

Wind River VxWorks MILS Platform 2.1

Companies responsible for creating potent defense, networking, industrial, and other infrastructure systems worldwide are demanding ever increasing functionality and secure and safe operation with very high assurance of protection from intentional or inadvertent threats or errors. At the same time, these systems must often operate with stringent requirements for reducing space, weight, and power (SWaP).

To meet these challenging demands, a new system architecture has emerged called multiple independent levels of security, or MILS. A MILS operating system partitions a single processor among multiple software components, with time and space resource allocation, information flow, and fault isolation all

strictly enforced to conform to security policies defined by developers and system integrators.

Use of the MILS architecture enables reduction of SWaP through hardware consolidation. MILS enables security-critical applications, carrying confidential and critical data, to coexist on the same system with medium- or low-security applications that connect to non-secure channels or that have not passed the rigor of high security assurance validation. MILS enables multilevel secure (MLS) systems, which use components at multiple levels of security, and cross domain solutions (CDS) systems, which use components with data from different domains (e.g., different members of coalitions).

Wind River has developed VxWorks MILS Platform for use in secure, partitioned systems requiring accreditation or certification. Wind River VxWorks MILS Platform 2.1 is a solution for software development of MLS and CDS devices with high-security, high-robustness, and high-performance requirements. It provides engineers with essential tools for developing, configuring, integrating, debugging, and testing secure device systems. Its run-time components are ready to be certified to high-robustness security assurance levels recognized by defense authorities. VxWorks MILS Platform is designed to be the foundation for your MLS and CDS systems.

VxWorks MILS Platform enables you to do the following:

- Run software components with multiple levels of data security, or with multiple data domains, securely on a single processor
- Isolate security-critical code for cost-effective assurance evaluation
- Enable independent teams to work in parallel on subcomponents
- Enable cost-effective technology refresh and reevaluation on subcomponents after deployment

Common Criteria Evaluation

Common Criteria for Information Technology Security Evaluation (ISO/IEC 15408) is an international standard that enables accredited laboratories to evaluate device software to determine whether it meets the security requirements of the product. The National Information Assurance Partnership (NIAP) is a U.S. government initiative that administers the Common Criteria Evaluation and Validation Scheme (CCEVS; <http://www.niap-ccevs.org/cc-scheme/>).

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Wind River VxWorks MILS Platform 2.1 has been developed in accordance to the U.S. Government Protection Profile for Separation Kernels in Environments Requiring High Robustness version 1.03 (SKPP) and is officially listed by NIAP as being in evaluation to EAL6+/NSA High Robustness under the CCEVS (http://www.niap-ccevs.org/cc-scheme/in_evaluation/). By using VxWorks MILS Platform, users can focus their efforts on development and certification of their user components.

Benefits

VxWorks MILS Platform 2.1 offers a range of benefits for defense device development teams, including the following:

- 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 domains, shortening the integration period and reducing integration errors
- Application support for high security assurance levels (EAL6+)
- Networking support for high security assurance levels (EAL6+)
- Run-time based on MILS architecture, providing time and space partitioning, information flow control, and fault isolation
- Portability and reusability of existing ARINC 653 applications, VxWorks kernel-mode applications and drivers, and Linux and other open source user-mode applications and components
- Powerful kernel-aware development and debugging tools: Wind River Workbench development environment, VxWorks MILS project and build system, on-chip debugging, and agent-based debugging
- Wind River expertise in high security systems in the form of professional services, customer education, and customer support services

VxWorks MILS Platform Features

VxWorks MILS Platform includes run-time components that form the foundation for security in MLS systems and tools for developing and integrating MLS systems efficiently.

Development Suite

XML Configuration	Agent-Based Debugging
GNU Compiler	Wind River ICE 2*
Wind River Workbench	Wind River Workbench On-Chip Debugging*

Software Partners

Common Criteria Certification Services	Ada for VxWorks	
Formal Methods Analysis	Java Virtual Machine	
MIL-STD-1553	OpenGL Graphics	DDS

