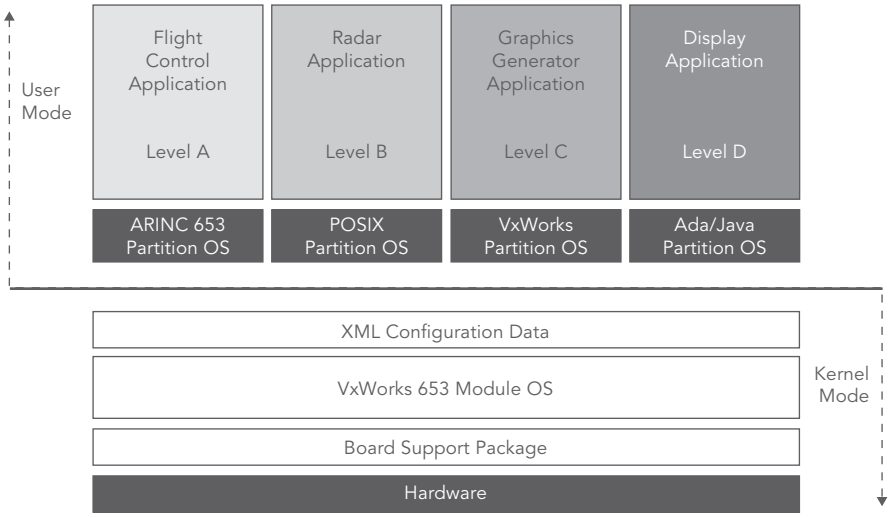

Figure 2: VxWorks 653 run-time components

Partition Management

Each application in an ARINC 653 system runs in its own discrete partition. The module OS provides space partitioning through memory management services. In addition, the module OS schedules the partitions according to a predefined, static schedule; partitions execute only when their allocated time slice is active. Partitions manage their own resources within their time slices, and performance is optimized by keeping as many routine calls as possible within the partition. Partitions run in user mode.

Partition Scheduling

VxWorks 653 Platform uses a high-performance, two-level scheduling architecture with very low overhead for context switching between partitions. VxWorks 653 Platform supports standard ARINC time-preemptive scheduling, where partitions execute until their time slice expires, when the next scheduled partition executes.

VxWorks 653 Platform also supports mode-based scheduling, in which a set of partition schedules can be statically configured and selectively enabled dynamically at the appropriate time by the module OS. This enables, for example, the health monitor fault recovery routines to utilize a different schedule or an appropriately privileged partition to effectively switch the operational mode of the system through use of a different schedule.

In addition, VxWorks 653 Platform offers a combined scheduling mode called ARINC plus priority-preemptive scheduling (APPS). In APPS, the module OS can switch to priority-preemptive scheduling under a variety of conditions, including when it detects idle time in a partition's time slice, when an application forces idle time, or if there is an idle partition time slice. Under priority-preemptive scheduling, the non-idle partition with the highest priority is scheduled to run during the idle time of the current time slice. APPS enables VxWorks 653 Platform systems to utilize idle time effectively, potentially reducing the overall response latency for high-priority tasks.

Partition Operating System

Each partition contains a partition-level operating system, called a partition OS, that provides a set of OS services. Applications call routines located in their partition OS. The partition OS completes the routine autonomously if it provides the requested service. Otherwise, if the application's privileges permit, the partition OS makes a system call to the module OS.

VxWorks 653 Platform supports warm start and cold start of partitions and of the entire system.

The VxWorks partition OS, vThreads, is a multi-threading technology that is based on VxWorks 5.5. Consisting of a kernel plus a subset of the libraries supported in VxWorks 5.5, vThreads has its own set of libraries that provide the API. Support for C, C++, and APEX (application executive) APIs is provided by vThreads. In addition, vThreads uses its own priority-preemptive scheduler and supports the combined APPS mode, controlled by the module OS.

vThreads runs in user mode in an application partition provided by the module OS. One instance of vThreads is completely distinct from both the module OS and other vThreads instances running in other partitions in the same VxWorks 653 system.

