

VxWorks 6

Wind River's VxWorks, the world's most widely adopted commercial-grade real-time operating system, is the premier foundation for all device software applications. The latest edition of VxWorks, version 6.2, is backward compatible with VxWorks 5.5, 6.0, and 6.1. This release includes enhanced memory protection and error management, improved operating system scalability, improved POSIX compliance, support for the latest networking and security protocols, and connectivity between devices and the enterprise.

New in VxWorks 6.2

The latest release of VxWorks extends the capabilities of previous versions with:

- Improved OS scalability using new configuration profiles
- Full support for the JTRS SCA AEP 2.2.1
- A new file system framework that supports:
 - Multiple file systems
 - Removable media and auto-detection of file systems
 - New POSIX-conformant highly reliable file system (HRFS)
- A new power management framework
 - Reference power managers for CPU performance and thermal management
 - Support for user-defined scenarios
- A new high-speed interconnect framework
 - PCI and local bus support
 - Enhancements to the network stack
- Support for additional architectures and BSPs
 - Momentum Maple-D (PowerPC 970)
 - MIPS malta24kec (malta24kec_mips32sf and malta24kec_mips32sfl) (MIPS32)
 - Wind River wrSbc834x (PowerPC 83xx)
 - Intel IXP46x (XScale)

Integrated Run-Time Technologies

Error Management	IPv4/IPv6	USB 1.1, 2.0	
Flash Support (TrueFFS)		DOS FS	
Transactional Reliable FS		Highly Reliable FS	
802.11 a/b/g	PPP	UDP	TCP
Servers: FTP, NFS, SNTP, Telnet, RSH, DHCP, TFTP			
Clients: FTP, NFS, SNTP, Telnet, RSH, DHCP, TFTP, Ping, DNS, Rlogin			

OS

VxWorks

Architecture of VxWorks 6.2

Features and Benefits

VxWorks is the industry's leading device software operating system. Its determinism, performance, scalability, and footprint make more than 300 million devices worldwide run faster and more reliably. The next generation of VxWorks adds powerful new features and a focus on openness, performance, reliability, and interoperability.

With VxWorks 6.2, companies can:

- Optimize developer productivity through open standards
- Increase reliability through MMU-based memory protection
- Accelerate time-to-market through enhanced error management
- Seamlessly migrate existing VxWorks-based IP and other existing IP, including open-source
- Continue to deliver products that rely on the core attributes of VxWorks, including high performance, reliability, determinism, low latency, small footprint, and scalability

Wind River also offers the following solutions to complement our operating system: the integrated, Eclipse-based Wind River Workbench development suite; broad middleware components; comprehensive processor and BSP availability; professional services support; legions of experienced VxWorks developers; and the Device Software Optimization industry's widest-ranging partner ecosystem of premier hardware, software, development tools, middleware, and applications providers.

Compatibility

VxWorks 6 was built from the ground up to ease migration from VxWorks 5.5. To that end, the kernel of VxWorks 6 supports the VxWorks 5.5 kernel operating environment. Most BSPs, drivers, and kernel applications developed for or ported to VxWorks 5.5 will run in the VxWorks 6 kernel, with only a recompilation required. By default, the VxWorks 6 kernel builds like that of VxWorks 5.5. VxWorks 6.2 is also backward compatible with VxWorks 6.0 and 6.1.

A set of migration guides in the product documentation describes:

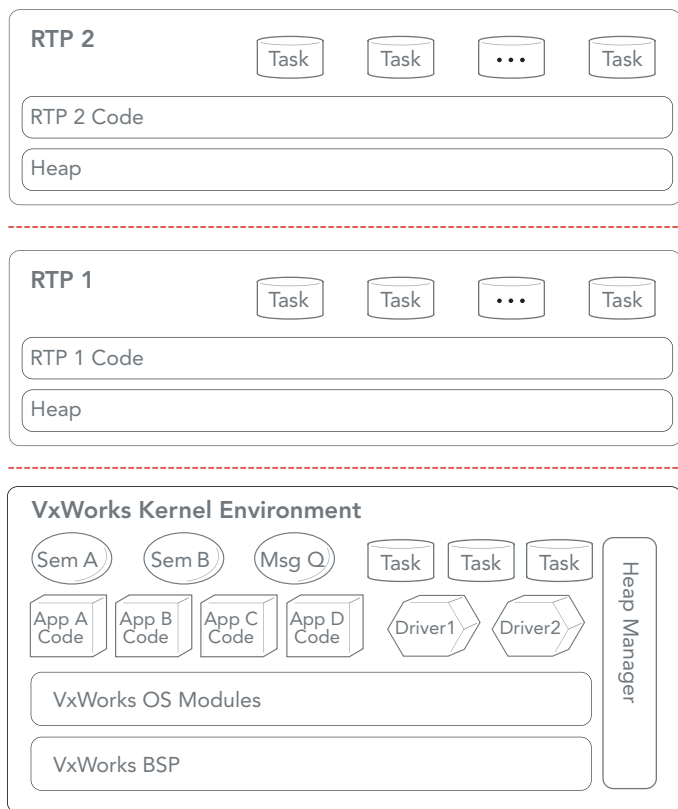
- Migrating BSPs and drivers
- Migrating VxWorks 5.5 kernel applications to the VxWorks 6 kernel and user mode
- Migrating VxWorks AE applications to VxWorks 6 user mode
- Migrating from Tornado and SNIFF+ projects to Wind River Workbench

In addition, VxWorks 6 provides increased support for open standards. This promotes compatibility between open-source applications and VxWorks 6, with the following improvements:

- Increased POSIX compliance eases porting of open-source and third-party software to VxWorks
- Standard process-based programming model reduces the learning curve for programming new applications on VxWorks 6
- Support for IPv6 enables development of the next generation of networked devices
- Standard sockets-based and modular message channels provide a common interprocess communication (IPC) interface

State-of-the-Art Memory Protection

VxWorks 6 enables manufacturers to increase their device reliability through MMU-based memory protection. VxWorks introduces process-based, user-mode application execution in addition to its traditional kernel-mode execution. The kernel is protected from user-mode applications running in VxWorks real-time processes (RTPs). These are also protected from each other.



VxWorks kernel environment and two real-time processes

Features of memory protection include:

- MMU-based memory protection provides isolation of the kernel from user-mode applications and of applications from each other, increasing device reliability
- Standard, process-based programming model simplifies application development
- Support of RTPs on MMU-less processors reduces device cost by enabling the use of low-cost processors
- The ability to use RTPs with the MMU enabled during development, and with the MMU disabled during deployment, speeds development and maximizes device performance
- VxWorks' preemptive, priority-based global task scheduler ensures real-time deterministic behavior
- Ability to create private or public objects in the kernel and in RTPs offers flexibility to use objects that are protected from manipulation, or that can easily be shared among kernel and process tasks
- Extensible system call interface enables application developers to employ custom-developed kernel services from user-mode execution
- Support for shared libraries among RTPs improves code efficiency and reusability, as well as speeding code development and debugging

Message Channels and Wind River TIPC

With memory protection comes the challenge of fast communications between applications in protected memory spaces. Message Channels are a new connection-oriented, bidirectional messaging mechanism that allows tasks to communicate across memory boundaries and complements traditional communication mechanisms provided in VxWorks.

