

# Wind River Product Technical Overview

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# Customer Situation

## Problem



### **Inefficient software development and deployment:**

- Developers lack the capability needed to efficiently complete the task at hand or find and correct problems
- Development tools fail to support “real world” applications because of limited scalability
- Changes and additions made to complex code bases are difficult and cause hidden problems
- Closed interfaces for tools limit integration of the development environment
- Developers are using different tools within and across projects, inhibiting collaboration and effectiveness

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## Solution



### **Standardization with Wind River Workbench:**

- Broad range of powerful capabilities from HW bring-up through application development in one environment
- IDE capabilities proven to scale to real-world application
- Code Analysis provides insight to code usage and relationships
- Eclipse open framework for easy integration of 3rd party tools
- Support for the most popular target operating systems and processors

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# Customer Situation

## Result

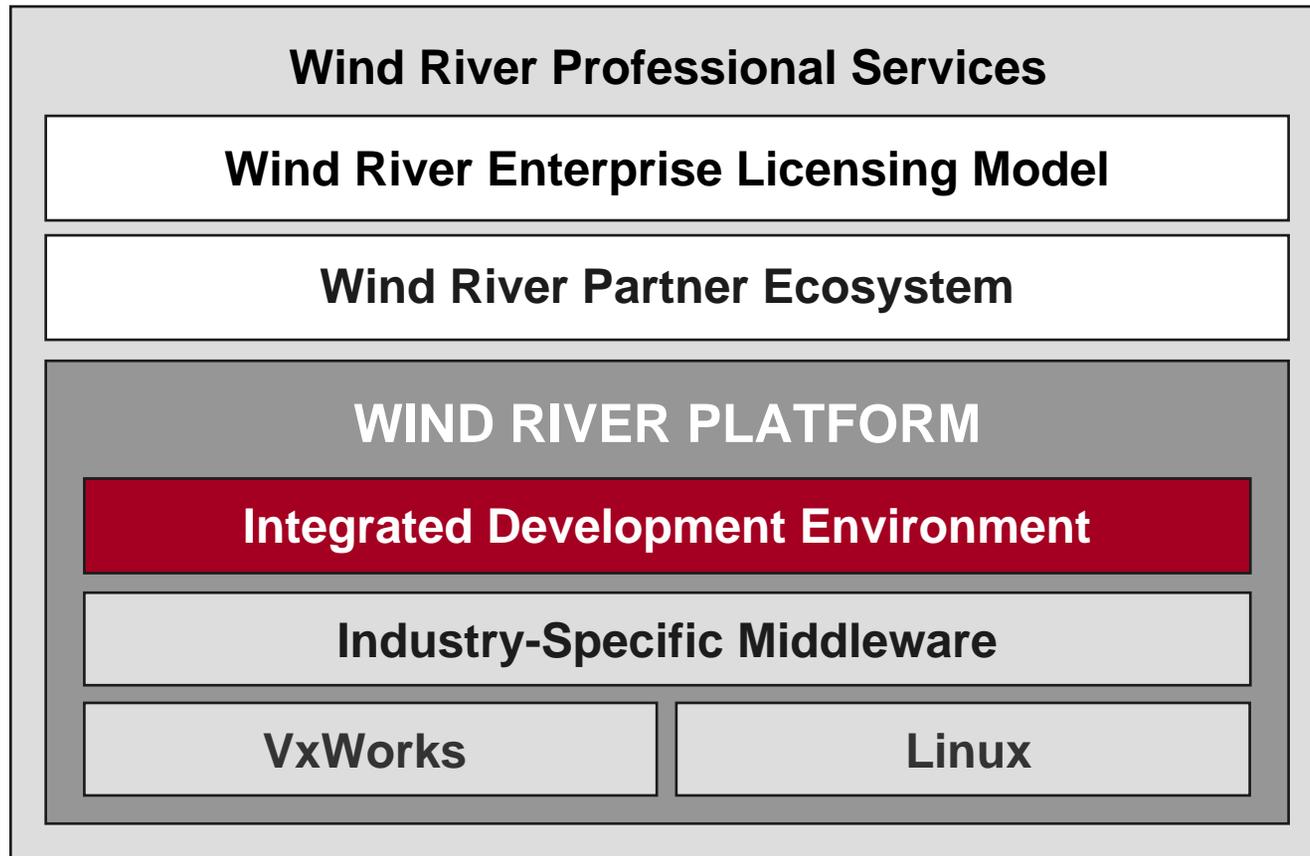


### **Impact on development projects:**

- Focus on product innovation, not on tool integration
- Debug complex products with coordination
- Skills with development tools are portable among projects
- Reduction in training cost and time