COIL

The core OS interface library (COIL) provides an interface to the module OS that enables developers to implement a custom partition OS. The COIL can be augmented to suit specific partition OS needs. The COIL includes the minimum services needed for an application to communicate with the module OS, including interrupt and exception management, device I/O, inter-partition messaging, and health monitor event injection. The COIL routines are independent of the vThreads partition OS, and the COIL also supports the combined APPS mode.

The COIL is often augmented, and the result is called the user partition OS. For example, if the APEX ports service is required, the user partition OS must provide it.

APEX Application Support

APEX is the ARINC 653 API defined between an application program and an operating system that supports the ARINC 653 specification. For VxWorks 653 Platform, the "operating system" is the combination of the vThreads partition OS and the module OS. APEX adds enhancements to a vThreads partition in the areas of time and process management and the ability to manage both periodic and aperiodic processes and their associated deadlines.

VxWorks 653 Platform includes the ability to create vThreads-based application partitions that provide full APEX support.

POSIX Application Support

To improve application portability, VxWorks 653 Platform provides POSIX APIs for vThreads partitions, in addition to C, C++, and APEX API support.

The POSIX API for vThreads includes support for asynchronous I/O, clocks and timers, condition variables, mutexes, memory locking, message queues, semaphores, signals, scheduling, and threads.

Inter-partition Communication

Communication between partitions in a VxWorks 653 system is achieved by sending and receiving messages (continuous, finite length blocks of data), which travel over channels (logical links between sources and destinations) that connect ports (access points defined for partitions). APEX inter-partition communication is supported for vThreads partitions, APEX partitions, and COIL partitions. VxWorks 653 Platform supports both sampling mode and queuing mode channels for APEX communications.

VxWorks 653 also supports communication to partitions and pseudo-partitions on other ARINC 653 systems through the use of pseudo-ports and direct access ports.

For unstructured communication between partitions, VxWorks 653 Platform provides shared data regions that can be accessed by more than one partition. Configuration and use of

shared data regions are usually the responsibility of the system integrator, platform supplier, and application suppliers. Developers of applications that share a data region must coordinate with each other to determine the structure and method of access for the shared data region. The system integrator must work with the application developers and the platform supplier to determine the number and size of the shared data regions to be provided by the platform. Access to shared data regions by applications is configured as part of the partition configuration.

Intra-partition Communication

For communication between processes within a partition, VxWorks 653 Platform supports multiple methods and technologies.

In partitions using the VxWorks partition OS, VxWorks 653 Platform supports the standard VxWorks events, message queues, semaphores, timers, and watchdogs, all of which are available to facilitate intra-partition communication.

In partitions using the ARINC 653 APEX API, VxWorks 653 Platform supports several APEX objects that are available to facilitate intra-partition communications. These objects include buffers, blackboards, semaphores, and events. Per the ARINC 653 specification, buffers and blackboards are provided for general inter-process communication (as well as synchronization), whereas semaphores and events are provided for inter-process synchronization.

Health Monitor

Per the ARINC 653 specification, the health monitor is responsible for monitoring and reporting faults and failures in the hardware, applications, and operating system. It helps to isolate faults and to prevent failures from propagating.

The VxWorks 653 Platform health monitor provides a framework to raise and handle events in a system, which can be alarms or notifications. Alarms are injected to represent faults in the system. They have handlers to perform health recovery actions. Health monitoring is supported for both vThreads and COIL partitions. The VxWorks 653 Platform health monitor implements not only the ARINC 653 APIs but also the optional hierarchical structure and response capability specified in the standard. VxWorks 653 Platform provides a process-, partition-, and module-level health monitor, including both cold and warm restarts at partition and module level.