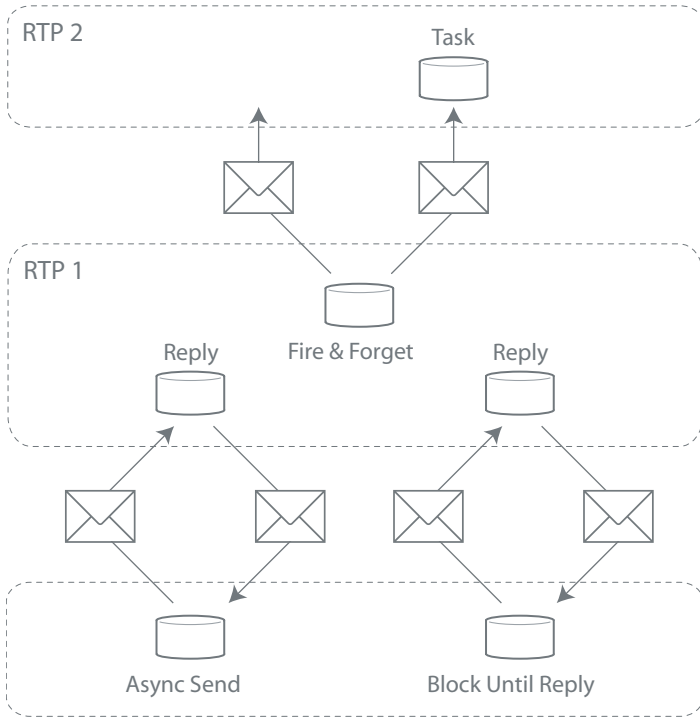
Tasks located in different processes or in the kernel can establish connections with each other independent of their location. Communication can take place between one task in a process and another in the kernel, or between tasks in separate processes, or between tasks in the same process. In VxWorks 6.1 and later, Message Channels use the open-source, industry-standard TIPC (Transparent Interprocess Communication) protocol to extend messaging to tasks in multiprocessor systems that run VxWorks, Linux, or any other operating system that supports TIPC.

Features of Wind River TIPC 1.2 include:

- Open-standard Transparent Interprocess Communication (TIPC)
 - High-speed, reliable message-passing service
 - Location transparency with logical address and internal address translation table
 - Lightweight, connectionless, connection-oriented communication modes
 - No message losses
 - No duplicates
 - Uninterrupted message sequence order
- OS independence, with interoperability between VxWorks and Linux
- Scalability from single processor to multi-core to cluster
- Extensible framework for failover
- Suitability for systems where short, real-time critical transactions are performed
- Complements traditional Wind River communication methods

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VxWorks Kernel Environment



Memory map showing various virtual memory contexts

Memory Management

Although VxWorks 6 provides MMU-enabled memory protection, it continues to use the non-overlapped addressing model used in all earlier versions of VxWorks. The non-overlapped memory model promotes backward compatibility with legacy VxWorks code and provides the following benefits:

- High determinism and low latency are maintained by not requiring memory to be mapped in or out, and by eliminating unnecessary cache flushes
- Address pointers are unique, enabling reuse of existing VxWorks drivers and applications, as well as simplifying new driver and application development
- Support for both MMU-enabled and MMU-less processors gives device manufacturers more flexibility to choose processors that fit their capability and budget requirements
- Memory translation tables are not required, saving memory space and improving memory access performance

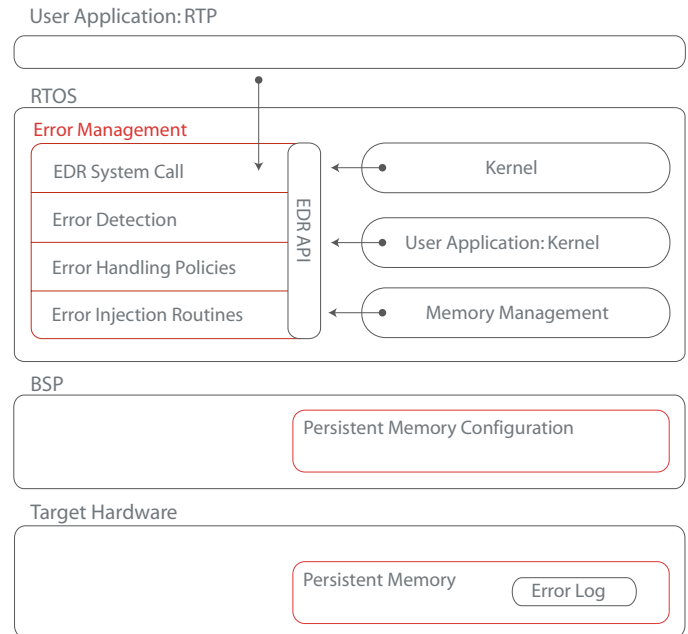
Other VxWorks 6 memory management enhancements include:

- Automatic resource reclamation—to maximize memory availability and help prevent memory leaks, improving device robustness
- Improved memory allocation using a "best fit" algorithm—to reduce memory fragmentation and achieve near deterministic memory allocation/free performance
- User-mode heap and memory partition support—to enable RTPs and user-mode execution
- Developer-replaceable user-mode heap allocator—to maximize system design flexibility
- Heap instrumentation for heaps and memory partitions in both the kernel and RTPs—to assist in diagnosing common memory problems by detecting and reporting memory errors

- Tight integration with error management—to maximize reliability and minimize time-to-market
- Compiler-assisted code instrumentation—to improve static code analysis of memory errors

Error Management

Wind River provides an error management framework to help customers isolate, diagnose, and correct error conditions encountered during development and testing. With this framework, customers can manage failures, minimizing the need to reproduce the failure in order to diagnose the device. The error management framework includes error detection and reporting technology that works automatically in both the kernel and in RTPs, provides a foundation for debugging device software out of the box, and is extensible to enable customers to design reliable devices.



Error management

Error management capabilities include:

- ISR and task stack overrun and underrun detection
- Code corruption detection
- Null pointer usage detection
- Heap block overrun and underrun detection
- Heap usage tracking and leakage detection
- API support for kernel application errors
- API support for user-defined application errors
- Customizable error handling policies
- Comprehensive error records with common headers, key OS information, hardware information, and user-defined optional string
- User-defined memory storage of error records

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Processor Abstraction Layer

With VxWorks 6, the Processor Abstraction Layer (PAL) provides the capability to extend OS support to similar architecture families with less effort than earlier versions of VxWorks required. An architecture-specific PAL defines the functional interconnects for each architecture family, and, to a degree, abstracts the functionality of that hardware feature from the operating system. While this is transparent to the application, the presence of a PAL for an architecture family facilitates the quick adoption of processor variants, improving time-to-market for VxWorks 6 customers.

Benefits of the Processor Abstraction Layer include:

- Faster processor ports within an architecture family give VxWorks 6 customers more design options and shorter time-to-market for new processors
- Easier application migration across architectures provides better flexibility for product life cycle management
- Increased systematic testing of common PAL components increases quality

Operating System Scalability

VxWorks 6.2 introduces improved scalability through the use of predefined configuration profiles. The functionality provided by the profiles varies, enabling customers to build OS images that fit their functionality, footprint, and performance constraints. Note that for all profiles, actual size depends on the specific processor and architecture, and whether the cache is enabled or disabled.

The Minimal Kernel Profile, the smallest default configuration, provides microkernel functionality in a footprint of less than 100KB, down to 36KB. This kernel is fully static (no dynamic memory allocation), and semaphores and watchdogs are optional capabilities.

The Basic Kernel Profile includes all the functionality of the Minimal Kernel Profile, with dynamic memory allocation and other features added to achieve a VxWorks image size of approximately 150KB.

The Basic OS Profile builds on the Basic Kernel Profile, adding functionality like the I/O system and coprocessor support to provide an approximately 250KB footprint.

Each profile provides a default configuration that may be configured further by enabling or disabling individual components, allowing for faster and easier optimization of the OS to meet specific device requirements.

File Systems

VxWorks 6 incorporates a new file system framework that enhances the capabilities, performance, and reliability of VxWorks-based file systems.

