



WIND RIVER VxWORKS 653 PLATFORM 2.4 AND 2.5

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

VxWorks® has long been used in aerospace applications, forming the foundation for federated (distributed) avionics systems. Wind River® VxWorks 653 Platform is a platform for delivering safety-critical, integrated modular avionics (IMA) applications. It provides DO-178C DAL A commercial off-the-shelf (COTS) certification evidence that can be used in the certification efforts of airborne systems.

The ARINC 653 Specification is 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 compute platform, reducing the system’s overall size, weight, and power (SWaP) requirements.

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

RTCA DO-178C 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-178C and EUROCAE ED-12C 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 71 objectives, describing the recommended software lifecycle and testing guidelines for the aviation industry.

VxWorks 653 Platform features the DO-178C and ED-12C COTS Certification Evidence DVD, which provides comprehensive safety certification documentation, enabling airframe manufacturers to meet stringent DO-178C objectives, enabling a faster time-to-market.

VxWORKS 653 PLATFORM BENEFITS

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

- Runtime 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, 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

Development Suite

Wind River Workbench

Software Partner Technologies

Ada Support
DDS
Graphics
Java
I/O

Additional Included Components

Wind River Highly Reliable File System (HRFS)	Wind River DO-178 Network Stack
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Operating System

VxWorks 653

Hardware Partner Technologies

Reference Designs	Semiconductor Architectures
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Services

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

Figure 1. Wind River VxWorks 653 Platform

VxWORKS 653 RUNTIME COMPONENTS

VxWorks 653 Platform includes runtime 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.

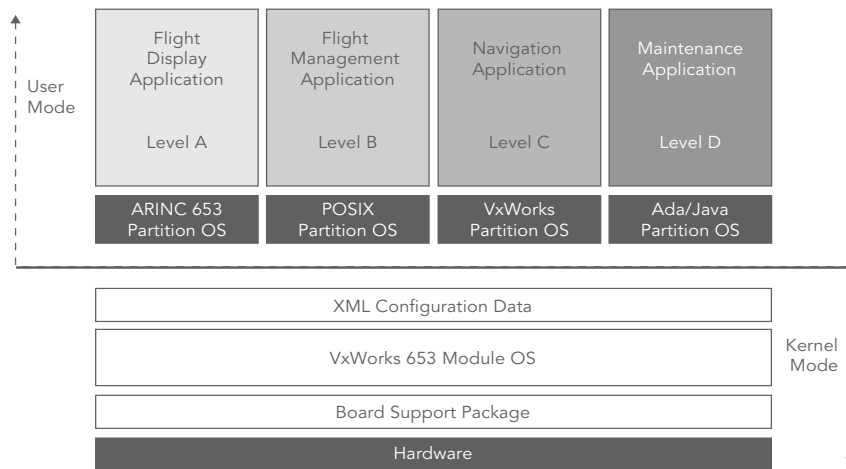


Figure 2. VxWorks 653 runtime components

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 runtime 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.

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 application programming interface (API). Support for C, C++, and application executive (APEX) 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.

FACE Technical Reference 2.0 and 2.1 Support

VxWorks 653 Platform supports open standards by allowing customers to choose from a variety of APIs when developing their applications. As stated above, applications can be written to ARINC, VxWorks, or POSIX® APIs. Wind River commitment to open standards and portability is strengthened by supporting the Future Airborne Capability Environment (FACE™) technical standard.

VxWorks 653 Platform 2.5 is the first RTOS to be certified conformant to the FACE Technical Standard Operating System Segment (OSS) Safety Base Profile supporting all ARINC 653 and POSIX capabilities required by the FACE Conformance Test Suite.

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

VxWorks 653 Platform includes the award-winning Workbench development suite. 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 plugins.

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.

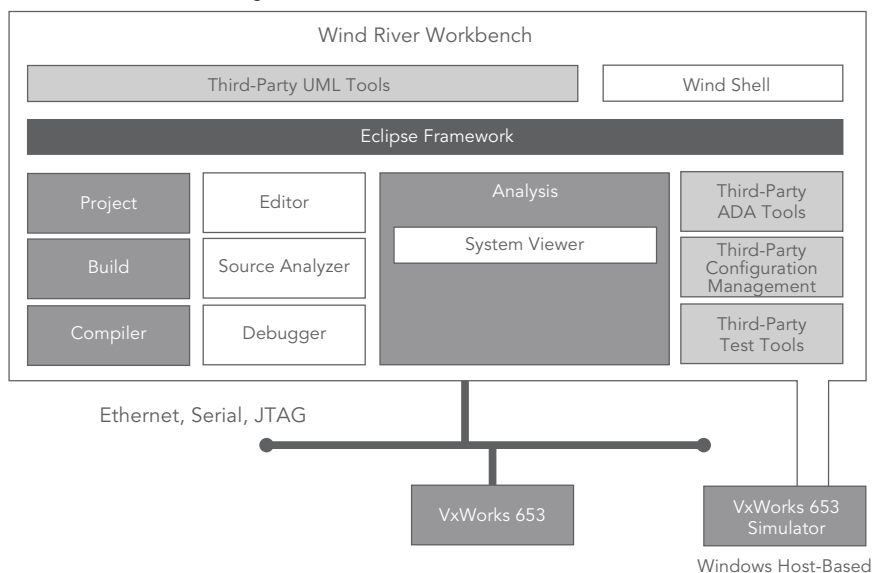


Figure 3. Wind River Workbench in VxWorks 653 Platform

Eclipse

Because of its openness, capability, and strong community support, Eclipse was chosen as the framework for the 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 VxWorks 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

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 partition 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 RTCA 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

Wind River 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.