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# Wind River's DSO Offering

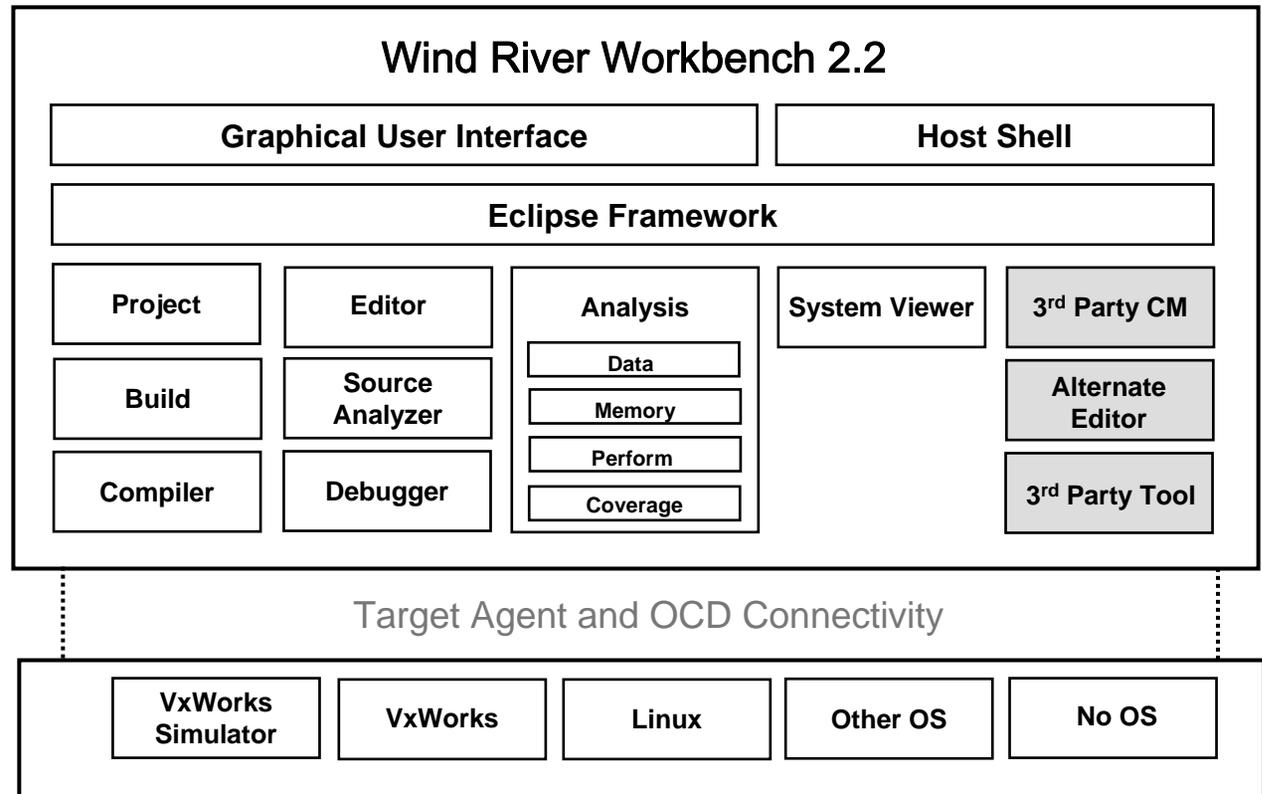


Wind River enables companies to develop and run device software faster, better, at lower cost, and more reliably.

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# Wind River Workbench 2.2

- Highly optimized environment for developing VxWorks 6.0 and Linux device software
- Makes debugging, porting and bring-up of VxWorks 6.0 and Linux devices more efficient
- Easily customizable and extensible with 3rd party plug-ins via the Eclipse framework



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# Eclipse

Eclipse is an open platform for tool integration that leverages open-source licensing and a community of tool developers

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## Eclipse provides

- GUI framework and tool integration capability
- Openness, extensibility, standardization
- Integration via plug-ins for over 350 different software tools (ClearCase, PVCS, and SlickEdit, and others)

# Project Facility and Build System

## PROJECT FACILITY

- Fits into any existing environment
- Easy configuration of the VxWorks 6.0 Kernel and application projects
- Easy setup of Linux kernel and application projects
- Graphically configurable

## BUILD SYSTEM

- Extremely powerful and customizable Makefile generator
- Imports existing Makefiles to quickly navigate to compiler errors in the IDE
- Support for scripts and nightly updates

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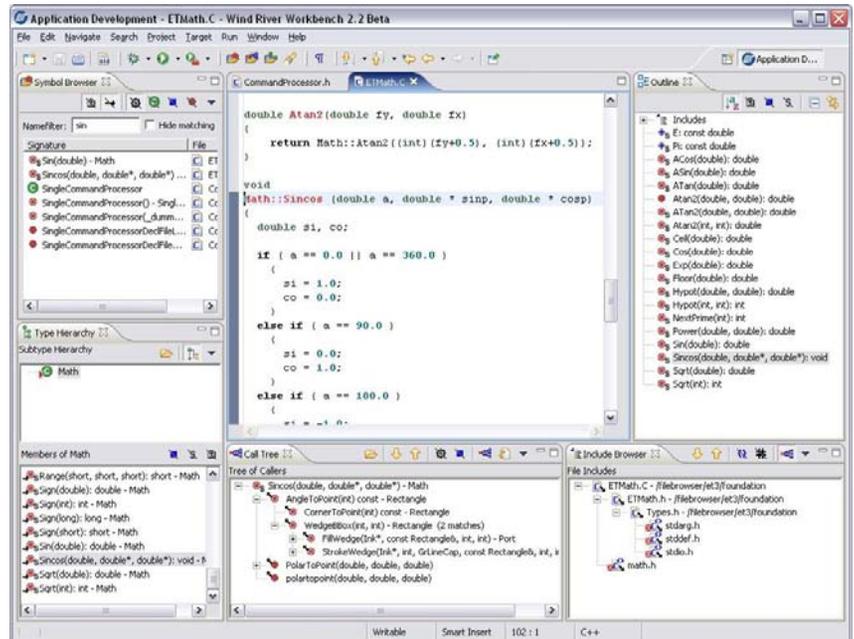
# Source Analysis