Features of the file system framework include:

- Support for multiple file systems, removable media, and automatic file system detection
- New transaction-based highly reliable file system (HRFS) that provides complete power-safe reliability, except for an interrupted write action
- Cache write-through option for dosFs ensures data is committed to the file system, enhancing reliability
- Improved CheckDisk for dosFs utilizes the "clean bit," allowing the file system to skip CheckDisk for improved boot-up performance
- Transactional layer for dosFs provides atomicity of file system updates, guaranteeing file system consistency
- Unicode filename support

Wind River VxWorks Simulator

VxWorks Simulator 6.2, formerly known as VxSIM, is a complete prototyping and simulation tool for VxWorks 6 applications. It enables you to develop and test significant portions of your application earlier in the development cycle, before hardware is available. The simulator is fully integrated into the Wind River Workbench development environment as a target connection, allowing complete configuration and debugging control through standard interfaces.

VxWorks Simulator is a native application that is derived from the VxWorks 6 operating system to accurately implement the sophisticated features of VxWorks 6, including real-time processes, memory protection, file systems, and UNIX-style networking (TCP/IP, rlogin, etc.). The simulator also provides network simulation capabilities that let you create complete simulations of complex networks consisting of multiple IPv4, IPv6, or other protocols, subnets, and routing systems.

The simulator runs on your chosen host workstation, decreasing the quantity of evaluation hardware typically purchased for early development. It also provides easy access to the host operating system API, so you can use the host facilities and peripherals in your simulation. For instance, a PCI card used in your final system can be installed on the host machine, then accessed by the simulator.

Features of VxWorks Simulator 6.2 include:

- Rapid and precise prototyping of VxWorks 6 applications
- Support for RTPs
- Support for user-level IP network simulation of complex network topologies
- Layer 2 network simulation
- Broadcast and multicast support
- Simulation of packet loss
- Support for simulation of a large number of nodes
- Support for VxWorks file systems
- Integration into Workbench development environment
- Support for broad range of host platforms
- Access to the host operating system API from within the VxWorks simulation
- Support for real-time clock
- VxWorks boot parameter parsing at startup to allow multiple instances of a single image to exist

Wind River Network Stack

Wind River Network Stack, an integral part of VxWorks, is a dual IPv4/IPv6 network stack based on a port of the KAME/FreeBSD TCP/IP release. High performance and scalability are two key elements. Wind River has invested significant effort and engineering resources into optimizing the TCP/IP stack for typical constraints found in device software environments. Wind River Network Stack has a clean code structure for easy integration and faster implementation. Extensive testing against third-party test suites and external test lab validation ensures high quality, standards conformance, and interoperability with other network devices. Wind River Network Stack is among the first TCP/IP stacks in the industry to receive the IPv6 Ready Logo, Phase 2.

Benefits of Wind River Network Stack 3.0 include:

- Full integration with the VxWorks operating system, development tools, device management products, and peripheral networking protocols and utilities
- Clear and structured code for ease of configuration and maintenance
- Flexible configuration options to optimize required memory resources

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- IPv6-enabled and enhanced utilities/applications
- Several performance enhancements to the stack for improved forwarding and end-to-end performance
- Several applications running on one or multiple RTPs
- Optimized, high-performance implementation from the leader in device software networking

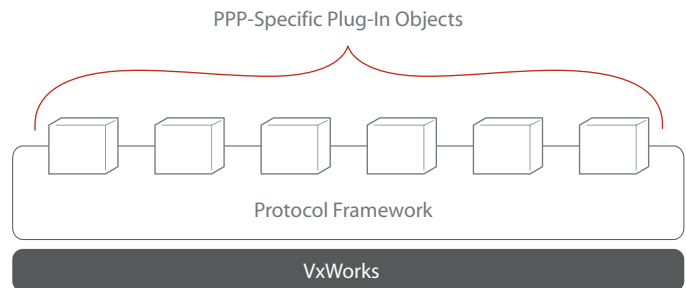
Features of Wind River Network Stack 3.0 include:

- Support for TCP, UDP, IPv4, and IPv6
- BPF devices for packet monitoring
- Fast IP forwarding
- IPv6 jumbograms
- ICMP
- IGMP versions 1 and 2 host
- ARP, Neighbor Discovery
- Proxy ARP client
- RARP
- NDP
- Router solicitation
- Router advertisement
- ICMP redirects
- RIP and RIPng
- DNS client
- Tunneling devices, gif, and stf
- fastUDPLib, a fast UDP-based communication API (faster than sockets)
- Sockets in the following domains:
 - IPv4 Internet communications domain (AF_INET)
 - IPv6 Internet communications domain (AF_INET6)
 - Routing communications domain (AF_ROUTE)
 - Local domain sockets for interprocess communication (AF_LOCAL)
- zbuf sockets (zero-copy sockets)
- RPC Protocol, version 2
- Remote access support: RSH, FTP, TFTP, rlogin, Telnet IPv4 server and client, Telnet IPv6 server and client
- NFS, versions 2 and 3
- BOOTP (boot images only)
- DHCPv4, server, client, relay agent
- DHCPv6, server, client, relay agent
 - prefix delegation option
 - DNS option
 - NTP option
- SNTP (updated with RFC 2030)
- Ping, Ping6
- IPv4 Auto Configuration to enable UPnP
- IPv6 Auto Configuration
- Standard MIB II instrumentation
- Enhanced Routing Table Manager
 - Route table support for multiple same-destination routes
- UNIX-like network stack configuration and monitoring utilities
 - ifconfig: configure a network interface
 - netstat: report network status
 - prefixcmd(): functionality could move to ifconfig() soon
 - routec: manually edit the route table
 - Sysctl/sysctl: set and get network stack configuration parameters

- Features available only in industry-specific Wind River platforms
 - Support for SCTP
 - Mobile IPv6—Mobile Node
 - Port-based, socket-based, and subnet-based VLAN tagging library support
 - IGMPv2 up-calls to support a routing protocol
 - IGMPv3 Host
 - Multicast Listener Discovery v2 host, proxy router
 - Two virtual instances of the stack

Wind River PPP (PPP, PPPoE, ML-PPP, RAF)

The Wind River PPP 2.2 component provides a set of PPP implementation modules that you can plug into a remote access framework. Using this framework, you can create one or more PPP stack instances. Using a PPP stack instance, you can create and manage a PPP connection with a remote peer. Bundled with Wind River PPP are modules that provide support for PPP over Ethernet connections, as well as modules that provide support for PPP multilink functionality. Using this multilink functionality, you can bundle multiple parallel point-to-point links into a single virtual high-bandwidth pipe.



PPP component—protocol framework

Wind River PPP is a source-code product, written in C with an object-oriented design. With Wind River PPP, you can implement a dynamically configured PPP stack for diverse remote access applications. These applications can have a variety of network interface types, network stack types, link speeds, numbers of PPP connections, control protocols, framing techniques, and so on.

Features of the Wind River PPP 2.2 implementation include:

- Multiple framework instances
- Multiple network type support
- Multiple driver type support
- Multiple PPP framing support
- Unlimited PPP connections
- Dynamic configuration of the stack
- Configuration profiles
- Multilink (ML-PPP), PPPoE, and RAF support

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Wind River USB

Wind River USB enables developers to quickly incorporate standard universal serial bus (USB) connectivity in VxWorks-based embedded devices and their attached peripherals.

Wind River USB 2.2 supports version 2.0 of the USB specification, providing support for the universal host controller interface (UHCI), the open host controller interface (OHCI), and the enhanced host controller interface (EHCI), and currently incorporates low-speed (1.5Mb/sec), medium-speed (12Mb/sec), and high-speed (480Mb/sec) data rates. All four USB modes of data transfer are available with Wind River USB: control, interrupt, bulk, and isochronous. These data transfer modes enable simultaneous transmission of asynchronous and isochronous data. Asynchronous data is typically error-rate-critical data, while isochronous data is typically used in multimedia applications, such as real-time audio or streaming video.

