



# WIND RIVER VXWORKS 653 3.0 MULTI-CORE EDITION

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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.”

These systems have evolved to contain multiple CPUs and hence have many more capabilities, as long as the system software can take advantage of all the CPUs at its disposal.

VxWorks® 653 3.0 Multi-core Edition is a safe, secure, and reliable real-time operating system that delivers the real-time capabilities and high performance required by safety-critical integrated modular avionics (IMA) applications, combined with commercial off-the-shelf (COTS) certification evidence for meeting stringent safety requirements such as the RTCA DO-178C DAL A and EUROCAE ED-12C on multicore hardware.

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 multi-core hardware platform, thereby reducing the system’s overall space, weight, and power (SWaP) requirements.

VxWorks 653 Multi-core Edition 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.

VxWorks 653 Multi-core Edition offers a commercial off-the-shelf (COTS) DO-178C and ED-12C Certification Evidence package, which provides comprehensive safety certification evidence, enabling avionics manufacturers to meet the stringent DO-178C. This certification evidence contains artifacts from core components VxWorks GOS APIs, and ARINC 653 APEX APIs. These artifacts include designs, tests, reviews, source code, build files, test results, annotated object-level code coverage, and tool qualification data for critical IMA systems.

### VxWORKS 653 3.0 MULTI-CORE EDITION BENEFITS

VxWorks 653 Multi-core Edition offers a range of benefits for avionics development teams, including the following:

- **Industry standards conformance:** Runtime conformant to global avionics and to business safety standards such as ARINC Specification 653, POSIX®, the Future Airborne Capabilities Environment (FACE™) Technical Standard, RTCA DO-178C, and RTCA DO-297
- **Safety and security:** Time and space partitioning with MMU and hardware virtualization assist, deterministic software, and strict communications control
- **Certification evidence:** COTS certification evidence to support rapid customer certification
- **Portability:** The ability to reuse existing ARINC 653 applications and VxWorks kernel-mode applications and drivers, from “simple” systems to complex systems and next-generation virtualized multi-core platforms
- **Development tools:** Powerful kernel-aware development and debugging tools including Wind River® Workbench development environment and VxWorks 653 project and build system capabilities

**Development Suite**

GNU Compiler	System Viewer
DO-178 and DO-330 Qualified Verification Tools	Wind River Workbench
Integrated Simulator	XML Configuration Suite

**Software Partners**

Cockpit Design Tools	ARINC 661 Graphics
Ada 95/2005 Compilers for VxWorks	ARINC 664 Compliant Stack
DO-178C Certification Service	Simulation Platform

**OS**

DO-178C DAL A Certification Evidence*
DO-178C Network Stack (UDP/TCP IPv4)*
VxWorks 653

\* Optional

**Hardware Partners**

COTS Boards
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**Services**

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

Figure 1. VxWorks 653 3.0 Multi-core Edition

## VxWORKS 653 MULTI-CORE EDITION RUNTIME COMPONENTS

VxWorks 653 Multi-core Edition 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.

### VxWorks 653 Module Operating System

The VxWorks 653 module operating system forms the supervisor-mode operating system 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 Multi-core Edition supports complete separation between guest operating systems and their applications and between applications and the module operating system. As a result, applications can interact with each other only through explicit mechanisms that the module operating system controls. Applications cannot affect the operation of the ARINC 653 system except in a controlled manner through resources that the module operating system explicitly allocates to them.