Operating System

VxWorks MILS

Hardware Partners

COTS Boards

Services

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

*Optional components

Figure 1: Wind River VxWorks MILS Platform

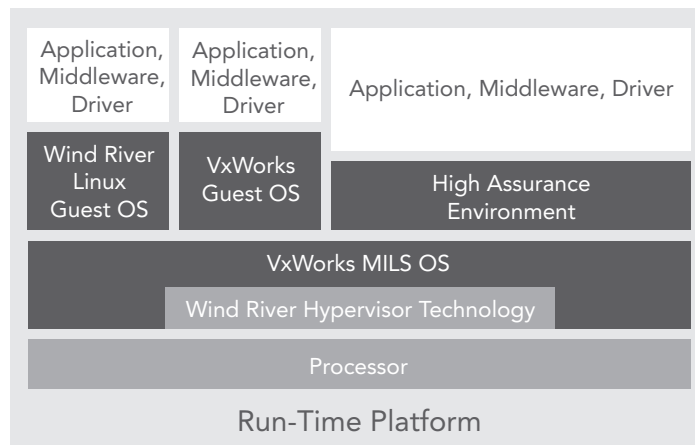


Figure 2: Wind River VxWorks MILS Platform run-time components

VxWorks MILS Run-Time Components

VxWorks MILS uses the MILS OS architecture with partitioned environments. The VxWorks MILS separation kernel forms the lower-level OS. The separation kernel enforces time partitioning and fault isolation on the user components to make sure that any damage or corruption is limited to the faulty application, and covert channels are prohibited. The upper-level user partitions are VxWorks MILS Platform

virtual boards where all user components, such as applications, middleware, and drivers, execute.

Separation Kernel

VxWorks MILS implements a separation kernel designed to meet the security specifications for a separation kernel compliant to the U.S. Government Protection Profile for Separation Kernels in Environments Requiring High Robustness version 1.03 (SKPP).

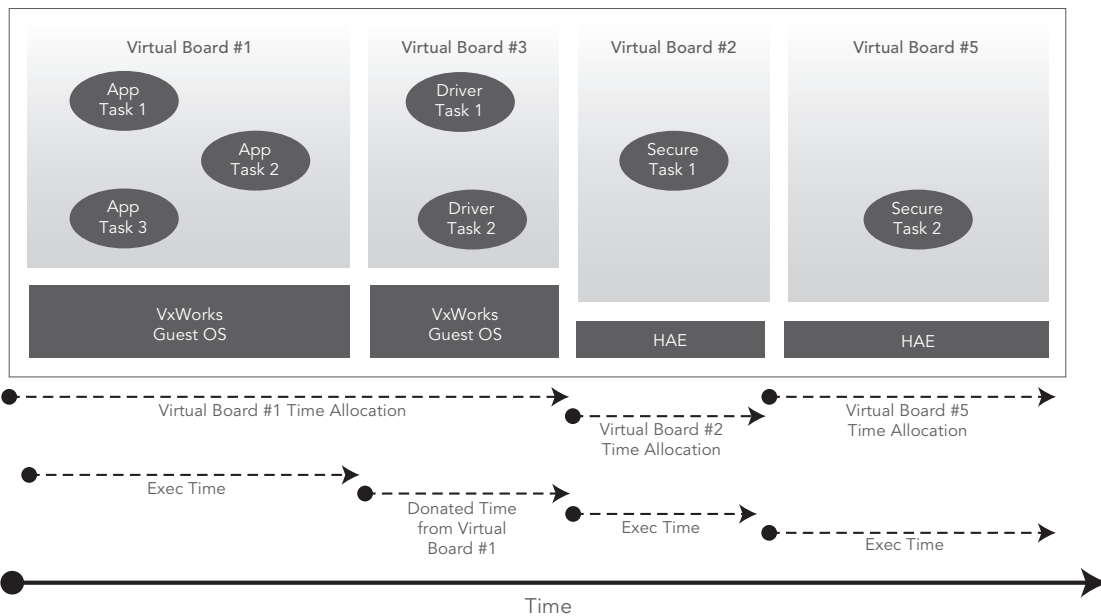


Figure 3: VxWorks MILS Platform virtual board scheduler with time donation

To achieve the functional requirements specified by the SKPP, the VxWorks MILS kernel allocates all resources under its control into space (memory) partitions called virtual boards. The actions of applications in virtual boards are isolated so that they cannot be detected by, or communicated to, applications in other virtual boards, unless that information flow has been explicitly allowed.

The VxWorks MILS kernel provides to its hosted software programs high assurance partitioning and information flow control properties that are non-bypassable, evaluatable, always invoked, and tamperproof (NEAT).