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

RTCA DO-330-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-330-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 the runtime)
- 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 RTCA DO-330, TQL-1. The ACE and the DO-330-qualified mode of the host shell are qualified as DO-330 TQL-5 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-178C 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 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-178C 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-330 TQL-5 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 4.3.3 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:

- C preprocessor
- GCC, the C and C++ compiler
- Programmable static linker
- 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 troubleshooting data that shortens the debugging cycle. For devices with a single serial port and multiple partitions, AMIO provides the capability for one serial port to be shared among multiple partitions. Once

configured with AMIO, an application 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 independent systems were running.

INCLUDED RUNTIME PRODUCTS

Wind River DO-178 Network Stack

Wind River DO-178 Network Stack for VxWorks 653, an optional add-on product for Wind River 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-178C Level A is available for DO-178 Network Stack, making this stack suitable for safety-critical applications.

Wind River Highly Reliable File System

The Wind River Highly Reliable File System (HRFS) for VxWorks 653 is a media-agnostic, power-fail-safe, transaction-based file system that is ready for use in systems requiring certification up to Level A of the RTCA DO-178C avionics software standard. HRFS provides file system access from the module OS or from a partition, and is flexible enough to support multiple devices, such as Serial ATA, RAM disk, and Flash-based devices. API access may be provided through I/O APIs in the module OS or through system calls or FACE APIs in a partition.

HRFS is designed to ensure that each file system transaction is either completed successfully or completely ignored, such that the system can recover to the last successfully completed transaction (for example, after recovering from a power failure). HRFS supports files up to 2 GB and disks up to 2 TB in size. File system formatting can be implemented in a non-cert configuration, and file checking can be performed in real time to ensure file integrity.

TECHNICAL SPECIFICATIONS

Supported Target Architectures

- PowerPC
 - PPC603 (e.g., MPC834x)
 - PPC604 (e.g., PPC750GX, MPC7457)
 - e500v2 (MPC8548)
 - e500mc (e.g., QorIQ P3xxx, P4xxx)

Supported Hosts

- Windows 7
- Solaris 10 (32-bit), version 2.4 only
- Linux (Red Hat, Ubuntu, and SUSE), version 2.5 only

Supported BSPs

Version 2.5:

- wrSbc750gx BSP for Wind River SBC750GX
- wrSbc7457 BSP for Wind River SBC7457
- wrSbc834x for Wind River SBC8349e (MPC834x)
- wrSbc8548 for Wind River SBC8548 (MPC8548)
- Freescale QorIQ P3041 DS
- wrSbcP4080 BSP for Wind River SBC QorIQ P4080

Version 2.4:

- wrSbcP4080 BSP for Wind River SBC QorIQ P4080
- wrSbc8548 for Wind River SBC8548 (MPC8548)

PARTNER ECOSYSTEM

The world-class Wind River 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 development and runtime 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:

- Abaco
- Aitech
- Creative Electronic Systems
- Curtiss-Wright Controls Embedded Computing
- NXP
- IBM
- Intel Corporation
- Kontron
- MEN Mikro

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

Software Partners

Technology components provided by our software partners include the following:

Technology	Partner
Ada support	AdaCore
Graphics	Core AVI, Presagis
I/O	RTI DDS
Java	aicas

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

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

PROFESSIONAL SERVICES

A CMMI Level 3–certified organization, Wind River Professional Services delivers a mix of embedded and vertical market expertise. We offer consultative thought leadership, deep technical capabilities, and innovative industry solutions to help you overcome your most strategic and pressing development challenges. Our industry-specific offerings span the entire project lifecycle, including consulting, architecture, design, development, porting, integration, and maintenance services; and we leverage our state-of-the-art platform simulation and test tools to accelerate deliverables and provide valuable reporting and documentation. Our global organization provides flexible engagement options for staffing that will meet your project resourcing requirements and budget. For more information, visit www.windriver.com/services.

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 the platform's potential.

EDUCATION SERVICES

With more than 30 years of embedded software experience, Wind River provides education services in every region of the world. We offer flexible training options to meet your business and learning needs, including public, private, and custom courses. For your specific project challenges, Wind River Mentoring provides coaching by experienced engineers to help you integrate Wind River solutions into your environment. And when you're too busy to attend a whole class, our on-demand learning options provide around-the-clock access to advanced and specialized topics. All of our education services are led by expert engineers who are closely connected to the Wind River technical community for access to specific expertise. For VxWorks 653 Platform we offer deeply technical hands-on courses, including VxWorks 653 Platform 2.x Essentials and VxWorks 653 Platform 2.x Porting and Advanced Topics. For more information, visit www.windriver.com/education.

CUSTOMER SUPPORT

VxWorks 653 Platform is backed by our award-winning global support organization. With more than 150 experts worldwide, you can get the help you need in the language and time zone that work best for you. Our online Wind River Support Network provides multifaceted self-help options, including an active Q&A forum. Optional premium services are available, including designated support engineers and hosting of customer-specific environments. Wind River Customer Support has achieved Service Capability and Performance certification.

Support on modified or unsupported configurations is best-effort-based. 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.

For more information, visit www.windriver.com/support.