In addition to dispatching events, the VxWorks 653 Platform health monitor can dispatch notifications, which are messages that a health monitor event has occurred. They can be used to handle any impact that the occurrence of an event in one partition may have on other partitions. For example, if partition A supplies data to partition B, and partition A experiences a fault and must be restarted, partition B may need to react to the fact that its source of data has been interrupted.

As part of the health monitor functionality, VxWorks 653 Platform provides logging capability. The health monitor logs are used to record events that could impact the stability of applications in the VxWorks 653 system. The module OS, as well as each partition, has a separate safety log into which events can be injected. Event injection can be configured to occur automatically or as needed by each event handler. Examples of events include hardware-generated exceptions, error paths in the code, and crossed thresholds.

The sizes of health monitor logs, their access rights, and their default policies are all managed in the VxWorks 653 Platform system configuration.

Wind River Workbench 3.2

VxWorks 653 Platform includes the award-winning Wind River Workbench development suite. Wind River Workbench is an Eclipse-based development environment designed to accelerate time-to-market for developers building embedded devices. From hardware and board initialization to application development, Workbench offers productivity-enhancing tools throughout the development process in a single integrated environment, with complete platform integration, including powerful tools for debugging, code analysis, and test. Based on the Eclipse framework, Workbench can be extended through in-house, third-party, open source, and commercial plug-ins.

The Workbench development environment helps reduce development costs, manage code complexity, ease tool integration, and enable standardization on a common development foundation across an organization.

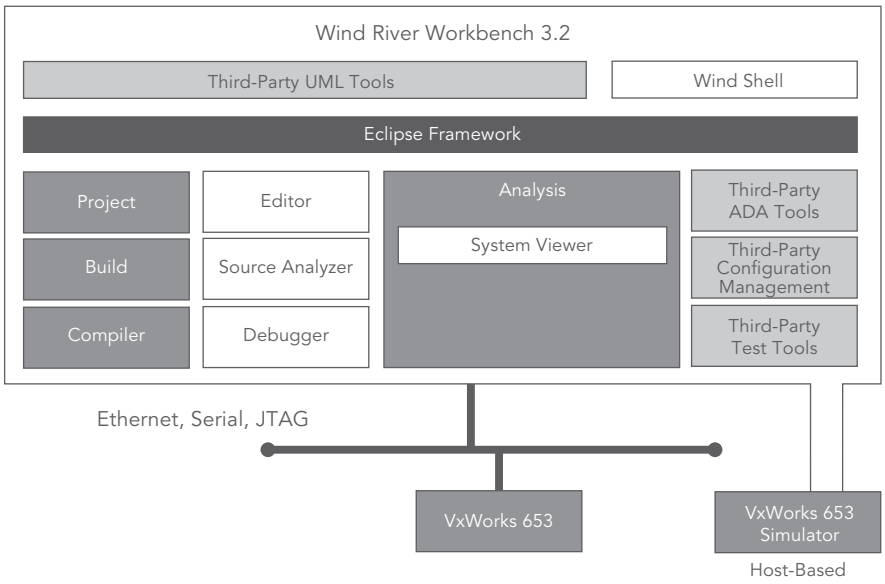

Figure 3: Wind River Workbench in VxWorks 653 Platform

Eclipse

Because of its openness, capability, and strong community support, Eclipse was chosen as the framework for the Wind River Workbench development suite. Wind River is a leader in the Eclipse development community and standards body, guiding the top-level Device Software Development Platform (DSDP) project. Open, extensible, and backed by a strong community of commercial and open source developers, the Eclipse framework provides a wide range of integrated functionality. Wind River has extended the Eclipse framework with its own unique technology to simplify the complexity of project management and debugging in partitioned systems such as VxWorks 653 Platform.

Project System

The Workbench project system allows developers to organize and manage the primary components in a VxWorks 653 Platform development project, including source files, partitions, and target systems. VxWorks 653 Platform projects of different types can be created for configuring and building 653 kernel images and partition-based application images. By design, Workbench enables users to manage multiple projects simultaneously and independently so that information separation among different development groups can be ensured.