Partition Management

Applications for a MILS system are distributed among user partitions, called virtual boards in VxWorks MILS. A virtual board is a schedulable entity with allocated memory space and physical hardware. It enforces space partitioning to ensure that secure data is isolated. Strict control of data flow between virtual boards is enforced by the secure inter-partition communication (SIPC) component according to predefined policies.

Virtual boards serve as containers for applications and drivers. Virtual boards run on a predetermined schedule, running during an allotted fixed time slice or slices in a schedule.

The VxWorks MILS separation kernel uses a high-performance, two-level scheduling architecture with very low overhead for context switching between virtual boards. For faster response times, VxWorks MILS allows an application virtual board to donate part of its allocated time to another virtual board, such as one in which a device driver runs. Time donation improves reaction time of a MILS system while maintaining robustness.

Virtualization and Guest Operating Systems

The VxWorks MILS separation kernel includes hypervisor technology that is leveraged from Wind River Hypervisor, which provides virtualization capabilities to enable guest operating systems to run in the MILS user-mode partitions, on virtual boards.

VxWorks MILS Platform 2.1 supports multiple user-mode execution environments for applications on virtual boards:

- The High Assurance Environment (HAE) is a small executive for single-threaded applications that may require high assurance certification or accreditation, such as Common Criteria EAL6+.
- VxWorks Guest OS is a more powerful environment for multitasking applications that can be validated at medium or low security assurance levels.

- Wind River Linux Guest OS provides a full Linux kernel and user mode environment for leveraging existing Linux and other open source applications and middleware on MILS-based systems.

High Assurance Environment

User components that have high assurance certification or accreditation requirements can run in the HAE. The HAE is a user-mode execution environment for virtual boards that provides an ANSI C programming environment, direct interface to the separation kernel, and SIPC, the secure inter-partition communication mechanism. Applications of this type run on a single thread in the HAE and have access to a debug console.

VxWorks Guest OS

Applications with less stringent security requirements can run on a VxWorks Guest OS virtual board. VxWorks Guest OS provides the standard VxWorks priority-preemptive multitasking environment within a virtual board.

VxWorks Guest OS also provides standard VxWorks system services, including task synchronization, inter-task communication, and I/O system calls.

VxWorks Guest OS enables portability from existing and legacy VxWorks-based products. Because it directly shares its codebase with the partition

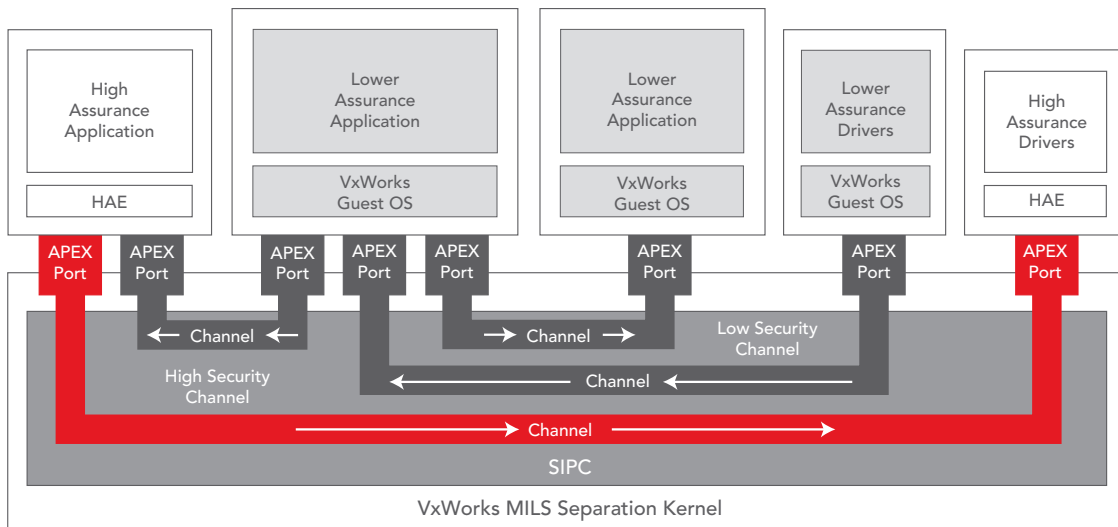


Figure 4: VxWorks MILS SIPC

OS from VxWorks 653, developers can repurpose their ARINC 653 applications for VxWorks MILS Platform. In addition, VxWorks Guest OS shares many APIs with VxWorks 5 and the kernel of VxWorks 6. Developers can port drivers, applications, and middleware from VxWorks 5 and 6 to create medium- and low-assurance applications and components for VxWorks MILS Platform.