Host-class drivers provided with Wind River USB allow developers to connect a wide range of peripherals, from the most common to the most advanced. Out-of-the-box class drivers included in the product support keyboard and mouse human interface devices (HIDs), printers, speakers (audio-isochronous), mass storage devices (bulk-only and control-bulk-interrupt), and communications devices (END and ACM). The mass storage and communications-class drivers enable developers to establish USB connections between embedded devices and advanced peripherals, such as Ethernet networks, modems, digital cameras, and portable storage devices.

Technical Specifications

VxWorks 6.2

- VxWorks 5.5, 6.0, and 6.1 compatibility
- Improved scalability through scaled OS configuration profiles
- State-of-the-art memory protection
- Improved memory management
- Memory error management
- Message Channels IPC, including support for multiprocessor and multi-OS messaging using TIPC
- Improved POSIX compliancy, including full support for JTRS SCA AEP 2.2.1
- Power management framework, with CPU power management
- TrueFFS flash file system
- dosFs file system
- Transactional layer for dosFs file system
- Highly reliable file system (HRFS)
- High-speed interconnect framework with PCI and local bus support
- VxMP
- Wind River Network Stack 3.0
- Wind River PPP 2.2
- Wind River USB 2.2

Supported Hosts

- Red Hat Enterprise Workstation 3, 4
- Solaris 2.8, 2.9
- SuSE Linux Desktop 9.2, 9.3
- Windows 2000 Professional, Windows XP

Supported Target Architectures

- ARM Architecture
 - ARM 9
 - ARM 11
- Intel Architecture
 - Pentium Family (Pentium 2/3/4, M)
- Intel XScale Architecture
 - IXP425
 - IXP465
- MIPS Architecture
 - MIPS 4Kx
 - MIPS 5Kx
 - MIPS tx49xx
 - MIPS24KEc
 - BCM125x
 - RM9000GL
- PowerPC Architecture
 - PowerPC 40x
 - PowerPC 44x
 - PowerPC 60x
 - PowerPC 7xx
 - PowerPC 8xx
 - PowerPC 74xx
 - PowerPC 82xx
 - PowerPC 83xx
 - PowerPC 85xx
 - PowerPC 52xx
 - PowerPC 970FX
- SuperH Architecture
 - SuperH-4
 - SuperH-4a

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Professional Services

Wind River Professional Services enables companies to reduce risk and improve competitiveness. Our experienced team delivers device software expertise that directly addresses key development challenges and contributes to the success of our clients. Based on our commercial-grade project methodology, service offerings include device design, BSP and driver optimization, software system and middleware integration, legacy application and infrastructure migration, and real-time best practices.

Education Services

Education is fundamentally connected not only to individual performance, but also to the success of a project or company. Lack of instructional services can translate into longer release schedules, poorer quality, and higher costs. The ability to learn—and to convert that learning into improved performance—creates extraordinary value for individuals, teams, and organizations. To help your team achieve that end, Wind River offers public courses and on-site education intended to increase your productivity as quickly as possible.

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 lab classroom format that allows students to leverage the experience of Wind River instructors and their peers. Courses provide a fast, cost-effective way for students to become more productive immediately.

Benefits of public courses include:

- 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 embedded 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

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

On-Site Education

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

Advantages of on-site education include:

- The entire team gains a common knowledge base
- The training format helps ensure that knowledge and skills will transfer from the classroom to the workplace
- The on-site location saves employees both travel expenses and time away from the office

Please consult your local Wind River sales representative for further information.

Support

Visit Wind River Online Support for fast access to product manuals, downloadable software, and other problem-solving resources. Online Support visitors can also access a community of developers to discuss their issues and experiences.

If you cannot find the information you need through Online Support, please contact our global support team:

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