



Portfolio of Vendor Projects

Wind River Systems

Wind River Systems, Inc. is a leading provider of software development tools, real-time operating systems, and advanced connectivity solutions for products throughout the Internet, telecommunications, aerospace/defense, and other markets.

Dot4 is a WindLink Partner and has completed several projects for this client and its Engineering Service customers. Selected projects are described below.

POSIX Threads for Tornado

Wind River's flagship product is the Tornado development package, the primary component of the package is the VxWorks real-time operating system. VxWorks sports a significant subset of the IEEE POSIX specification, but a glaring omission was support for POSIX Threads, or pThreads.

Wind River asked Dot4 to develop a subset of pThreads support while pursuing a sales opportunity with a major customer. Implementing POSIX style threads involves fundamental operating system enhancements when implemented natively. Conforming to the IEEE specification required that threads could be created, canceled, prioritized, and queued. POSIX style mutexes and condition variables were also implemented in order to support pThreads correctly.

Dot4's partial implementation of pThreads convinced Wind River that it would be an important product in their 3rd Party Software catalog. With much encouragement and support from Wind River, Dot4 completed the pThreads implementation and launched the pThreads for Tornado product.

Dot4's pThreads product leveraged large sales opportunities for Wind River, including customers in the defense, aerospace, and telecommunication industries. These customers typically had made large investments in the development of POSIX compliant applications. This strategic product was acquired by Wind River and incorporated into the Tornado AE product release.

Particle Measurement Systems

Dot4 was hired to help PMS, a Wind River engineering services customer, complete the development of their next generation gas particle measurement product line. Dot4 developed VxWorks device drivers for two LCD displays. The first device was a color 320x240 LCD panel from Kyocera. The second device was a monochrome 320x240 LCD display from Planar. 2-bit and 4-bit UGL drivers were developed for this project, and Zinc graphic applications were used to exercise the drivers.

This project is quite typical of several that Dot4 successfully competed in our vendor support role for Wind River.

Palm PDA Board Support Packages

Wind River funded Dot4 to develop Board Support Packages (BSP) and device drivers to port VxWorks to Palm Pilot models III, IIIx, and V as an internal engineering exercise.

This effort required an extensive reverse engineering effort due to the proprietary hardware/software of the various Palm models.

Dot4 developed the BSP for the DragonBall EZ processor (Motorola 68328EZ processor), the basic booting and kernel functionality, the device driver for the Optrex touchscreen, and the UGL device drivers for graphics display. Dot4 also developed drivers and API's to control the serial and infrared ports. This project also required a custom tool to convert object images from the standard VxWorks compiler into an image that could be flashed onto memory expansion boards for the various Palm PDA products.

The final result allowed a user to insert a new FlashROM and boot VxWorks on the Palm unit and execute standard Tornado demonstration applications.

LynuxWorks (formerly Lynx Real-Time Systems)

LynuxWorks, Inc. is a pioneer of open standards with their LynxOS real-time operating system, and a leader in the embedded Linux market with their BlueCat Linux.

Dot4 has been a key engineering partner to LynuxWorks since 1994. Dot4 has successfully completed over two dozen projects for this client, several involving major contributions to the LynxOS product baseline functionality. Many of these projects have been custom engineering efforts developed for LynuxWork's Engineering Services organization.

Brief summaries of a few key projects illustrate the close and trusted relationship Dot4 has enjoyed with this company.

POSIX mmap Support

The operating system features known as mmap/munmap allow regions of memory to be treated as files, thus permitting very fast file type access from realtime applications. Support for memory files is optional as defined in the POSIX 1003.1b standard and LynuxWorks had not implemented this capability. These features affect an OS's Virtual Memory (VM) subsystem and presents a difficult design challenge with respect to real-time OS's such as LynxOS, where Unix style memory paging does not occur. Dot4 overcame the design challenges and implemented mmap and munmap for LynxOS then conducted POSIX conformance testing to insure full compliance with the POSIX 1003.1b standard.

V-Node Mapping

LynxOS file operations were traditionally coupled tightly to the underlying file system mechanization. This architectural approach made it difficult for the company to add support for different file systems to the RTOS. In fact, the various file systems supported by LynxOS at that time (LynxFS, NFS, and ISO9660) all used different levels of abstraction.

These issues resulted in a lack of the infrastructure necessary to map regular files as memory objects as is done in UNIX. In particular, adding support for the Linux EXT2 file system was impossible without modifications to the kernel infrastructure. Supporting the Linux file system had become paramount to LynuxWorks business strategy.

This project added v-node abstraction to LynxOS using that of Linux as a model. Dot4 designed, implemented, and conducted POSIX conformance testing on this major OS enhancement project.

POSIX 1003.1c Thread Support Under LynxOS

Lynx Real-Time Systems was an early adopter of the IEEE POSIX standard for LynxOS, and this was particularly true with respect to the POSIX Threads (pThreads) specification. The IEEE had advanced nine drafts since Lynx's original implementation of pThreads, including the formal ratification of the specification.

LynuxWorks asked Dot4 to update the pThreads implementation in LynxOS from POSIX.1a Draft 4, to the ratified POSIX.1c standard. Included in this effort were the extensions specified in the POSIX.1j Unix98 specification. To accomplish this goal, Dot4 also had to implement fundamental changes to the Inter-Process Communication mechanisms and message queues to allow conformance to the POSIX .1c standard.