Wind River Linux Guest OS

VxWorks MILS Platform 2.1 includes support for Wind River Linux to run as a guest OS on virtual boards. This enables Linux and other open source applications and middleware to run on VxWorks MILS Platform-based systems. Wind River Linux Guest OS provides the same commercial-grade embedded Linux solution as standalone Wind River Linux, with 2.6.27 kernel, GCC 4.3.2, and outstanding performance as a guest OS, using industry-standard benchmarks. Wind River Linux Guest OS contains a preintegrated, fully tested, validated, and supported Linux distribution with rich tools and the same Workbench development environment based on the Eclipse framework as used for VxWorks MILS Platform. Wind River Linux Guest OS also provides core networking and connectivity protocols, NFS client support, and interoperability with RTI data distribution service (DDS) middleware.

General Network Stack

The general network stack is an IPv4-based network stack available on VxWorks Guest OS. It provides UDP and TCP connectivity and is suitable for use with low- and medium-assurance applications and components.

High Assurance Network Stack

High Assurance Network Stack is a new, optional add-on product available with VxWorks MILS Platform 2.1. High Assurance Network Stack uses a two-partition architecture to provide an IPv4-based network stack capable of supporting separated data streams, such as for multilevel secure networking or networking for cross domain systems.

The High Assurance Network Stack foundation layer runs in an HAE virtual board and can discriminate incoming and outgoing packets, based on data labeling (e.g., 802.1Q virtual LAN support) to separate data streams and route them to the appropriate application virtual board. The network foundation layer has been designed and developed to be amenable to high assurance certification or accreditation.

The protocols stack supports UDP, TCP, IGMP, and multicast and runs on a VxWorks Guest OS virtual board. The network foundation layer is capable of supporting multiple data streams, destined for multiple protocol stacks, each running on a separate VxWorks Guest OS virtual board.

High Assurance Network Stack also enables multiple VxWorks Guest OS applications to share a common Ethernet port in a secure manner.

Inter-partition Communications

The secure inter-partition communications (SIPC) component provides a communication mechanism between virtual boards. SIPC guarantees data integrity, such that data can reach only the intended recipient virtual board. SIPC is suitable for the EAL6+ evaluation level and can be used by components running in HAE, VxWorks Guest OS, or Wind River Linux Guest OS. Its API is designed around the ARINC 653 APEX queuing port interface, enabling ARINC 653 applications to be ported into VxWorks MILS Platform.

SIPC ensures tight control of information flow between user partitions. Messages pass from one partition to another through unidirectional channels. Message flow policies are specified using configuration at system integration time.

Shared memory may also be used as a form of inter-partition communication between virtual boards. Although shared memory regions do have configurable access rights, shared memory is inherently unsecure and should be used only by applications at the same security level. For legacy applications and drivers relying on

shared memory, this feature allows straightforward porting to the VxWorks MILS Platform environment, in the HAE, on VxWorks Guest OS, or on Wind River Linux Guest OS.

Security and Safety Auditing

VxWorks MILS Platform manages two kinds of logs: security logs and safety logs. Each virtual board has both a security log and a safety log; there is also a security log and a safety log for the MILS kernel.

Security logs record events that could impact the security of the MILS system. Safety logs record events that could impact the stability of applications in the MILS system but can be generally used by applications to record any type of event. The logs are managed at the MILS system level, and applications running in virtual boards can inject events into their own logs. Rights to access the security and safety logs are part of the VxWorks MILS system configuration.

Hardware Support

Device drivers and the network stack run on virtual boards. They have allotted space partitioning and share the same fault isolation and data isolation properties as applications. They can run in specific time slices just like applications, or they can be called like middleware and run in the time slice of the calling application.

VxWorks MILS Platform 2.1 includes support for Ethernet and RS-232 drivers as well as board support packages (BSPs) for the Curtiss-Wright VPX6-185 and Wind River SBC8548. Partner technology is available for MIL-STD-1553 support.