Editor

Wind River Workbench includes useful new features from the Eclipse C/C++ Development Tools (CDT) project, many of which were developed and contributed by Wind River for the benefit of Wind River customers. Included in CDT 4.0 is the comprehensive visual editor for C/C++ source code, which provides syntax highlighting, content and code assistance, code folding, and code formatting as well as integrated debugging features. In addition, many of the advanced features of the code editor are customizable to individual tastes.

Build System

VxWorks 653 Platform enables a modularized approach for handling complex teamwork, system integration, and asynchronous certification cycles. The platform supports a build system that is independent for each partition application. Each team working on an application manages its own build system independently of other teams. The build system is designed so that each team creates an independent VxWorks 653 Platform image file for its partition. A system integrator collects the image files from each for integration into the whole system. VxWorks 653 Platform provides a powerful configuration scheme for the system integrator to define strict policies for each application and the inter-partition communication mechanism.

The Workbench build system specifies the tools, options, and parameters to use when building VxWorks 653 Platform software projects, enabling developers to set build parameters easily from the project level down to the individual file level. The VxWorks 653 Platform build environment ensures DO-297 role separation and supports independent build, link, and load. This means that the individual modules that make up a VxWorks 653 Platform system do not require source or binaries from other parts of the system to build, link, and load their applications.

Command-Line Project Build System

In addition to the Workbench build system, a full-featured command-line build system is provided for developers who prefer this type of environment. Using GNU make, Tcl libraries, and VxWorks 653 Platform–specific tools, developers can configure VxWorks 653 Platform source and build VxWorks 653 images as well as develop applications and libraries using command-line build facilities. These command-line tools can be easily integrated into a customized build system.

Workbench Debugger

Workbench Debugger addresses the needs of VxWorks 653 Platform developers involved with hardware bring-up, firmware/driver/board support package (BSP) development, and application development. Tools such as breakpoint management, symbol browsing, and stack tracing are available to the user. VxWorks 653 Platform extends the Eclipse debug framework with device connections and multi-partition context awareness. It provides full visibility into the VxWorks 653 platform multi-partition execution environment. This capability can be extended further with Wind River's JTAG-based Workbench On-Chip Debugging solutions.

Target Shell

The target shell provides access to VxWorks 653 Platform module OS task information and system memory. It is a shell that runs on the target itself as part of the VxWorks 653 Platform kernel partition and provides command capability over a standard serial port.

Note: The target shell is only available in the debug environment (i.e., it is not qualified for use in the certification environment). For both the debug and certification environments, application multiplexed I/O (AMIO) is available.

vThreads Shell

The vThreads shell runs as a thread in a VxWorks 653 Platform vThreads partition. Like other vThreads threads, it runs only during the partition time slot. The vThreads shell provides access to more information about the partition than is available from the other shells.

Note: The vThreads shell is only available in the debug environment (i.e., it is not qualified for use in the certification environment).

System Configuration

The build system for VxWorks 653 Platform supports the DO-297 role separation approach to development.

Partitions are independently built and linked but can still reference the entire system. The image files from partitions can be independently loaded and updated on the system.

The VxWorks 653 Platform system configuration specifies the separation and resource allocation policies of each VxWorks 653 Platform object, including schedules and partition resource access. The underlying configuration data is based on XML tables compatible with ARINC 653. For certification purposes, translation of system configuration data into binaries must be traced. All tools performing the translation must be proven to be reliable and consistent.