## Features

- Symbol browsing
- Function call trees
- Dependency graphs
- Class and diagrams
- Include hierarchies
- Code completion
- Conditional code highlighting

## Benefits

- Better understand Linux kernel updates and open source software
- Better understand legacy software
- Port to custom hardware more quickly
- Simplify code reviews



# Source Analysis

## Navigate instantly

- Through millions of lines of code
- Thousands of files and directories
- Without getting lost
- Every code symbol at your finger tip

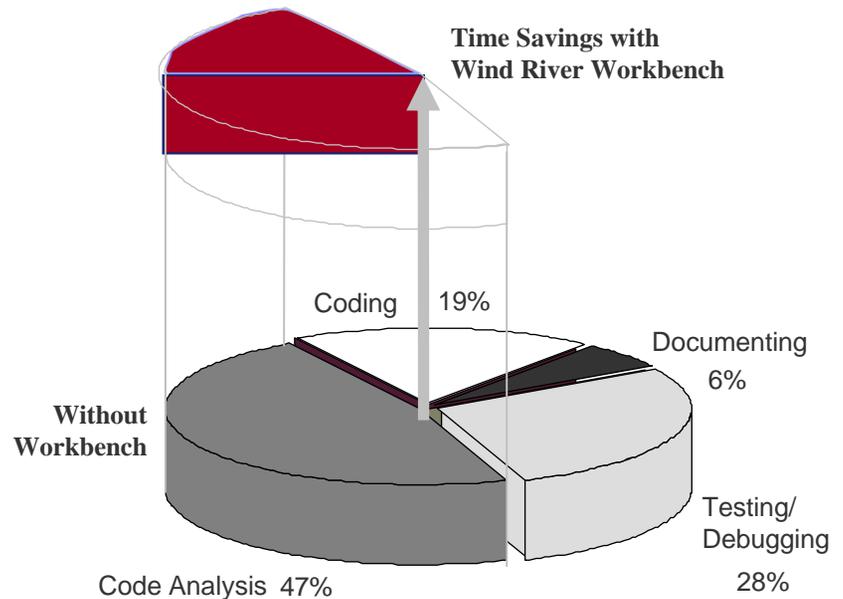
## Better comprehend source code

- Excellent dependency visualization
- Rapid employee ramp-up

## Make code reuse reality

- Understand VxWorks 6.0 and Linux source code
- Port to custom hardware more quickly
- Simplify code reviews

## How do developers spend their time?



Source: Software Quality: Producing Practical, Consistent Software"  
Mordecai Ben-Menarche & Garry S. Marliss, Thomson Computer Press

# Wind River Debugger

Only debugger that can concurrently view, control and debug multiple:

- Tasks (VxWorks 6.0)
- Real Time Processes (VxWorks 6.0)
- Processes and threads (Linux)
- Processors and operating systems

## Superior Wind River Target Agent (WDB)

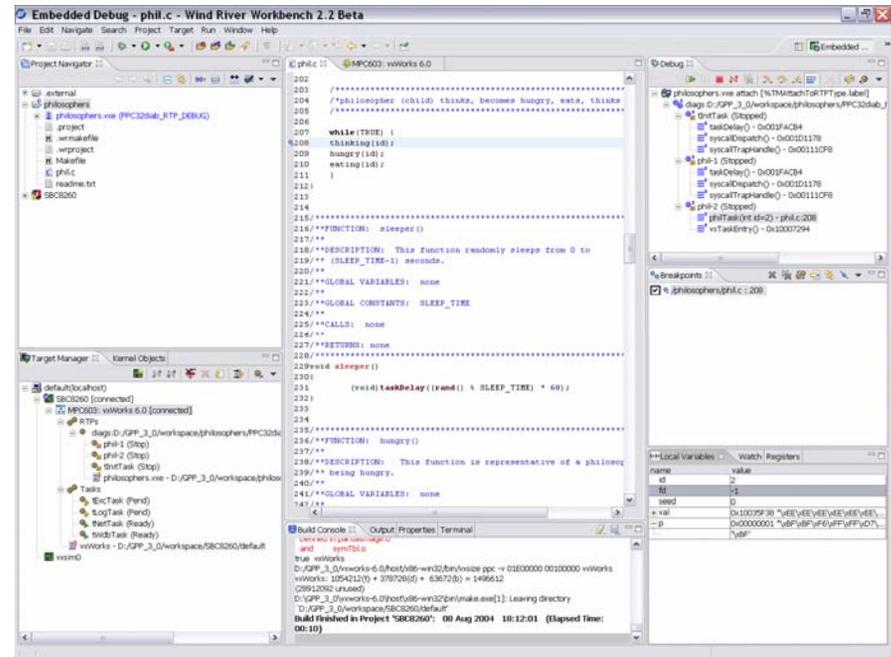
- Single instance of the debug agent for both task (user) and system mode debugging
- Only debugger that can switch between Kernel and User mode debug sessions via a single agent

