VXWORKS
The Safe, Secure, Reliable, and Certified RTOS for Critical Infrastructure

For 30 years, the VxWorks® real-time operating system (RTOS) has been chosen by industry leaders as the trusted foundation to power billions of intelligent devices. From literally out-of-this-world projects such as the InSight Mars lander, now operating on the Red Planet, to medical infusion pumps and imaging systems, manufacturing robots, and other devices in the Internet of Things (IoT), VxWorks is repeatedly selected as the RTOS for innovative solutions that deliver safe and secure deterministic applications across a wide array of industries, including aerospace, automotive, defense, industrial, medical, and telecommunications.

ENABLING THE FUTURE OF EDGE COMPUTING SYSTEMS
VxWorks is a deterministic, high-performance RTOS that sets the standard for a scalable, future-proof, safe, secure, and reliable operating environment for powering critical infrastructure that must meet the highest standards.

Real-Time Performance
Capable of dealing with the most demanding time constraints, VxWorks is tuned for both determinism and responsiveness. Its real-time process (RTP) model allows clear separation of functions in user space while not impacting performance.

• Real-time: As a deterministic, priority-based, preemptive RTOS with low latency and minimal jitter, VxWorks is ideal for hard real-time embedded applications, with flexible
features needed for various industries. For example, in addition to standard preemption, VxWorks offers round-robin and adaptive foreground/background scheduling as well as time and space partitioning.

**Future-proof:** As new features and functionality are added to VxWorks, compatibility is always top of mind. VxWorks helps developers rapidly respond to changing market requirements, customer needs, and technology advancements, preserving company investments. This enables fast feature additions and upgrades with minimal retesting of the entire system, saving both project time and expense, and allows developers to take advantage of the latest VxWorks innovations.

**Rich connectivity and communications:** VxWorks supports IPv4 and IPv6 stacks, Routing Information Protocol (RIP), quality of service (QoS), and more. Additionally, VxWorks enables Time-Sensitive Networking (TSN), guaranteeing real-time communications and packet delivery within a bounded time or latency on a switched Ethernet network.

VxWorks supports innovative industrial applications based on OPC-Unified Architecture (OPC-UA). It also supports SocketCAN used in automotive applications and provides host, target, and OTG USB support.

**Extensive multi-core and multiprocessing support:** VxWorks supports 32-bit, 64-bit, and multi-core processors, including Intel®, Arm®, and Power Architecture®. Its comprehensive multi-core processor support allows OS configurations for asymmetric multiprocessing (AMP), symmetric multiprocessing (SMP) with CPU affinity to address bound multiprocessing (BMP) scenarios, and hardware-optimized multi-core acceleration.

**Broad board support:** Together with our ecosystem of partners, VxWorks has the most extensive list of board support packages in the embedded software industry providing early prototyping, cost savings and flexibility of choice. Addressing the need to be able to quickly prototype on inexpensive hardware, VxWorks now has open source BSPs available on GitHub, starting with the Raspberry Pi BSP.

**Robustness and tuning:** With VxWorks, developers have access to the source code to adapt and tune the environment for any particular need or application. The modularity of VxWorks makes it easy to choose and adapt capabilities as required, changing only the modules needed. (Certifications may need to be reevaluated when changing VxWorks code used in a previously certified application.)

**Virtualization:** Integrated support for virtio enables VxWorks to run in a virtualized environment such as Wind River® Helix™ Virtualization Platform or with other popular hypervisors including qemu, VMware, and KVM. VxWorks will run efficiently under virtualization, offering near-native performance. However, not all hypervisors are easily certifiable. Helix Platform enables running VxWorks with other operating systems while providing a built-in certifiable Type 1 hypervisor.

**Fault-tolerant file system:** VxWorks supports the Wind River Highly Reliable File System (HRFS) for fault tolerance and recovery of operations in case of system error and shutdown. VxWorks also supports a FAT-compatible dosFS file system.

**Mixed OS support:** VxWorks supports communicating with other operating systems in a mixed environment using OpenAMP. Developers can build interactive functionality across VxWorks real-time and other non-real-time environments.
A FAMILY OF PRODUCTS DESIGNED FOR EMBEDDED SYSTEMS

System architectures requiring an embedded RTOS or with mixed operating systems vary. The Wind River family of products covers them all with versions designed for today’s embedded solutions:

**VxWorks**: The most widely trusted and deployed RTOS for critical infrastructure.

**VxWorks Cert Edition**: VxWorks with safety certification evidence options to accelerate the certification processes in regulated industries.

**VxWorks 653**: Designed for integrated modular avionics (IMA) solutions requiring safety certification and conformance with ARINC 653, to support consolidation of critical aeronautical applications on a single compute platform.

**Wind River Linux**: The most widely deployed commercial Linux distribution used in embedded designs, meeting the needs of modern DevOps practices for fast prototyping and development.

**Wind River Helix Virtualization Platform**: A heterogeneous platform using virtualization technology to support VxWorks, Wind River Linux, and other guest operating systems integrated into a single environment, providing all the resources needed to design mixed-criticality systems.

- **Multimedia**: VxWorks offers support for many standard graphic libraries, such as OpenGL, OpenGL ES, OpenCV, and Vulkan, and libraries to handle JPEG and PNG images.