Dot4 successfully met all of the client's requirements, delivering a tested, up-to-date, IEEE conformant version of LynxOS. Dot4's implementation also allowed existing LynxOS customers continued use of the outdated pThreads implementation, and provided binary compatibility for existing application to be used under the new version of LynxOS.

Miscellaneous Projects

Dot4 has successfully completed many other Linux and LynxOS projects for LynuxWorks including development of an SS7 STREAMS driver, device drivers for PCI based SCSI adapters, device driver for various ethernet chipsets, driver and protocol work for a PCI based FDDI adapter, STREAMS based DLPI driver, and LynxOS' PPP capability.

Axcelis Technologies (formerly Eaton Semiconductor)

Axcelis Technologies was formerly the division of Eaton Corp. responsible for their semiconductor fabrication equipment product line. In 2000 the division was spun out as its own publicly traded corporation.

Axcelis line of ion-implantation semiconductor fabrication equipment is recognized as some of the best the industry has to offer. Several generations of their products are deployed with customers around the world.

Dot4's initial project with this vendor was to analyze, design and implement a set of system metric tools that would allow Axcelis engineering and customer support teams to monitor a wide variety of system components and identify problems and performance bottlenecks while the equipment was in operation.

The ion-implanter product architecture includes Motorola 68K/VME based single board computers running VxWorks, data acquisition boards known as cell controllers, Sun workstations running Solaris, and other components connected by ethernet or RS422 serial communications. Their software architecture relied heavily upon a message passing design. The problem that Axcelis faced was that as system load increased, messages would be dropped, or received out-of-sequence causing system errors and lost production time. Finding the source of these problems without instrumentation was difficult and extremely time consuming.

Dot4's system metric toolkit is tunable, allowing the engineering staff to perform a very high level of monitoring, or a minimal level of monitoring thereby imposing less impact on the system being monitored. The toolkit is able to monitor message traffic between software modules, VME bus traffic, network traffic on multiple networks, CPU activity and load, and process/thread execution.

Dot4 also developed a GUI based control software to allow users to activate/deactivate various monitoring activities, and archive test results. With Dot4's monitoring tools Axcelis engineers have been able to locate and resolve many performance related issues across several generations of deployed products.

Dot4 engineers have since been part of Axcelis' engineering team to design and implement the next generation of ion-implanter fabrication products at Axcelis, and have also responded to problem reports with existing Axcelis products.

Venturcom, Inc.

Venturcom provides tools, operating platforms, training and services to designers of dedicated systems and equipment. Venturcom design tools and products leverage Windows Operating Systems and development platforms to provide a robust, solutions oriented development environment spanning the medical, simulation, industrial automation and network infrastructure markets. Their flagship product, RTX, provides real-time features to Windows NT, CE, 2000, and XP platforms.

Dot4 has delivered several successful projects for this client, including:

BBN Technologies, NTDR

BBN Technologies was contracted by ITT to develop early models of a wireless internet device known as the New Technology Digital Radio (NTDR) for the US Army. This digital radio is capable of forming a wireless TCP/IP network with other NTDR units for voice and data communication.

Dot4 ported a set of real-time extensions from Venturcom's legacy VENIX product to the then-current version of SCO's UnixWare operating system. These extensions would permit UnixWare to operate in an embedded environment (without keyboard, monitor, or disk drive), and provide some real-time management of events. Since Venturcom had exited the Unix market, a Unix kernel development company such as Dot4 was needed to bring these technologies to a current Unix operating system.

Dot4's work involved the Virtual Memory subsystem, file system, creating a FlashROM reloading utility, and integrating these enhancements with the PC/104 hardware selected for the NTDR. Dot4's efforts allowed the NTDR's x86 based hardware to boot UnixWare 7 and operate as an embedded device.

Dot4 was then contracted to resolve several issues with the ethernet device driver, and to address problems with the build and packaging of the operating system components for FlashROM resident operation.

Philips Medical Systems

Philips Medical Systems in Amsterdam is developing a state-of-the-art X-Ray imaging system known as IBIS. This product is targeted for use in cardiovascular surgery principally for its ability to capture and display live images of the patient, from any angle, during surgical procedures.

The operating system used for IBIS is Windows NT. This system incorporates custom video display chipsets designed by Philips and implemented in PCI boards referred to as Picasso display boards. The system was designed to handle as many as 16 high resolution monochrome displays driven by as many as 8 Picasso boards. Philips asked Venturcom and Dot4 to develop a set of enhancements to Windows NT that would allow a primary VGA display and all of the monochrome displays to function as a single "virtual desktop" allowing users to move images and windows

across them as desired. The requirement that created the need for a custom solution is that Philips required that the virtual desktop be accessible to applications via the standard video display context.

Dot4's solution involved enhancements to the Windows NT GDI and Video Port. Dot4 developed a custom DDI and mini-port driver for the Picasso display boards.

Multiprocessor HAL for RTX

Venturcom's RTX product is a set of real-time extensions to Windows NT, 2000, CE, and XP. The product is built around a real-time kernel developed by Venturcom that loads into the Windows OS as a device driver. Application developers are able to create real-time threads that are managed by the RTX kernel.

Dot4 was asked to help design and develop an enhanced Hardware Abstraction Layer (HAL) capable of supporting symmetric multi-processor computer architectures.

This successful project allowed Venturcom to bring their real-time products to very high compute multiprocessor platforms.