VXWORKS

The Secure, Safe, Reliable, and Certifiable RTOS for Critical Infrastructure and Embedded Systems

For more than 30 years, the VxWorks® real-time operating system (RTOS) has been chosen by global industry leaders as the trusted foundation to power billions of safety-critical intelligent devices, machines, and systems. 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 embedded devices in the Internet of Things (IoT), VxWorks is repeatedly selected as the RTOS for innovative solutions that deliver secure, safe, and reliable applications across a wide array of industries, including aerospace, automotive, defense, industrial, medical, and transportation.
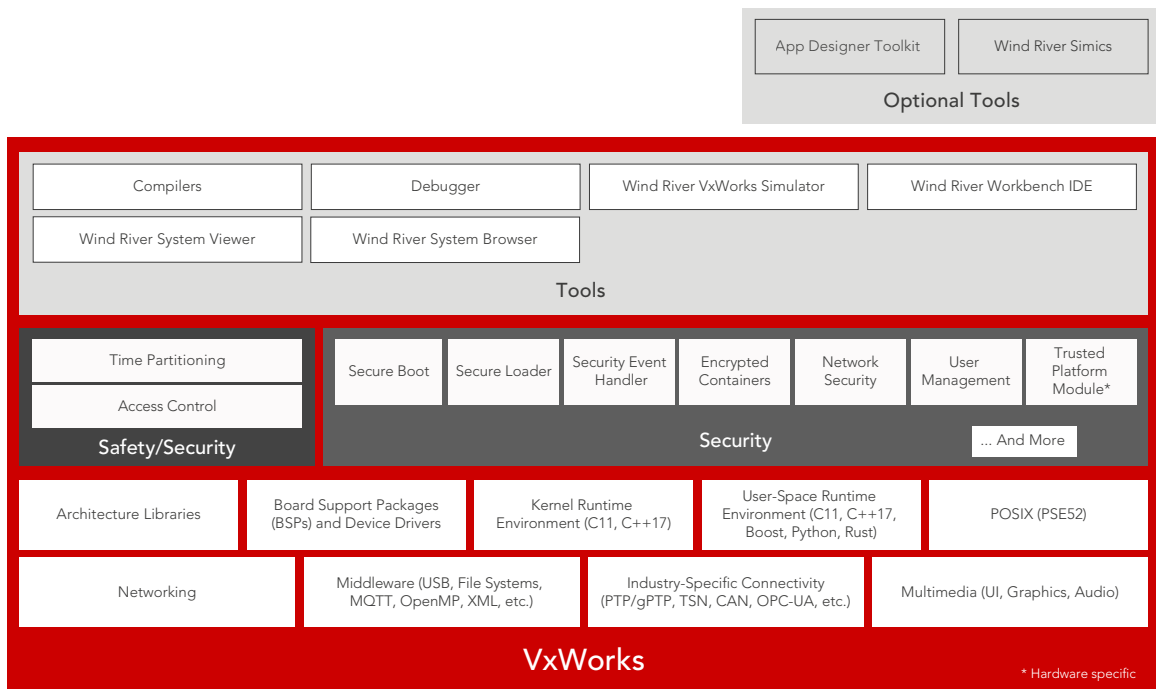

Figure 1. VxWorks

ENABLING THE FUTURE OF EDGE COMPUTING SYSTEMS

VxWorks is a deterministic, high-performance RTOS that sets the standard for a scalable, future-proof, secure, safe, and reliable operating environment for mission-critical devices and systems that must meet the highest standards.

- **Real time:** VxWorks is ideal for hard real-time embedded applications because it is a deterministic, priority-based, preemptive RTOS with low latency and minimal jitter. In addition to standard preemption, VxWorks can ensure that safety- and time-critical applications get a predetermined number of CPU cycles through various

- Number one commercially deployed embedded RTOS
- Broad spectrum of embedded processor support
- Proven in multiple vertical market designs
- Certifications: DO-178C DAL A, ISO 26262 ASIL D, IEC 61508 SIL 3, and IEC 62304

SAMPLE OF VXWORKS CUSTOMERS

- ABB
- Airbus
- Alcatel-Lucent
- Boeing
- Delphi
- Mitsubishi
- NASA
- Northrop Grumman
- Siemens
- Varian

AWARD WINNING

HOW TO PURCHASE

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forms of scheduling as well as time and space partitioning. It also provides flexible features needed for various industries.

- **Future-proof:** As new features and functionality are added to VxWorks, compatibility is always top of mind because Wind River® strives to protect and future proof its customers' software and tool investments. Compatibility allows developers to take advantage of the latest VxWorks innovation, enabling them to quickly add new features and upgrades with minimal retesting of the entire system, thereby saving both project time and expense.

- **Rich connectivity and communications:** VxWorks has robust IPv4 and IPv6 stacks that are also time-sensitive networking (TSN) capable, guaranteeing real-time communications and packet delivery within a bounded time or latency on a switched Ethernet network. VxWorks supports innovative industrial applications, including but not limited to OPC Unified Architecture (OPC UA); SocketCAN used in automotive applications; and host, target, and on-the-go (OTG) USB.

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

- **Broad board support:** Through joint development with our ecosystem partners, VxWorks has the most extensive list of board support packages in the embedded software industry, enabling early prototyping, cost savings, and flexibility of choice. Addressing the need for quick prototyping on inexpensive hardware, VxWorks has open source BSPs available on GitHub, starting with support for Raspberry Pi.

- **Robustness and tuning:** The modularity of VxWorks makes it easy to choose and adapt capabilities as required, changing the modules only as needed. (Certifications may need to be reevaluated when changing VxWorks code used in a previously certified application.)

- **Virtualization:** VxWorks delivers efficient, near-native performance in virtualized environments, such as Wind River® Helix™ Virtualization Platform, or with other popular hypervisors, including QEMU, VMware, and KVM. Helix Platform, which has a built-in certifiable Type 1 hypervisor that can save time and effort compared to other hypervisors that are not easily certifiable, will also run VxWorks with other operating systems.

- **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, as well as a FAT-compatible dosFS file system.

- **Mixed OS support:** VxWorks supports communicating with other operating systems in a mixed environment using OpenAMP, allowing developers to build interactive functionality across VxWorks real-time and other non–real-time environments.

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

Security

VxWorks integrates an extensive and continuously evolving set of security capabilities that allows developers to meet rigorous security requirements and address security threats—from boot-up operation to power down. These capabilities allow architects to develop a level of security that is 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

Wind River Professional Services offers deep insight and support to help architects fully capitalize and tune VxWorks security capabilities to their unique situation.

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, IEC 62304, and IEC 61508 SIL 3

ACCELERATING APPLICATION DEVELOPMENT WITH VXWORKS

To help accelerate the development of safety- and mission-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 create efficient, portable applications. Developers can also leverage the performance of multi-threaded processing with 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,

WIND™

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
- 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.