## Asynchronous Controls/Messaging

No need to wait for a command to complete

## Smart Window Update Policy

- Only update what is needed
- Minimize target impact



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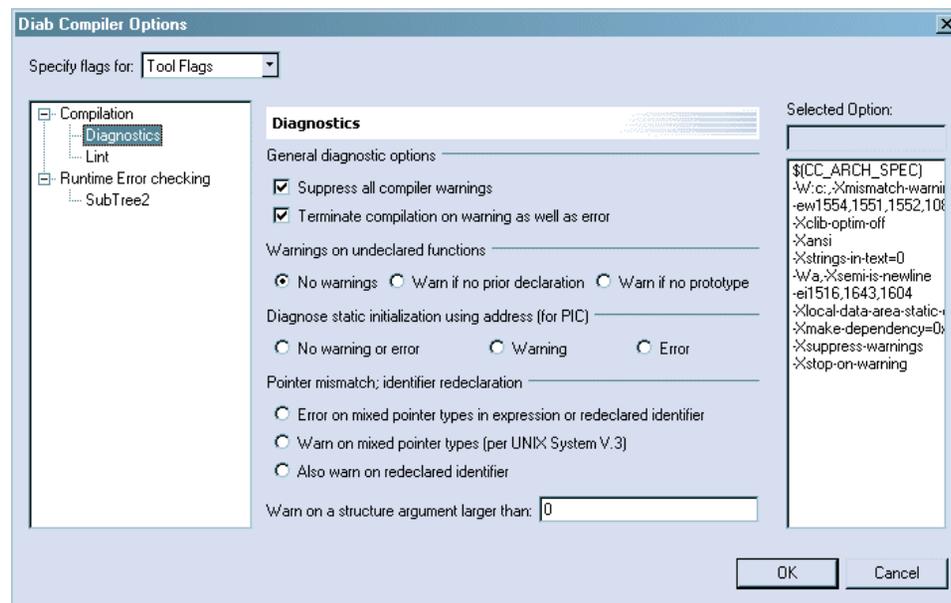
# Wind River Compilers for VxWorks

## Wind River Compiler (WRC) 5.2.2

- Default compiler for building the VxWorks 6.0 kernel, libraries, and BSPs
- C++ COMDAT improvements
- Integrated run-time error checking

## GNU 3.3.2

- New version for VxWorks 6.0
- Optional license monitoring and management
- More closely aligned with Open Source Community
- Exceptions are options required to configure VxWorks

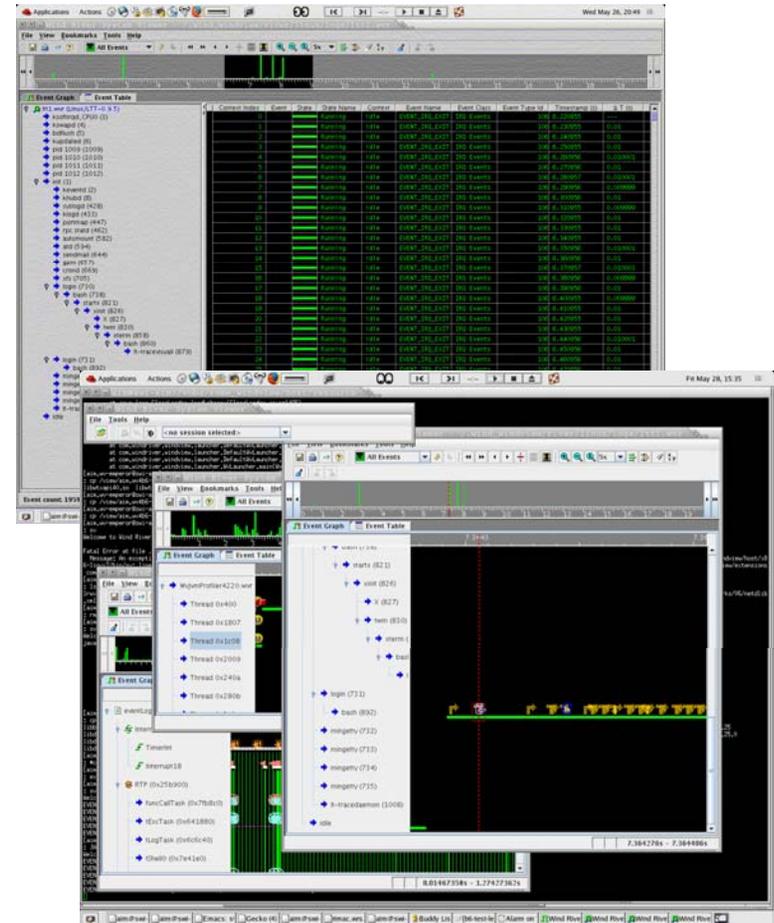


## New Eclipse compiler options dialogue for both WRC and GNU

- Select target architecture
- Specify compile options, e.g., speed, size, etc.
- Define debug information

# Wind River System Viewer

- Graphical visualization of all system activity over time
- Multiple data collection and upload methods including ring-buffer and post-mortem
- Data export for advanced analysis
- Operating System Support
  - Linux (Linux Trace Tool data)
  - VxWorks 6.0 (including triggering)



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# Wind River OCD Tools

## Debugging enhanced with the addition of On-Chip Debugging support

- Support for Board and Operating System Bring-up
- CPU and Board initialization
- Analyze and debug system crashes
- Program Flash devices in-circuit
- Built-in diagnostics for board testing

## Hardware supported

### Wind River ICE

- High Speed Ethernet connectivity
- Wind River JTAGServer™ support for multiple JTAG devices
- Wind River JTAGAccelerator™

