

## Wind River Real-Time Core for Linux

Demand is growing for real-time. Real-time requirements for a multitude of applications, spanning a diverse range of industries, have radically changed the playing field for device application vendors. Wind River is the leading provider of real-time solutions to the device software market.

“Real-time” can mean many things to many people. Simply put, the real-time requirement for a particular application is based on its tolerance or constraint for interrupt and scheduling latencies. “Conditional” real-time provides a guarantee of a specific level of central processing unit (CPU) bandwidth per unit of time. So an application must have a specified allocation of CPU cycles over a specific interval, but it is insensitive as to how or when the CPU bandwidth is made available during the course of that interval. “Guaranteed” real-time, on the other hand, considers response time rather than bandwidth guarantee. In this case, it is imperative for an application to respond to an asynchronous event within a specified bounded time frame to ensure correct operation. Failure in the case of guaranteed real-time may yield severe outcomes, whereas failure in conditional real-time may result in decreased quality of service.

A digital media device and a vehicle anti-lock braking system might demonstrate examples of conditional versus guaranteed real-time applications. Digital media devices, such as set-top boxes, digital video recorders, or MP3 players, have conditional real-time capabilities for users to enjoy their viewing experience. In the event that CPU cycles are backed up, the worst-case scenario is that the user will lose a few seconds of audio or video, and the device will resume after a delay or dropout. In most modern automobiles with guaranteed real-time anti-lock braking systems, guaranteed response time is a must, otherwise system failures can result in catastrophic results.

### Expanding the Market Opportunity

Wind River acquired intellectual property from the software industry’s only commercially available, patented, guaranteed real-time Linux technology developed by Finite State Machine Labs Inc. (FSMLabs). FSMLabs has been a leader in real-time technology for over 10 years, delivering guaranteed real-time solutions for when failure is not an option and security is a must. With this investment, Wind River’s real-time technology expertise is expanded while further accelerating the market opportunity. Wind River provides a broad and robust portfolio of real-time capabilities that meet the specific needs of device manufacturers across a variety of industries.

### Enabling Real-Time Linux Applications with Real-Time Core

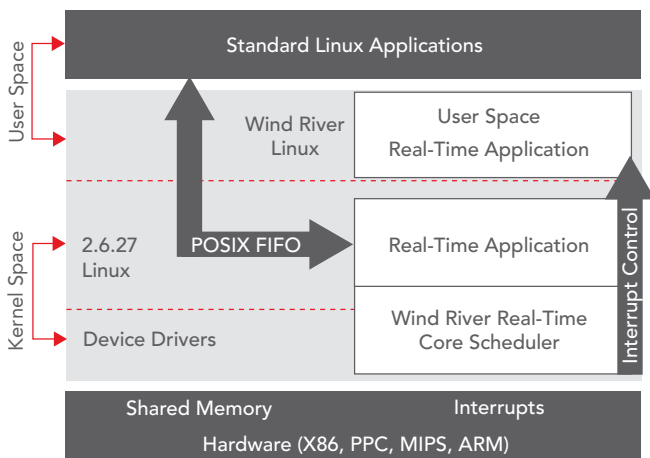
Wind River Real-Time Core for Linux enables guaranteed real-time response for applications ranging from single-core feature phones, high-bandwidth Internet Protocol communications, robotics, and industrial control. This technology has been regarded in the industry as one of the best, most mature guaranteed real-time Linux solutions available today. Real-Time Core includes a guaranteed real-time executive that coexists with the Wind River Linux kernel. Together, they combine the guaranteed real-time capabilities necessary for high-performance deterministic responsiveness with an optimized and integrated commercial-grade Wind River Linux platform.

### Optimized for Developers

Wind River Real-Time Core and Wind River Linux provide device manufacturers with mature, proven technology for developing complex, next-generation Linux-based applications that require guaranteed real-time with microsecond-level interrupt and scheduling latency. Real-Time Core employs a simple real-time executive that runs the non-real-time Linux kernel as its lowest priority task and routes interrupts to the Linux kernel through a virtual interrupt layer. All interrupts are initially handled by Real-Time Core and are passed to Wind River Linux only when there are no real-time tasks to run. Real-time applications are loaded in kernel space and receive interrupts immediately, resulting in near hardware-threshold speeds for interrupt processing.

Wind River Real-Time Core and Wind River Linux user tasks communicate through lock-free queues and shared memory in the current system. From the application programmer’s point of view, the queues look like standard Linux character devices, accessed via Portable Operating System Interface (POSIX) read/write/open/ioctl system calls. Shared memory is currently accessed via the POSIX mmap calls.

Real-time tasks are implemented as POSIX threads, using a standard format that does not require user knowledge about Linux kernel modules or features. Real-time application development is therefore both simplified and nonintrusive on standard Linux operations.



Wind River Real-Time Core

## Real-Time Applications and Industries

### Aerospace and Defense

Aerospace and defense (A&D) applications include next-generation avionics, command-and-control, navigation, safety, security, signals, targeting, vehicle control, weapons, and other systems. Military, civilian aerospace, and commercial-space-based systems require a robust, high-performance and highly connected operating system and have some of the most demanding and exacting requirements for embedded platform software.

### Industrial Control, Instrumentation, and Robotics

Industrial control demands a mix of high-reliability, predictability, and performance. Applications in manufacturing, chemical engineering, power generation, transportation, and other electromechanical systems are by definition mission-critical. Failures can cost millions of dollars or even human lives. Whether the project involves building an assembly line robotic arm, a remote-controlled unit, a free-roving wheeled robot, or even a bipedal humanoid model, it will have exacting performance and responsiveness.

### Telecommunications

Modern data and voice applications present a mix of guaranteed and conditional real-time requirements along with the need for ultra-high packet traffic. Voice and other media streams demand a quality of service that surpasses the capabilities of off-the-shelf, general-purpose operating systems. High throughput requirements and heavy traffic can also swamp the simple networking stacks that accompany general-purpose operating systems. One common example in data communications is routing, which requires real-time operation to quickly route thousands of IP packets.

## Mobile Handheld

Real-time is one of the key requirements for new single-core cell phone designs. Single-core designs enable mobile feature phone vendors to reduce costs. However, these low-cost phones still require the ability to support both the base-band protocol (with strong real-time requirements) and end-user applications, including streaming media and other real-time applications.

## Summary

Complex devices in an ever more complex world demand industry-proven, quality-tested real-time Linux solutions. Why trust your real-time requirements to anyone else? Wind River delivers the most comprehensive solutions for your application development needs.

## Features and Benefits

- Wind River Real-Time Core provides guaranteed real-time capabilities combined with easy development, integrated tools, and rapid deployment of Wind River Linux.
- Guaranteed real-time application determinism performance is guaranteed to the threshold limits of the underlying hardware, with microsecond response times across a broad range of architectures.
- Real-Time Core allows you to leverage the optimized integration, knowledge base, and commercial-grade services and support of Wind River Linux plus the open source community for drivers and applications.
- Simple POSIX interfaces allow guaranteed real-time applications to be nearly indistinguishable from standard UNIX applications. This helps you leverage existing skills to accelerate development time and deliver products to the market faster.
- User space real-time enhances the base Real-Time Core technology by adding a memory protection layer to real-time threads and increases the programming language support. With this valuable Real-Time Core module, you can rest assured that no real-time thread will bring the entire system down should one ever fail.
- Coupled with Wind River Advanced Networking Technologies, Real-Time Core adds real-time networking support for those mission-critical applications requiring deterministic networking capabilities. This real-time networking module for Real-Time Core ensures your network applications send and respond to network packets in a fully deterministic fashion.