**Security**

VxWorks integrates an extensive and continuously evolving set of security capabilities that allow developers to meet rigorous security requirements and address security threats—from boot up to operation to power off. These capabilities allow architects to develop a level of security appropriate for the attack surface and threats unique to their applications and environments. Security capabilities include the following:

- **Kernel hardening**: Non-executable pages, stack guard pages, optional support for kernel page table isolation (KPTI), protection of code and read-only data
- **Cryptography**: Latest OpenSSL and FIPS 140-2 modules
- **Boot and load**: Secure boot, secure ELF loader
- **Secure data**: Encrypted data at rest with full-disk encryption and in transit with network security protocols (SSL, SSH, IPsec, IKE, GDOI, SCEP, etc.)
- **Security events**: Detection and notification of events
- **Access controls**: Control over permissions of objects in the system, such as communication channels, file systems, kernel objects, etc.
- **Firewall**: A built-in firewall that can be configured to protect access to the system
- **User controls**: User login policies, password policies, and support for AD/LDAP to restrict user access
- **TPM 2.0**: Support for hardware-based security
- **Arm® TrustZone**: Support for OP-TEE
- **GE Digital® Achilles Level II**: Certification for compliance with IEC 62443-4-2 security for industrial automation and control systems
- **Secure configuration**: Simplified process of enabling security features to make VxWorks a highly secure RTOS

With these rich features, architects can efficiently and effectively safeguard devices, data, and intellectual property in the connected world.

To help architects fully capitalize and tune VxWorks security capabilities to their unique situation, Wind River Professional Services offers deep insight and support to develop robust, secure solutions around VxWorks.

**Safety Certification**

VxWorks has an extensive portfolio of safety certification history, including:

- 600+ safety certification programs in 100+ civilian and military aircraft
- More than 360 customers using the VxWorks safety platform
- Certification to DO-178C DAL A, ISO 26262 ASIL D, and IEC 61508 SIL 3

Its robust safety features provide advanced time and space partitioning capabilities to enable reliable consolidation of multiple applications with different levels of criticality on a single- or multi-core platform. Additionally, conformance to standards such as POSIX™ and FACE™ have been leveraged in the certification of VxWorks to DO-178C, IEC 61508, and ISO 26262 safety standards.
ACCELERATING APPLICATION DEVELOPMENT WITH VXWORKS

To help accelerate development of critical systems, Wind River provides important tools with VxWorks, designed specifically for application developers.

Compilers, Programming Languages, and Frameworks

VxWorks supports C11/C++17 programming language standards, Python programming language, and Boost C++ libraries, helping application developers in creating efficient, portable applications. Developers can also leverage the performance of multi-threaded processing with support for OpenMP. Future programming language support will drive application modernization and innovation.

Wind River Workbench Development Tools

Wind River Workbench offers integrated development and debugging tools along with cutting-edge system analysis tools for optimizing applications running on Wind River solutions. Workbench is a fully integrated, Eclipse-based open development suite, optimized to support design, development, test, and debugging of applications. The suite includes:

- A project facility to define application resources
- An XML configuration tool to easily define the static configuration required for safety-critical applications
- LLVM compiler for Arm and Intel architectures and GCC compiler for PowerPC Architecture
- Built-in VxWorks simulator

COMPLEMENTARY SOLUTIONS FOR EMBEDDED SYSTEMS DESIGN

Wind River Simics

Wind River Simics® simulates systems, from the smallest to the most complex, so developers can adopt new development techniques that are not possible with physical hardware. Simics allows teams to move faster and improve quality, easily bringing Agile and DevOps software practices to embedded development. For more information, visit: www.windriver.com/products/simics.

Wind River Labs

Wind River Labs is an online sandbox where developers can gain access to Wind River–compatible software projects, proof-of-concepts, open source integrations, experimental software, and new technologies. Featured projects supporting VxWorks include OpenMP, Robot Operating System (ROS 2), OpenCV computer vision and machine learning, AWS IoT Device SDK, Google Cloud IoT core SDK, and Microsoft Azure IoT SDK, with more coming. Check it out at labs.windriver.com.
Wind River Partner Ecosystem

The Wind River partner portfolio includes a large ecosystem of complementary third-party hardware and software solutions. The portfolio helps accelerate time-to-market and differentiate platforms with best-of-breed capabilities, while reducing development costs. Visit our partner ecosystem at www.windriver.com/partners for a full list of our partners and their products.

Wind River Professional Services

The CMMI Level 3–rated Wind River Professional Services organization leverages years of system design and development expertise to work collaboratively with customer design and program teams. Professional Services interprets system requirements; architects platform options; and provides recommendations for meeting business, technical, and program goals. For more information, visit www.windriver.com/services.

Wind River Education Services

Wind River offers instructor-led, on-demand, and mentored learning, including our anytime, anywhere access to online subscription-based e-learning. For more information, visit www.windriver.com/education.

Wind River Customer Support

VxWorks is backed by our award-winning global support organization. We offer live help in multiple time zones, the online Wind River Support Network with multifaceted self-help options, and optional premium services to provide developers the fastest possible time-to-resolution. For more information, visit www.windriver.com/support.

HOW TO PURCHASE

To connect with a sales representative, visit www.windriver.com/company/contact, call +1-800-545-9463, or email salesinquiry@windriver.com.