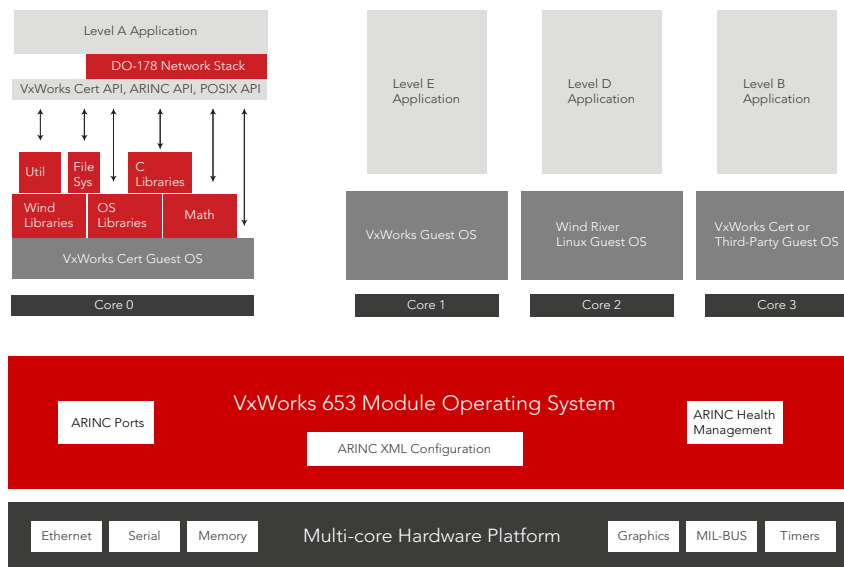


Figure 2. System architecture diagram

The module operating system is a layer that sits on the hardware and allows the scheduling of guest operating systems on each of the cores. It contains the ARINC XML configuration records that define which guest operating system is to execute on which core. There is an optional time partition scheduler to set up time partitioning if so desired. It is below the guest operating systems, so any communication is done via the module operating system. In addition, there is ARINC health management to assess the health of each guest operating system and either alert the system manager or allow for the guests to be restarted, without impacting or sacrificing the entire system.

### **VxWorks 653 Guest Operating System**

The GOS is a particular guest operating system that is responsible for the resources that were levied to it. It interacts through normal communication layers and with the hardware that the configuration record dictates. Each guest operating system can exist at different criticality levels, thus ensuring that one guest cannot bring down another guest. Because of this separation, each guest operating system is independently certifiable on the system. Therefore, a change in one partition that would warrant recertification will not cause the entire system to be recertified. The certification evidence provided for other partitions will still hold true, which reduces costs in recertifying a system that has had only one guest operating system modified.

### **Other Guest Operating Systems**

The module operating system is designed to support other guest operating systems and will receive a configuration record that articulates specifically what system resources it has direct access to. That includes memory, interrupts, and I/O. This includes the VxWorks 6.9, VxWorks 7, and Linux guests. In addition, since the module operating system includes hardware virtualization assisted hypervisor technology, it is possible to support a third-party operating system, allowing the inclusion of various federated systems that can be combined to run on the VxWorks 653 Multi-core Edition IMA architecture.

### **ARINC 653 Applications**

Each application in an ARINC 653 system runs in its own cert guest operating system. The module operating system provides space partitioning through virtualization and memory management services. In addition, the module operating system schedules the guest operating systems according to a predefined, static schedule; partitions execute only when their allocated time slice is active and on predetermined cores. The guest operating systems manage their own resources within their time slices, and performance is optimized by allowing the guest operating system direct access to the hardware where possible.

### **Optional Time Partition Scheduling**

VxWorks 653 Multi-core Edition uses a scheduling architecture with very low overhead for context switching between guest operating systems that share a single core. VxWorks 653 Multi-core Edition supports standard ARINC time-preemptive scheduling, where guest operating systems execute until their time slice expires, when the next scheduled partition executes.

VxWorks 653 Multi-core Edition 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 operating system. 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 Multi-core Edition offers a combined scheduling mode called ARINC plus priority-preemptive scheduling (APPS). In APPS, the module operating system can switch to priority-preemptive scheduling under a variety of conditions, including when it detects idle time in a guest operating system'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 guest with the highest priority is scheduled to run during the idle time of the current time slice. APPS enables VxWorks 653 to utilize idle time effectively, potentially reducing the overall response latency for high-priority tasks.

### **Partition Operating System**

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

VxWorks 653 Multi-core Edition supports warm start and cold start of partitions and of the entire system. The VxWorks partition operating system is a multi-threading technology that is based on VxWorks 6.6.5. Consisting of a kernel plus a subset of the libraries supported in VxWorks 6.6, its own set of libraries that provide the application programming interface (API). Support for C, C++, and APEX (application executive) APIs is provided by the partition operating system. In addition, it uses its own priority-preemptive scheduler and supports the combined APPS mode, controlled by the module operating system.

Because this is a complete VxWorks guest, it will run code in both user mode and kernel mode, without interactions from the module operating system. One instance of the module operating system is completely distinct from both the module operating system and other guest operating system instances running in other partitions in the same VxWorks 653 system.