Benefits of the VxWorks 653 Platform system configuration tool include the following:

- Cost savings; scalable process means even small systems can benefit without overhead costs
- Improvement in configuration quality; certification requirements are easier to state and review
- Fast reconfiguration/update time
- Faster time-to-market

DO-178B-Qualified Tools

Wind River has developed industry-leading tools to develop, configure, build, debug, test, retest, and certify each application independently, incrementally, and asynchronously. These tools, designed around role-based build procedures, compile and display the configuration data in a clear and concise way to assist in certification of systems while maintaining individual developers' productivity and intellectual property protection. These DO-178B-qualified tools include the following:

- Agent for the certification environment (ACE) qualified development tool
- Host shell command tool (qualified verification tool)
- Port, CPU, and memory monitoring tools (certified as part of run-time)
- XML file checker to verify the consistency of the configuration
- XML compiler to build the XML configuration data into the VxWorks 653 Platform system
- XML table generator to translate XML into human-readable tables, organized by role

The XML compiler and configuration tool is qualified as a development tool under FAA 8110.49 Chapter 9. The ACE and the DO-178B-qualified mode of the host shell are qualified as verification tools and can be used in test-for-credit efforts for systems and application tests.

VxWorks 653 Platform also provides a number of on-target monitoring tools. These monitoring tools are qualified as verification tools and are designed to provide support for debugging and test-for-credit in the certification environment. The target-resident components also have DO-178B certification evidence as part of the standard VxWorks 653 Platform Certification Evidence DVD. Thus, these low-overhead tools are part of the certified environment and are deployed in airborne systems. Always present in the target platform, they can be enabled or disabled without impact on system performance. The monitoring tools include the following:

- **Memory usage:** Reports the memory usage of heap, stacks, ports, and health monitoring per partition
- **Performance:** Reports CPU usage in each module, either in the core OS or a partition OS
- **Port:** Logs port activity occurring in a VxWorks 653 Platform system

Agent for the Certification Environment

The ACE is a debugging facility that works with the Workbench Debugger on a cert module OS, enabling the debugger's target-based agent to be loaded separately and independently from the module OS. This allows DO-178B certification evidence to be generated for the module OS independent of the debug agent. The ACE is supported when the module OS is built with the certified kernel functionality subset, to facilitate debugging the cert configuration in a test-for-credit environment.

When using the non-cert configuration (or "debug version") of the module OS, debugging and development can be done with the traditional Workbench Debugger agent.

The platform supplier can provide both the non-cert and cert configurations of the module OS, enabling application suppliers to debug their applications using the full debugging capabilities of VxWorks 653 Platform with the non-cert configuration of the module OS and to debug their applications using ACE in the test-for-credit certification environment or on a deployed system in the field.

Host Shell

The host shell provides a command-line debugging interface that allows you to invoke both VxWorks 653 Platform and application subroutines. This DO-178B-qualified tool also provides monitoring and debugging capabilities for applications in the VxWorks 653 Platform kernel partition. The host shell executes on the development host, not the target, but it enables you to spawn tasks, read from or write to target devices, and exert full control over the target. Because the host shell executes on the host system, you can use it with minimal intrusion on target resources. It also provides break-on-data-access (BODA) breakpoints that allow a data breakpoint for any variable available within the host shell. The host shell provides both C and Tcl interpreters to provide a wide degree in command flexibility and scripting support. Host shell commands are applied to a selected partition, including partition-specific breakpoints.

Wind River GNU Compiler

Wind River GNU Compiler is based on the Free Software Foundation (FSF) distribution of the GNU compiler. Wind River has modified a general distribution version of the compiler specifically for use with the VxWorks product line.

Version 3.3.2 is the default compiler for VxWorks 653 Platform as well as for all partition-level user components that run in vThreads partitions or COIL partitions.

Wind River GNU Compiler includes the following:

- cpp, the C preprocessor
- GCC, the C and C++ compiler
- id, the programmable static linker
- as, the portable assembler
- Binary utilities

Application Multiplexed I/O

Application console I/O is often used in the course of development and for demonstration purposes. The console output can provide valuable trouble-shooting data that shortens the debug-ging cycle. For devices with a single serial port and multiple partitions, application multiplexed I/O (AMIO) provides the capability for one serial port to be shared among multiple partitions. Once configured with AMIO, an applica-tion reads from and writes to the port using standard VxWorks I/O APIs as if it had sole use of the serial port.