### Wind River Probe

- USB 2.0 Hardware supported
- USB 2.0 (1.x compatible)
- USB Powered, no additional power supplies required
- Support for 'suspend' on laptops
- 100MHz JTAG Clock support

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# ScopeTools

## ProfileScope

- Statistical Profiling

## MemScope

- Memory Analysis with Leak Detection

## Stethoscope

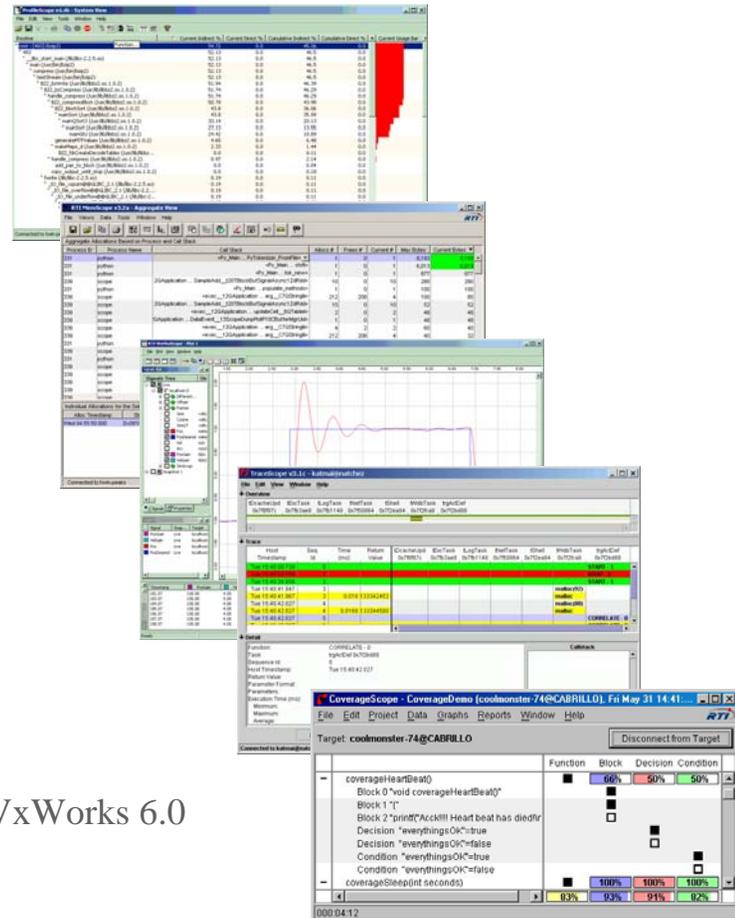
- Graphical Data Monitoring Tool that provides visualization of data

## TraceScope

- Code Execution tracing tool for VxWorks 6.0

## CoverageScope

- Complete code coverage information for testing VxWorks 6.0



# Support and Training

## Support...

- Worldwide technical support team
- Online support
- Access to updates, patches, major upgrades

## Training...

### Wind Sprint

- On-site installation
- Hands-on orientation
- Project and support advice

### Public Workshops

- Hands-on application of tools and concepts
- Real-time design issues
- How to develop drivers, porting, or applications

### Custom On-site

- Knowledge transfer to workplace
- Save time and expense away from office

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# Wind River Workbench

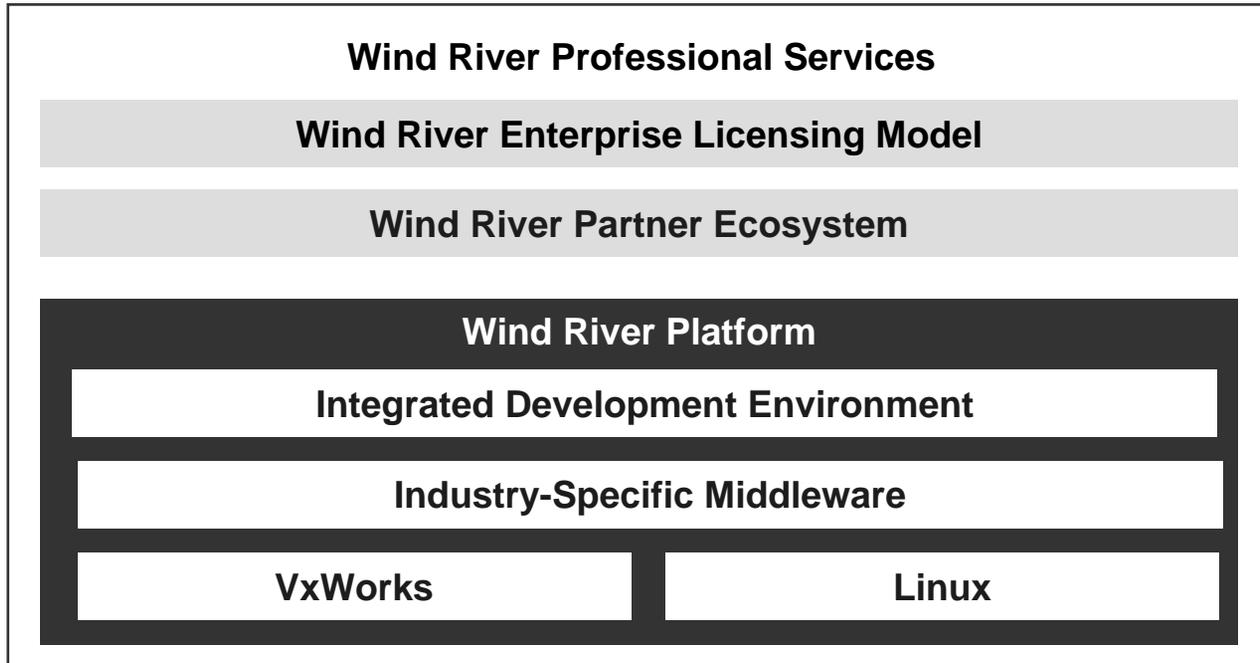
- End-to-End Integration** ➤ Set of tools for the entire development lifecycle, from hardware bring-up to product test and manufacture
- Multiple Contexts** ➤ Supports multiple OSEs, CPUs, architectures, cores, languages and connection types
- Extensible, Scalable Framework** ➤ Based on Eclipse, seamlessly integrates 3rd-party and in-house plug-ins for total customization and scalability