Middleware

Middleware that is available for VxWorks can be ported to the VxWorks Guest OS. Middleware enables applications to take advantage of advanced technologies in a MILS system. Technologies for VxWorks MILS Platform 2.1 that are enabled by middleware include the following:

- Ada
- DDS
- Java Virtual Machine (JVM)
- OpenGL

Evaluation of middleware components is the responsibility of the individual vendors.

VxWorks MILS Platform Development Environment

VxWorks MILS Platform includes the award-winning Wind River Workbench. This Eclipse-based development environment offers one common interface across all development phases of the security device through development, debug, and test and for all of the VxWorks MILS Platform run-time environments. Workbench inherits Eclipse's intuitive development environment for working with complex code. Many of Wind River's partners extend the development environment to provide more powerful design and analysis tools.

Workbench includes the following features.

Eclipse

Because of its openness, capability, and strong community support, Eclipse provides a powerful framework for the Wind River Workbench development suite. Wind River is a leader in the Eclipse development community, guiding the C/C++ Development Tooling (CDT) and Device Software Development Platform (DSDP) projects. The Eclipse 3.5 framework supplies the necessary infrastructure to graphically and functionally integrate the components of Workbench. Open, extensible, and backed by a strong community of commercial and open source developers, the Eclipse framework provides a wide range of additional integrated functionality. Wind River has extended the Eclipse framework with its own unique technology to manage the complexity of project management and debugging in partitioned systems such as VxWorks MILS Platform.

Project System

The Workbench project system allows developers to organize and manage the primary components in a VxWorks MILS Platform development project, including source files and target systems. VxWorks MILS Platform projects of

different types can be created for configuring and building VxWorks MILS separation kernel images as well as images for VxWorks Guest OS, Wind River Linux Guest OS, and HAE virtual boards for MILS application development. By design, Workbench enables users to manage multiple projects simultaneously and independently so that information separation between different development groups can be assured.

Build System

The Workbench build system specifies the tools, options, and parameters to use when building VxWorks MILS Platform software projects, enabling developers to set build parameters easily from the project level down to the individual file level. The VxWorks MILS 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 MILS system do not require source or binaries from other parts of the systems to build, link, and load their applications.

Defense systems can be extremely complex, with a large number of components integrated into one system, each with strict policies on the data it can expose or isolate. The challenge in this complexity is managing each sub-project successfully so that all teams can work independently and in parallel. Management of piece-wise certifiable systems depends on allowing development of independent components to be completed in parallel and asynchronously. Applications are scaled, extended, and modified over time; new applications are built just as developed applications are completing. For the costly and time-consuming certification process, the development process must operate so that components can be independently certified and recertified. The system becomes scalable and extendable over the certification cycle.

VxWorks MILS Platform enables this modularized approach for handling complex teamwork, system integration, and asynchronous certification cycles. The platform supports a build system

that is independent for each 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 MILS image file for its component. A system integrator collects the image files from each for integration into the whole system. VxWorks MILS Platform provides powerful configuration tools for the system integrator to define strict policies for each application and the inter-application communication mechanism.

Debugging Environment

The debugging environment in VxWorks MILS Platform extends the powerful debug and analysis capabilities of Eclipse. Capabilities such as kernel debugging, virtual board debugging, time-slice-specific breakpoint management, symbol browsing, and stack tracing are available to the user. VxWorks MILS Platform extends the Eclipse debug framework with device connections and context awareness. The debug connection between Workbench and the device is one of the following:

- An on-chip debugger using JTAG allows debugging of VxWorks MILS separation kernel bring-up, Wind River Linux Guest OS kernel debugging, and debugging in HAE and VxWorks Guest OS environments.

- The VxWorks MILS Platform run-time debug agent allows debugging of HAE and VxWorks Guest OS, executing in a virtual board.
- The Wind River Linux user-mode agent allows Workbench debugging on Wind River Linux Guest OS applications.

Wind River Workbench On-Chip Debugging is essential for hardware bring-up, BSP development, and debugging of virtual board initialization. The same environment provides a powerful debugging environment for application development throughout the development life cycle. Workbench's debug environment provides source-level debugging in system mode with full system visibility and control using separate connections to each virtual board. Users can debug the operating system and application software without a software agent.

The VxWorks MILS debug agent provides a debugging environment through an Ethernet connection, useful when JTAG is unavailable. The agent can be used to debug HAE components and VxWorks Guest OS components. The agent can be configured in and out of the system with no impact to certification and can be configured to debug only a certain subset of virtual boards to limit system visibility to only what is important to a particular application supplier.