### **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 Multi-core Edition, the "operating system" is the combination of the partition operating system and the module operating system. APEX adds enhancements to a partition operating system in the areas of time and process management and the ability to manage both periodic and aperiodic processes and their associated deadlines.

VxWorks 653 Multi-core Edition includes the ability to create partition operating system-based application partitions that provide full APEX support.

### **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 the partition operating system partitions, APEX partitions, and COIL partitions. VxWorks 653 Multi-core Edition 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 Multi-core Edition 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 Multi-core Edition supports multiple methods and technologies.

In partitions using the VxWorks partition operating system, VxWorks 653 Multi-core Edition 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 Multi-core Edition 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 Multi-core Edition 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. The VxWorks 653 Multi-core Edition health monitor implements not only the ARINC 653 APIs but also the optional hierarchical structure and response capability specified in the standard. VxWorks 653 Multi-core Edition 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 Multi-core Edition 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 Multi-core Edition 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 operating system, 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 Multi-core Edition system configuration.

### Wind River Workbench

VxWorks 653 Multi-core Edition 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.

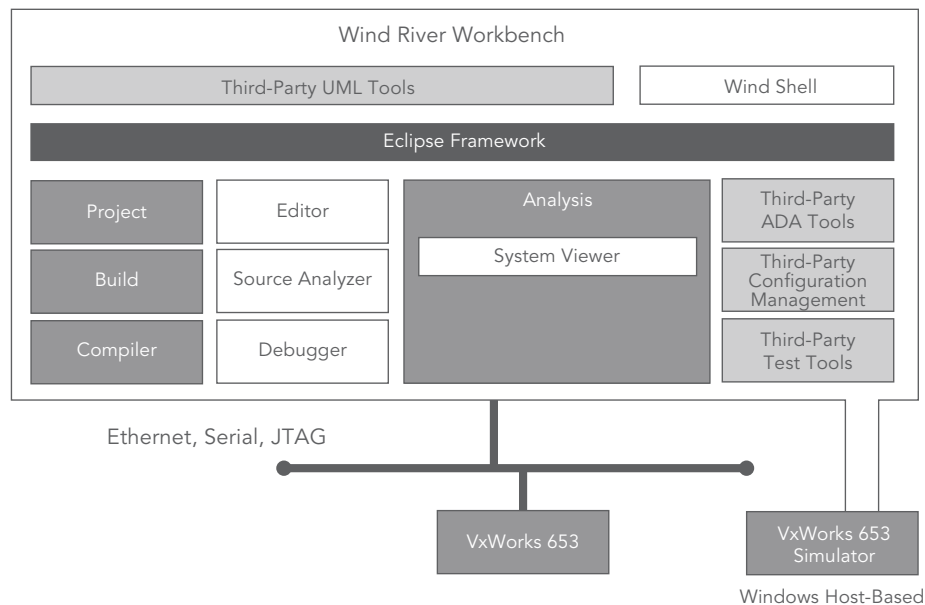


Figure 3. Wind River Workbench in VxWorks 653 3.0 Multi-core Edition



### ***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 Multi-core Edition.

### ***Project System***

The Workbench project system allows developers to organize and manage the primary components in a VxWorks 653 Multi-core Edition development project, including source files, partitions, and target systems. VxWorks 653 Multi-core Edition 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***

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 Multi-core Edition 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 Multi-core Edition image file for its guest operating system partition. A system integrator collects the image files from each partition for integration into the whole system. VxWorks 653 Multi-core Edition provides a powerful configuration scheme for the system integrator to define strict policies for each guest operating system partition, and the inter-partition communication mechanism.

The Workbench build system specifies the tools, options, and parameters to use when building VxWorks 653 Multi-core Edition software projects, enabling developers to set build parameters easily from the project level down to the individual file level. The VxWorks 653 Multi-core Edition 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 Multi-core Edition 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 Multi-core Edition platform-specific tools, developers can configure VxWorks 653 Multi-core Edition and 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 Multi-core Edition 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 Multi-core Edition extends the Eclipse debug framework with device connections and multi-partition context awareness. It provides full visibility into the VxWorks 653 Multi-core Edition multi-partition execution environment. This capability can be extended further with JTAG-based On-Chip Debugging solutions.