Serial port sharing is transparent to the developer. De-multiplexing of I/O on the host development environment is performed by the Wind River monitor host application. Console I/O for each partition is displayed in a separate AMIO console window as if multiple indepen-dent systems were running.

Optional Add-on Products

Wind River DO-178B Network Stack

Wind River DO-178B Network Stack for VxWorks 653, an optional add-on product for VxWorks 653 Platform, is a UDP/TCP IPv4 network stack that provides the following main features:

- UDP/TCP IPv4 stack over Ethernet
- BSD sockets API
- ICMPv4
- IGMPv1
- Multi-cast

Certification evidence for DO-178B Level A is available for DO-178B Network Stack, making this stack suitable for safety-critical applications.

Wind River DO-178B File System

Wind River DO-178B File System, an optional add-on product for VxWorks 653 Platform, is a power-fail-safe, transaction-based file system, providing fail-safe storage, hierarchical organization, and the manipulation, navigation, access, and retrieval of file data. It supports NOR flash memory and RAM disks.

DO-178B File System is built as a component of the module OS. From within the module OS, all of the standard I/O libraries can be used, although only a subset are available as part of a cert module. The file system is also accessible by applications in any partition, support-ing multiple reader applications and a single writer application, through the use of system calls using the standard I/O APIs (read( ), write( ), open( ), close( ), ioctl( )).

DO-178B File System is supported for a certification environment and is ready for certification to DO-178B Level A.

Wind River Workbench On-Chip Debugging

Wind River Workbench On-Chip Debug-ging is essential for hardware bring-up and BSP development and provides a system-level debugging environment for VxWorks 653 systems. The same environ-ment provides a powerful debugging environment for application development throughout the development life cycle. Using a JTAG connection to hardware running the VxWorks 653 environment provides maximum control and inspec-tion capability while using a certified operating system. Workbench On-Chip Debugging provides source-level debugging in system mode with full system visibility and control of each partition. Users can debug the operating system and application software without a software agent.

Wind River Workbench On-Chip Debug-ging supports Wind River JTAG debug units, Wind River Probe and Wind River ICE 2. Wind River Probe is Wind River's entry-level portable JTAG probe that supports a wide range of single-core processors. USB connectivity enables easy plug-and-play connectivity and reduces the need for an external power supply. Wind River Probe is designed to work with Wind River Workbench On-Chip Debugging and Wind River On-Chip Debugging API. Wind River ICE 2 is Wind River's high-performance, network-attached JTAG debug unit that supports a wide range of 32-bit and 64-bit single-core and multi-core processors. Wind River ICE 2 excels in complex system debugging and multi-site development. Wind River ICE 2 is designed to work with Wind River Workbench On-Chip Debugging and Wind River On-Chip Debugging API.

Technical Specifications

Supported Target Architectures

- PowerPC
  - PPC603 (e.g., MPC82xx, PowerQUIC-CII, MPC834x)
  - PPC604 (e.g., PPC750GX, MPC7457)
  - e500 (e.g., MPC8560)
  - e600 (e.g., MPC8641D)
- Intel IA-32
  - Core 2
  - Celeron

Supported Hosts

- Windows XP Professional , Service Pack 2
- Solaris 10 (32-bit)

Supported BSPs

- wrSbc750gx BSP for Wind River SBC750GX
- wrSbc7457 BSP for Wind River SBC7457
- wrSbcPowerQuiccII for Wind River SBCPowerQUICC II (MPC82xx)
- wrSbc834x for Wind River SBC8349e (MPC834x)
- wrSbc8560 for Wind River SBC8560 (MPC8560)
- vpx6-185 BSP for Curtiss-Wright VPX6-185 (MPC8641D)
- gefanuc-7768 BSP for GE Intelligent Plat-forms (formerly GE Fanuc) V7768 (Intel Core 2, Intel Celeron)

