

VxWorks RTOS

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Abstract- VxWorks is a Unix-like real-time operating system made and sold by Wind River Systems of Alameda, California, USA. VxWorks is generally used in embedded systems. Unlike "native" systems such as UNIX and Forth, VxWorks development is done on a "host" machine running UNIX or Windows, cross-compiling target software to run on various "target" CPU architectures as well as on the "host" by means of VxSim. VxWorks was created in the early 1980s, when Wind River's founders set out to scale the expertise they'd gathered in the Real-Time Systems Group at the Lawrence Berkeley Laboratory from large physics experiments to device control systems. Over more than 20 years, VxWorks has evolved through six incrementally improved releases and has been deployed in more than 350 million devices; making it the most widely used and thoroughly tested real-time operating system available today.

Index Terms- wind river system, embedded system, cross-compiling, real-time operating system.

I. INTRODUCTION

With a reputation for performance, flexibility, compatibility, and scalability, VxWorks provides an extremely reliable runtime platform for embedded application development. VxWorks is flexible, with more than 1800 powerful application program interfaces (APIs); scalable, from the simplest to the most complex product designs; reliable, used in mission-critical applications ranging from anti-lock braking systems to interplanetary exploration; compatible, works with numerous industry standards; and available, can on all popular CPU platforms. The VxWorks RTOS comprises the core capabilities of the WIND® Microkernel along with advanced networking support, powerful file system and I/O management, and support for C++ and other runtime standards.

II. FEATURES

Memory Protection:

- MMU-based memory protection
- Extensible user-mode system call interface

- Shared memory for processes and tasks
- Shared libraries for processes
- Location-independent message channels for interprocess communications

Error Management:

- Task stack overrun detection
- Code corruption detection
- Null pointer usage detection
- Heap block overrun detection
- Heap usage tracking and leakage detection
- RTP error detection
- API support for kernel application errors
- API support for user-mode application errors

High-performance microkernel design

At the heart of the VxWorks run-time system is the highly efficient WIND Microkernel. This microkernel supports a full range of real-time features, including

- Efficient task management
- Multitasking, unlimited number of tasks
- 256 priority levels
- Priority-based preemptive and round-robin scheduling
- Fast, flexible intertask communications
- Fast, deterministic context switching
- Binary, counting and mutual exclusion semaphores with priority inheritance
- VxWorks events
- Local and distributed message queues
- POSIX pipes, counting semaphores, message queues, signals and scheduling
- Control sockets
- Dynamic memory management
- Improved "best-fit" memory allocation algorithm
- Automatic resource reclamation
- Incremental linking and loading of components

- Fast, efficient interrupt and exception handling
- Optimized floating-point support
- System clock and timing facilities
- Highly scalable footprint
- Highly flexible design allows for wide range of applications

Scalable run-time software

VxWorks is designed for scalability, enabling developers to allocate scarce memory resources to their application, rather than to the operating system. From deeply embedded designs requiring a few kilobytes of memory, to complex high-end real-time systems (where more operating system functions are needed), the developer may choose from over 100 different options, to create highly customize configurations. Individual modules may be used in development and omitted in production systems. Furthermore, these individual subsystems are themselves scalable, allowing the developer to optimally configure VxWorks' run-time software for the widest range of applications. For example, individual functions may be removed from the ANSI C run-time library, or specific kernel synchronization objects may be omitted if they are not required by the application.

Comprehensive networking facilities

VxWorks was the first real-time operating system to integrate industry-standard TCP/IP networking facilities optimized for real-time applications. This tradition of innovation continues with standard support for the latest Berkeley networking features, including:

- BSD 4.4 TCP/IP networking
- IP, IGMP, CIDR, TCP, UDP, ARP
- RIP v1/v2
- Standard Berkeley sockets, zbufs (a.k.a., zero-copy sockets)
- SLIP, CSLIP
- BOOTP, DNS, DHCP, TFTP
- NFS, SUN RPC
- FTP, rlogin, rsh, telnet

POSIX compliance

VxWorks supports the POSIX 1003.1b and POSIX 1003.1c specifications and basic system calls in the

1003.1 specification, including process primitives, files and directories, I/O primitives, language services, and directory handling. In addition, VxWorks adheres to the final approved standard for POSIX 1003.1b Real- Time Extensions, including POSIX-compliant asynchronous I/O, counting semaphores, message queues, signals, memory management (page locking), and scheduling control. The pThreads implementation of POSIX 1003.1c comes standard in VxWorks.

Broad silicon support

Wind River supports a wide range of the latest RISC and CISC architectures so users can select the right silicon for their designs. In addition, Wind River offers off- the-shelf turnkey integration with an extensive set of commercial and evaluation boards. VxWorks' open design is highly portable and complete across all supported processors, allowing application migration between architectures with minimal effort.

Hardware reference designs and tools

In addition to supporting a wide range of industry-standard boards, VxWorks offers validated BSPs for Wind River's hardware reference designs, and specification details for chip evaluation and early hardware and software development. VxWorks also supports a full line of optional hardware-assisted tools to aid in the entire development cycle, from board bring-up to real-time trace and data acquisition.

Operating system accessories

Accessory products give developers access to an unprecedented range of features and help to extend the VxWorks platform. These products include the BSP Developer's Kit (included as standard), support for flash file systems with TrueFFS for Tornado, support for graphics applications, Java, virtual memory management with VxVMI, multiprocessing with VxMP and VxFusion, and connectivity through the Common Object Model (COM, included as standard) and the USB Developer's Kit.

III. VXWORKS BENEFITS

- Increase reliability through MMU-based memory protection
- Accelerate time-to-market with enhanced error management

- Optimize developer productivity through open standards
- Continue to deliver products that rely on the core attributes of VxWorks, including high performance, reliability, determinism, low latency and scalability
- Realize high-performance devices
- Optimize device costs using scalable runtime software
- Build next generation interconnected devices using comprehensive networking facilities
- Leverage existing and open source IP with backward compatibility to VxWorks 5.5 and increased POSIX compliance
- Widen processor and board choices through broad silicon support and easy porting to custom hardware
- Speed device design using hardware reference designs and tools

IV. PRODUCTS USING VXWORKS

- The Mars Exploration Rovers *Spirit* and *Opportunity* and the *MRO* use VxWorks running on Power Architecture platforms. VxWorks is in use in several other spacecraft as well, for example, the *Deep Impact* mission.
- Boeing intends to use the operating system in their new *787* airliner.
- The *Linksys WRT54G* wireless router (without the designation 'WRT54GL') uses VxWorks on models v5 and higher.
- Several LiteON DVD recorders use VxWorks.
- ReplayTV uses VxWorks on its digital video recorder.
- Siemens Medical Solutions uses VxWorks to control the real time events of its MRI scanners.
- MA Lightning uses VxWorks for Light Show Commanders and the GrandMA Series of lighting consoles.

REFERENCES

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