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Wind River  
General Purpose Platform,  
VxWorks Edition  
Technical Overview

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# Wind River's DSO Offering



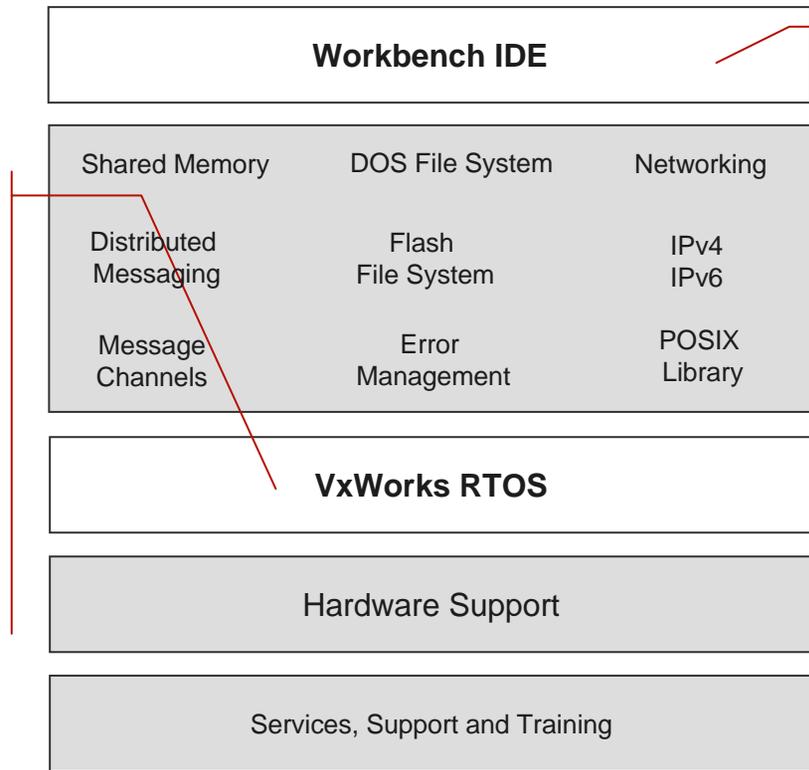
**Wind River enables companies to develop and run device software faster, better, at lower cost & more reliably**

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# General Purpose Platform Components

## VxWorks 6.0

- VxWorks 5.5 Compatibility
- VxWorks core values
- State-of-the-art memory protection
- Standards based:
  - POSIX compliance
  - IPv4/IPv6
  - Common communication interface

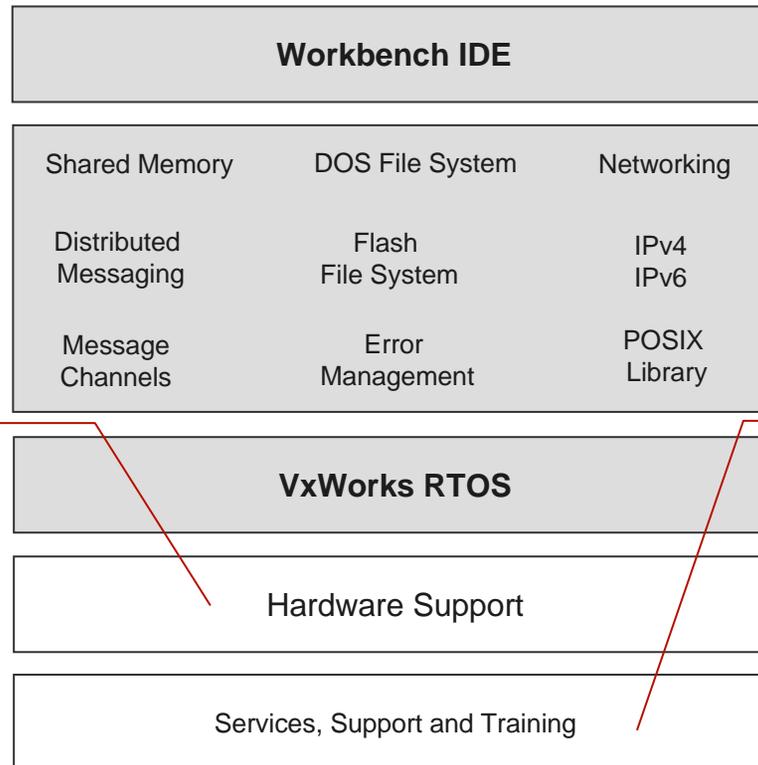


## Workbench IDE

- Eclipse 3.0 Framework
- Project System
- Build System
- Editor
- Source Code Analyzer
- Debugger
- Wind River Compiler & GCC Compiler
- System Viewer
- VxWorks Simulator
- Host Shell
- Kernel Shell
- On-Chip Debugger
- Support for Linux Targets
- Scope Tools (option)