Host Shell

The host shell provides a command-line interface with gdb syntax for debugging in HAE and VxWorks Guest OS environments. The host shell uses the VxWorks MILS debug agent or on-chip debugging to communicate with the target and provides run control and register and memory access.

The host shell executes on the development host, not the target. The host shell receives commands, executes them locally on the host, and dispatches requests to the target agent for any action involving the symbol table or target-resident programs or data. Since the shell executes on the host system, you can use it with minimal intrusion on target resources.

The host shell could be used for interactive debugging and monitoring or for scripting and batch mode operations such as automated testing.

System Configuration

The build system for VxWorks MILS Platform supports the role-separation approach to development. Virtual boards are independently built and linked but can still reference the entire system. The image files from virtual boards can be independently loaded and updated on the system.

The VxWorks MILS Platform system configuration specifies the security policies of each MILS object, including scheduling, virtual board resource access, and SIPC. The underlying configuration data is based on XML tables compatible with ARINC 653 configuration data. For security and 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.

XML Compiler and Configuration Tools

VxWorks MILS Platform security policies are written in XML. These XML files are compiled into binary objects and linkable images using the Wind River XML Configuration Compiler (XCC) and

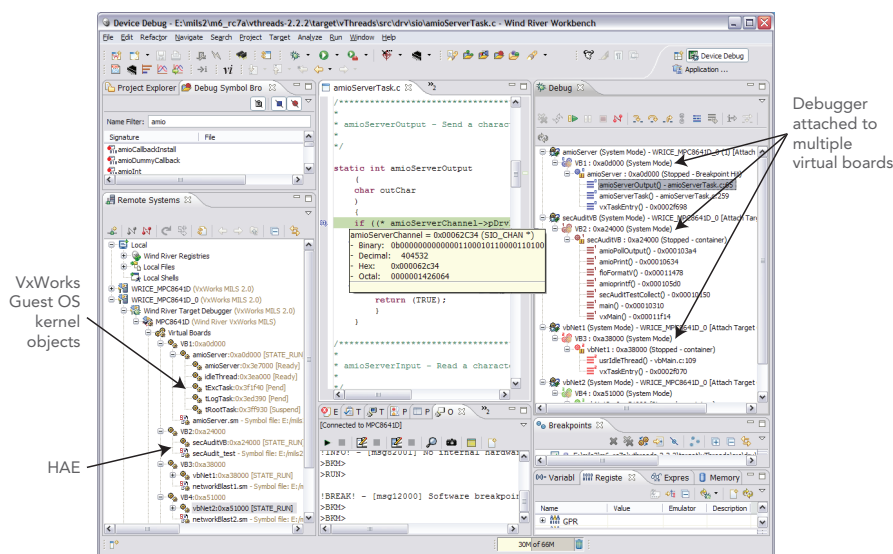


Figure 5: Wind River Workbench in VxWorks MILS Platform

Configuration Vector Generation tools (CVGEN). These configuration images are then loaded on the target to be referenced during system boot.

These XML configuration tools allow developers to make changes to application and/or system configuration information without rebuilding and retesting the entire system. Changes to independent applications can be made without the need to retest or recertify other applications or the underlying OS in the system. This significantly reduces the time to initial certification, as well as the cost of change and maintenance throughout the device life cycle. In addition, these tools fully comply with the DO-297 IMA Development Guidance and Certification Issues document, enabling intellectual property and security separation between the platform provider, application developer, and system integrator.

Wind River GNU Compiler

Several versions of Wind River GNU Compiler are used for the different run-time environment in VxWorks MILS Platform. Wind River has modified general distribution versions of the compiler specifically for use with the VxWorks product line.

Version 4.1.2 is the default compiler for the VxWorks MILS separation kernel, for the HAE, and for user components that run in the HAE.

Version 3.3.2 is the default compiler for the VxWorks Guest OS as well as all user components that run on the VxWorks Guest OS.

Version 4.3.2 is the compiler version for Wind River Linux Guest OS as well as all user components and software that run on Wind River Linux Guest OS.