### **Target Shell**

The target shell provides access to VxWorks 653 Multi-core Edition module operating system task information and system memory. It is a shell that runs on the target itself as part of the VxWorks 653 Multi-core Edition 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.*

### **System Configuration**

The build system for VxWorks 653 Multi-core Edition 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 guest operating system partitions can be independently loaded and updated on the system.

The VxWorks 653 Multi-core Edition 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 Multi-core Edition 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 runtime)
- XML file checker to verify the consistency of the configuration
- XML compiler to build the XML configuration data into the VxWorks 653 Multi-core Edition 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 Multi-core Edition 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 Multi-core Edition Certification Evidence package. 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 operating system or a partition operating system
- **Port:** Logs port activity occurring in a VxWorks 653 Multi-core Edition system

***Agent for the Certification Environment***

The ACE is a debugging facility that works with Workbench Debugger on a cert module operating system, enabling the debugger's target-based agent to be loaded separately and independently from the module operating system. This allows DO-178C certification evidence to be generated for the module operating system independent of the debug agent. The ACE is supported when the module operating system 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 operating system, 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 operating system, enabling application suppliers to debug their applications using the full debugging capabilities of VxWorks 653 Multi-core Edition with the non-cert configuration of the module operating system 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 Multi-core Edition and application subroutines. This DO-330 TQL-5 qualified tool also provides monitoring and debugging capabilities for applications in the VxWorks 653 Multi-core Edition 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.

Wind River GNU Compiler includes the following:

- cpp, the C preprocessor
- GCC, the C and C++ compiler
- ld, 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 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, a configurable option for Wind River VxWorks 653 Multi-core Edition, 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 Cert Highly Reliable File System (HRFS)**

The Cert 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-178B/C avionics software standard. Cert HRFS provides file system access from the module operating system 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 operating system or through system calls or FACE APIs in a partition.

Cert 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). Cert 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.

**Wind River Workbench On-Chip Debugging**

Wind River Workbench On-Chip Debugging is essential for hardware bring-up and BSP development and provides a system-level debugging environment for VxWorks 653

systems. The same environment provides a powerful debugging environment for application development throughout the development lifecycle. Using a JTAG connection to hardware running the VxWorks 653 environment provides maximum control and inspection 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.

Workbench On-Chip Debugging supports the Wind River JTAG debug units, Wind River Probe and Wind River ICE 2. Wind River Probe is the Wind River 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. Probe is designed to work with Workbench On-Chip Debugging and Wind River On-Chip Debugging API. Wind River ICE 2 is the Wind River high-performance, network-attached JTAG debug unit that supports a wide range of 32-bit and 64-bit single core and multi-core processors. ICE 2 excels in complex system debugging and multisite development. ICE 2 is designed to work with Workbench On-Chip Debugging and Wind River On-Chip Debugging API.

## 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
- Linux (Red Hat, Ubuntu, and SUSE)

### Supported BSPs

Version 3.0:

- Freescale QorIQ P3041 DS
- wrSbcP4080 BSP for Wind River SBC QorIQ P4080
- Freescale QorIQ T2080

## 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

A partial list of our hardware partners for VxWorks 653 includes the following:

- Abaco
- Aitech
- Curtiss-Wright
- Intel
- Kontron
- MEN Mikro
- Mercury Systems
- NXP

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

### Software Partners

Technology components provided by our software partners include the following:

Technology	Partner
Ada Language Support	AdaCore
Graphics Drivers	Core AVI

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

Technology	Partner
High-level design	IBM Rational, The Mathworks
Qualified graphics design	Ansys, Presagis
Qualified system design	Ansysl
Test	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](http://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 accelerates engineering productivity and helps our customers reach the full potential of the VxWorks 653 3.x Platform.

### 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 Wind River VxWorks 653 Multi-core Edition we offer deeply technical hands-on courses, including VxWorks 653 Multi-core Edition Essentials and VxWorks 653 Multi-core Edition Porting and Advanced Topics. For more information, visit [www.windriver.com/education](http://www.windriver.com/education).

### CUSTOMER SUPPORT

Wind River VxWorks 653 Multi-core Edition is backed by our award-winning global support organization. With six major support centers, 21 additional support hubs, and 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. 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. For more information, visit [www.windriver.com/support](http://www.windriver.com/support).