Partner Ecosystem

Wind River's world-class partner ecosystem ensures tight integration between our core technologies and those of the premier hardware and software companies we've chosen to complement our solutions. Our partners help extend the capabilities of Wind River's development and run-time platforms by offering out-of-the-box integration and support for key technologies in the fast-moving industrial market. Our customer support team is trained to troubleshoot partner technologies in use with Wind River products, making ours the most comprehensive and best-supported partner ecosystem in the embedded and mobile industries.

Hardware Partners

Our hardware partners include the following:

- Creative Electronic Systems
- Curtiss-Wright Controls Embedded Computing
- Freescale
- GE Intelligent Platforms
- IBM
- Intel Corporation
- Kontron
- MEN Mikro

For a full list of hardware partners, refer to http://www.windriver.com.

Software Partners

Technology components provided by our software partners include the following:

Technology	Partner
Ada support	AdaCore, Atego (Aonix)
Graphics	3DVU, ALT Software, Presagis
I/O	Acromag, AIM, GE Intelligent Platforms, TechSat
Java	aicas, Atego (Aonix)

Software development tools provided by our software partners include the following:

Technology	Partner
Ada development	AdaCore, Atego (Aonix)
High-level design	Atego, IBM Rational, The Mathworks
Java development	aicas, Atego (Aonix)
Qualified graphics design	Esterel, Presagis
Qualified system design	Esterel
Test	IPL, LDRA, Vector

Professional Services

Wind River Professional Services, a CMMI Level 3–rated organization, enables you to reduce risk and focus on development activities that add value and differentiate your design. As part of our comprehensive solution, Wind River offers industry-specific services practices, with focused offerings that help you meet strict market deadlines while keeping development costs down. Our experienced team delivers device software expertise that solves key development challenges and directly contributes to our clients' success.

Backed by our commercial-grade project methodology, Wind River Professional Services include the following:

- Requirements discovery and definition
- BSP and driver optimization
- Software system and middleware integration
- Application and infrastructure development
- Hardware and FPGA design for prototyping or market-ready systems

Typical projects range from two to four man-weeks for driver and BSP implementation, to one man-month to one man-year for hardware design or extensions to an existing software solution, to multi-man-year programs that bring customer concepts to reality through design, creation, and system test and verification.

Professional Services has implemented both hardware and software solutions for the embedded device market and continues to work with standards organizations to establish the next-generation platforms.

Installation and Orientation Service

Proper installation and orientation of the VxWorks platforms means you won't waste time solving easily avoidable problems before you can begin your next development project. Wind River offers an Installation and Orientation Service to ensure your project starts on time and without hassle by delivering the following:

- **Onsite installation:** Guided installation on your hardware and host platform, along with a sample build process, demonstrations, and examples of customizations
- **Hands-on orientation:** Architecture, development file system, adding open source packages, porting drivers, addressing design issues
- **Advice:** Introduction to Wind River support channels and processes, additional services, project review, and consultation

The Wind River Installation and Orientation Service will expedite your path to productivity, allow you to rest assured that we have eliminated a common source of user error, and help you realize all of the platform's potential.

Education Services

Education is fundamentally connected not only to individual performance but to the success of a project or entire company. Lack of product knowledge can translate into longer development schedules, poor quality, and higher costs. The ability to learn—and to convert that learning into improved performance—creates extraordinary value for individuals, teams, and organizations. To help your team achieve that result, Wind River offers flexible approaches to delivering product education that best fits your time, budget, and skills development requirements.

Public Courses

Wind River's public courses are scheduled for your geographical convenience. They are conducted over one to five days, using a mixed lecture and interactive lab classroom format that leverages the experience of Wind River instructors and other course participants. Courses provide a fast, cost-effective way for students to become more productive in Wind River technology.