Application Multiplexed I/O

Console I/O sent from target-based applications back to the development host are 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 virtual boards, application multiplexed I/O (AMIO) provides the capability for the serial port to be shared among multiple virtual boards. Once configured with AMIO, a VxWorks Guest OS 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 virtual board is displayed in a separate AMIO console window as if multiple independent systems were running.

Technical Specifications

VxWorks MILS Platform

- VxWorks MILS 2.1 separation kernel
- VxWorks MILS High Assurance Environment (HAE) 1.1
- VxWorks MILS VxWorks Guest OS 1.0.1
- VxWorks MILS 2.1 General Network Stack, with IPv4, UDP, and TCP
- VxWorks MILS 2.1 Secure IPC (SIPC)
- VxWorks MILS 2.1 device drivers: RS-232 and Ethernet

Wind River Workbench 3.2.2

- Based on Eclipse 3.5
- MILS system configuration
- MILS project system
- MILS build system
- Debugger
- Host shell
- VxWorks MILS debug agent
- Wind River GNU Compiler 3.3.2 and 4.1.2
- Index-based global text search-and-replace

Architectures, Hosts, and Board Support Packages

Supported Target Architectures

- PowerPC 86xx, MPC8641D
- PowerPC 85xx, MPC8548

Supported Hosts

- Windows XP Professional, Service Pack 2

Supported Board Support Packages

- BSP for Curtiss-Wright VPX6-185
- BSP for Wind River SBC8548

Optional Wind River Components

- High Assurance Network Stack 1.0 for VxWorks MILS Platform 2.1
- Wind River Linux 3.0.3 Guest OS for VxWorks MILS Platform 2.1
- Workbench On-Chip Debugging 3.2.2
- Wind River ICE 2
- Wind River Probe

Partner Ecosystem

Wind River's world-class partner ecosystem ensures tight integration between Wind River core technologies and those of the premier hardware and software companies we've chosen to build out our solutions. Partners help to 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 aerospace and defense market. The customer support team at Wind River is trained to troubleshoot partner technologies in use with Wind River products, making it the most comprehensive and best-supported partner ecosystem in the embedded and mobile industries.

Professional Services

Wind River VxWorks MILS Platform is complemented by Wind River Professional Services, a CMMI Level 3–certified organization that provides aerospace and defense (A&D) device manufacturers with expert outsourced engineering services specifically designed to speed new products to market while minimizing development costs. Capable A&D specialists are available to help with implementing parts or all of the system. Services include installation and orientation, design of partitioned real-time operating systems (RTOS), assistance with creating High-EAL certifiable code, BSP and driver migration and creation, software system and middleware integration, legacy application and infrastructure migration, platform extensions, and process compliance.

Common Criteria High-EAL/High Robustness evaluation is an exacting process requiring very close cooperation between the customer and

OS vendor and requires several years for multilevel secure systems built on MILS. These activities must be carried out for the OS and middleware as well as the customer's application. Wind River Professional Services has developed years of expertise on design and implementation of safe and secure systems. Wind River is committed to assisting its customers with their specific evaluation requirements.

Backed by our commercial-grade project methodology, Wind River Professional Services includes 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.

Hardware Partners

Wind River hardware partners include the following:

- Curtiss-Wright Controls Embedded Computing
- Freescale
- GE Intelligent Platforms
- Intel Corporation

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:

Tools	Partner
Ada support	AdaCore
Graphics	Presagis
Java	Atego (Aonix)

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

Tools	Partner
Ada development tools	AdaCore
Java development tools	Atego (Aonix)
Qualified graphics design tools	Presagis

Professional Services has extensive experience with platform design, including safety critical systems and navigation/infotainment systems. Wind River 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, and 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

Wind River Customer Education brings engineers up to speed quickly to shorten the learning curve. Public courses and onsite education can be delivered. Lectures and interactive labs provide an effective way for students to become productive quickly with Wind River technology, with the help of experienced instructors.

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.

The following are some advantages of onsite education:

- Your entire team gains a common knowledge base.
- It 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 VxWorks MILS Platform. Your subscription 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 OLS at <http://www.windriver.com> 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.

Customer Support will provide bug fixes following the process outlined in Wind River's Customer Support User's Guide (CSUG), available at <http://www.windriver.com/support/resources/csug.pdf>. Customers with a current maintenance or subscription agreement are eligible for all updates of VxWorks MILS Platform free of charge. Customers under a current subscription are also eligible for all upgrades of VxWorks MILS 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.

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