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# General Purpose Platform Components



## Hardware Support

- Broad architecture support
- Processor Abstraction Layer
- Comprehensive BSPs and device drivers for reference designs and COTs boards

## Professional Services, Support & Training

- Quick start training
- On-site training
- Worldwide technical support
- Online support
- Access to updates, patches and major upgrades

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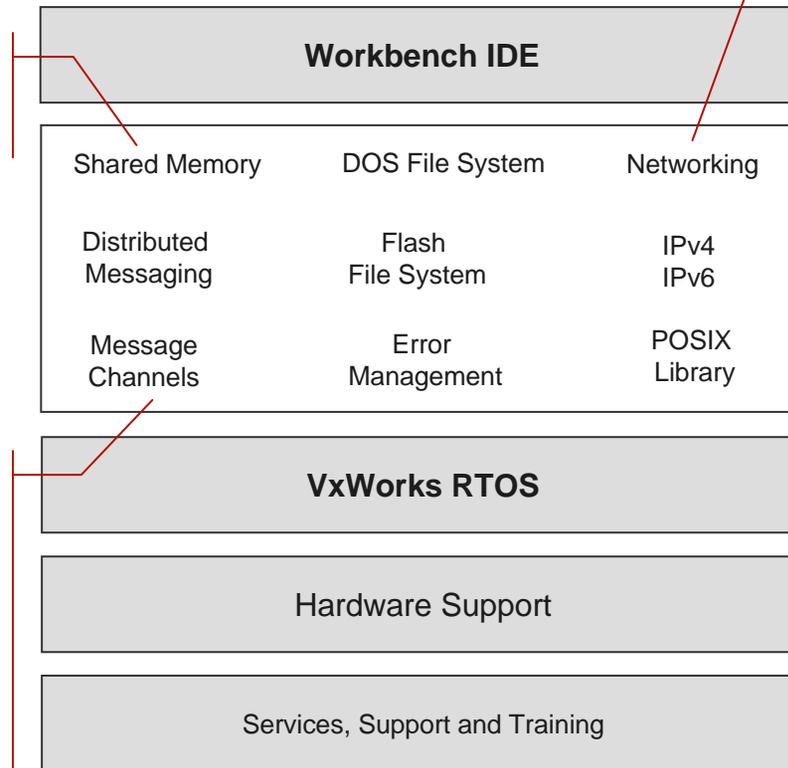
# General Purpose Platform Components

## Memory Management

- VxFusion

## Message Channels

- Connection oriented, bi-directional messaging for task-task communication on a single node
- Designed for future multi-processor use



## Networking

- Commercial-quality IPv4/IPv6 dual stack
  - TCP, UDP, PPP, 802.3 and 802.11 drivers
- Configurable for IPv4 only
- Pre-integrated v6 components:
  - SNMP, Telnet, SNTP, ARP/ND, HTTP Server, Rsh/Rlogin, IGMPv2/MLD, DHCP v4/v6, IPsec, 802.1x, FTP/TFTP, DNS
- Zero Copy buffer libraries
- BootP – For system initialization
- Auto-IP configuration for IPv4 Standard IPv4 and IPv6 APIs
- RIPv1/v2 and RIPng
- Transition Mechanisms
- Separation of IPv4 and IPv6 Logical Networks
- IPv6 Downed Interface Processing
- True blocking Sockets calls
- Multithread safe

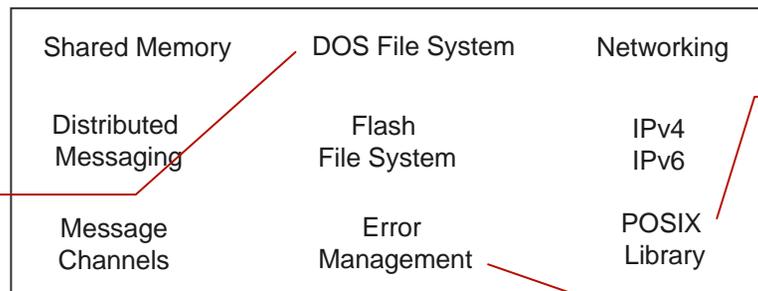
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# General Purpose Platform Components

## MS-DOS File System

- Cache write-through option
- CheckDisk utilizes “clean bit”
- Unicode file name support
- Optional transactional file system layer provides lightweight journaling

Workbench IDE



## POSIX Library

- Increased POSIX compliancy

## Error Management

- Error detection and reporting
  - ISR/Task overrun and under-run
  - Code corruption
  - Null-pointer usage
  - Heap block overrun
  - RTP error
  - Heap leakage
- API for application errors
- Extensible

VxWorks RTOS

Hardware Support

Services, Support and Training

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# Hardware & Host Support

<b>Architectures</b>	Intel Architecture, MIPS and PowerPC
<b>Architecture Families</b>	<ul style="list-style-type: none"><li>• Pentium ,2,3,4</li><li>• MIPS 5Kx, tx49xx, bcm125x</li><li>• Freescale PowerPC 60x, PowerPC 7xx, PowerPC 74xx, PowerPC 82xx, PowerPC 52xx, PowerPC 85xx</li><li>• IBM PowerPC 405, PowerPC 44x</li></ul>
<b>Hosts</b>	<ul style="list-style-type: none"><li>• Windows 2000 professional</li><li>• Windows XP</li><li>• Solaris 2.8, 2.9</li><li>• Red Hat Enterprise Workstation 3.0</li></ul>