Benefits of public courses include the following:

- A conceptual introduction that orients students to the subject matter
- A selective examination of the details, focusing on the most commonly used areas, or on areas with which users tend to be least familiar
- Personal guidance and hands-on application of individual tools and course concepts
- The chance to grasp device software concepts, as well as the fundamental issues involved in real-time design
- The knowledge needed to develop device drivers, perform hardware porting, or develop applications
- Answers to specific questions about topics addressed in the course

Consult your local Wind River sales representative for course schedules and fees.

Onsite Education

If you have a large project team or a number of new users, you may benefit from custom onsite education. Instructors will consult with you and, based on the workshop series curriculum, determine which topics should be included and emphasized. This type of education offers an opportunity for one-on-one discussions with our instructors about your specific project needs, technical requirements, and challenges—all in the comfort of your own office.

Advantages of onsite education include the following:

- Your entire team gains a common knowledge base.
- Onsite education helps ensure that knowledge and skills will transfer from the classroom to your workplace.
- Use of your location saves employees travel expenses and time away from the office.

Consult your local Wind River sales representative for further information about onsite education.

Customer Support

Wind River Customer Support, a Service Capability and Performance (SCP)–certified organization, provides support for all Wind River VxWorks platforms. Your subscription to VxWorks platforms includes full maintenance and support, delivered through Wind River's Online Support (OLS) website and our worldwide technical support team. While under subscription, customers receive both maintenance updates and major upgrades.

Visit Wind River Online Support at www.windriver.com/support for fast access to product manuals, downloadable software, and other problem-solving resources. OLS offers a comprehensive knowledge base with a robust search feature for locating product information and manuals by keyword, author, published date, document type, language, and solution category.

Additional support features, including proactive email alerts covering particular technologies, platforms, or product patches and technical tips for common problems, are available for all customers on subscription. OLS visitors can also access a community of developers to discuss their issues and experiences.

Support on modified or unsupported configurations is best-effort-based. Wind River Customer Support will try to reproduce the problem on a supported configuration. If the problem can be validated, Wind River will provide a fix that will be tested on a supported configuration. Wind River Professional Services can provide support for boards or host operating system versions that are not supported by the standard product, as well as for customized versions of the source code or additional nonstandard packages.

Customers with a valid support or subscription agreement are eligible for all updates and major upgrades to their platform free of charge.

If you cannot find the information you need through Online Support, contact our global support team for access to the industry's most knowledgeable and experienced support staff.

For more details on our support processes including escalations and defect resolution, consult Wind River's Customer Support User's Guide (CSUG), available at www.windriver.com/support/resources/csug.pdf.

North America, South America, and Asia/Pacific

Hours: 6:00 a.m.–5:00 p.m.
(U.S. Pacific time)
Email: support@windriver.com
Toll-free tel.: 800-872-4977
(800-USA-4WRS)
Tel.: 510-748-4100
Fax: 510-749-2164

Japan

Hours: 9:00 a.m.–5:30 p.m. (local time)
Email: support-jp@windriver.com
Tel.: +81 3 5778 6001
Fax: +81 3 5778 6003

Europe, Middle East, Africa

Hours: 9:00 a.m.–6:00 p.m. (local time)
Email: support-ec@windriver.com
Toll-free tel.: +800 4977 4977
France tel.: +33 1 64 86 66 66
France fax: +33 1 64 86 66 10
Germany tel.: +49 899 624 45 444
Germany fax: +49 899 624 45 999
Italy tel.: +39 011 2448 411
Italy fax: +39 011 2448 499
Middle East region tel.: +972 9741 9561
Middle East region fax: +972 9746 0867
Nordic tel.: +46 8 594 611 20
Nordic fax: +46 8 594 611 49
UK tel.: +44 1793 831 393
UK fax: +44 1793 831 808

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