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# VxWorks 6.0 New Features

- **Kernel execution environment compatible with 5.5**
- **Real-time Process environment for user-mode code**
- **MMU-based memory protection**
- **Error detection and reporting facility**
- **Better POSIX compliance, esp. in RTPs**
- **dosFS improvements**
- **Transaction-based Reliable File System**
- **ROMFS Filesystem**
- **New and enhanced IPC facilities**
- **Shared library support**
- **Object ownership and resource reclamation**
- **Kernel (target) shell enhancements**
- **New processor/device support**
- **Improved OS configuration and build facilities**

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## VxWorks 6.0 – Real-time Processes

- **Real-time Processes (RTPs) are containers for user-mode applications.**
- **Each RTP has own copies of code, data, stacks, heap and resources.**
- **RTPs are not scheduled – tasks within RTPs are.**
- **RTPs are launched from a fully-linked relocatable executable loaded from a file system (a la UNIX).**

# VxWorks 6.0 – Kernel Enhancements

- **Object Management (private and public scope)**
- **ISR Objects**
- **Optimized mutex semaphore for processes**
- **Task preemption prevention in processes (taskRtpLock/Unlock)**
- **Priority-inheritance enhancement**
- **Configurable kernel work queue size**

# VxWorks 6.0 Memory Management

- **Non-executable stack pages (certain CPUs.)**
- **Stack overrun and underrun detection.**
- **NULL pointer dereference detection (certain CPUs.)**
- **Text segment write protection**
- **Heap and partition manager instrumentation (run-time checking)**
- **Kernel heap allocator improvements (best-fit vs. first-fit)**
- **User-space heap and partition allocators**

## VxWorks 6.0 – ED&R

- **New error detection and reporting facility**
- **Persistent error logs**
- **Configurable behaviors on a task, process, and system level**
- **Exception handlers instrumented to log information**

# VxWorks 6.0 – File System

- **Improved dosFs file system**
- **Safest-order writes of metadata and user data to minimize chances of corruption**
- **Optional cache write-through**
- **Support for O\_SYNC flag on open() operations**
- **FIOSYNC ioctl fully flushes block device caches**
- **Support for Unicode file names**
- **Enhanced CHKDSK (FAT recovery, performance, etc.)**
- **TRFS lightweight journaling filesystem**
- **ROMFS read-only filesystem**

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# VxWorks 6.0 – Kernel (Target) Shell

- **C interpreter enhancements for process information**
- **Handles long long, short, float, signed, unsigned types**
- **Path completion (if filesystem supports it)**
- **New UNIX shell like interpreter**
- **Allows custom interpreters**
- **Multiple shell support**
- **Secure access (user id/password protection)**
- **Fault management support (ED&R)**
- **VI or EMACS style command line editing**
- **C++ symbol handling enhancements**

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# Migrating from Tornado 2.2.x to GPP 3.0

# Migrating from 2.2.x to 3.0

- **VxWorks 6.0 is source code compatible with previous version, but:**
  - Some deprecated features have been dropped
  - New tool versions
  - Performance (code size/speed) changes

# Migrating from 2.2.x to 3.0

- **Obsoleted Features**

- RT11 Filesystem (unsupported in 5.5)
- VxVMI (made redundant)
- BOOTP (still supported for boot loader)
- BSD 4.4 Ethernet drivers
  - Also, other BSD driver support routines
  - etherhooks
  - if\_sm replaced with smEnd

# Migrating from 2.2.x to 3.0 - Tools

- **GNU 3.3.2 (was 2.96+)**
  - -O3 still unsupported. Code that previously worked with this option may now break.
- **Wind River Compiler (formerly Diab) 5.2.2**
- **For C code:**
  - Kernel applications use native VxWorks C library
  - RTP applications use Dinkum C library
- **For C++ code:**
  - Both use Dinkum C++ / Embedded C++ libraries
  - SGI STL replaced by Dinkum STL

## Migrating from 2.2.x to 3.0 - Size

- **VxWorks 6.0 build is bigger than 5.5**
  - Around 15-20%
  - Additional features within existing APIs
  - Network stack is bigger
- **Shouldn't be an issue for most applications**
  - Review configuration; remove unneeded components
  - Future releases will have some improvements

# Migrating from 2.2.x to 3.0 - Performance

- **Goal: “Maintain existing 5.5 characteristics”**
  - Overarching 6.0 goals: backward compatibility and memory protection
- **Memory allocation made deterministic**
  - Achieves deterministic allocation & less fragmented heap
    - Free blocks in AVL tree vs. linked list (best-fit algorithm)
    - Slower (20%) than 5.5 in low fragmentation state
- **OS primitives have performance degradation compared to 5.5**
  - OS primitives generally slower (a few are faster)
  - Creation/deletion routines generally much slower (see malloc)
  - User-mode system call adds overhead
  - This refers to OS primitives NOT networking, C library calls, etc!!!
- **Priority for enhancement in future releases**
  - Areas for improvement already identified
  - Investigating multiple component implementations: size vs speed

**Thanks!**

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