

# OS Portability Enhances Elekta's Leading-Edge Medical Technology



**Modern healthcare practices are under pressure to perform consultations and deliver treatments quickly, both to improve the effectiveness of the treatment and to minimize patient waiting times. This article looks first at how international medical technology group Elekta is basing its new generations of equipment on LynxOS-SE to get to market quickly with systems that deliver high levels of functionality, fault tolerance and safety.**



**Elekta's platforms run just one operating system on one processor, but there are already signs that future medical systems will require multiple operating systems running on single or multi-core processors. The second part of this article looks at a proof-of-concept developed by Intel®, in partnership with LynuxWorks™ and Portwell, which uses virtualization technology to allow this to be implemented in the context of a safety-critical medical system.**

Elekta specializes in systems and solutions for radiotherapy and radiosurgery, for the treatment of cancer and brain disorders. The company markets a number of treatment systems including Leksell Gamma Knife® and image-guided radiation therapy systems.

The Elekta Synergy® image-guided radiation therapy system uses high-resolution imaging taken in 3D and at the time of treatment. By streamlining the processes of assessing patients and beginning treatment, surgeons are able to commence treatment directly. In addition to speeding-up treatment, this brings a

further powerful advantage in that surgeons can work using up-to-date image data, and can therefore be sure to target a higher proportion of the affected area while minimizing damage to surrounding healthy tissue.

The company's current product development activities include a new digital treatment control system named Integrity™. Integrity is used to drive the digital linear accelerator range of products. "A key factor of our development strategy is to accelerate completion of new products," explains Adrian Smith, Product System Engineer (Linear Accelerators) of Elekta.

"Hence it is important that we can quickly port proven software applications to a variety of products to enhance reliability and reduce time to market."

## **Higher performance requirement**

To meet these objectives, the properties of the operating system are fundamental considerations. Although quality standards covering the design of medical systems are already well developed, there are fewer stipulations concerning the technical requirements and safety provisions for operating systems. A number of OSs currently on the market have been

successfully used in medical systems. However, for its new treatment system, and subsequent generations of products, Elekta sought a higher-performing solution with hard partitioning that could allow other applications to run concurrently without interfering with each other. "In addition, we wanted to find a solution that would allow us to use proven applications across a number of systems, for example using POSIX® technology," adds Adrian Smith.

Development of the RTOS image, using LynxOS-SE, was carried out at Elekta's UK design center in Crawley, West Sussex. A small team of engineers who are

experienced in real-time development, completed the design, including porting and writing of drivers, within project time scales. The portability and open-standards aspects of LynxOS-SE were fundamental to achieving this short time to availability of the first prototype image.

### **Platform for portability**

Looking ahead, another key objective for the team at Elekta is to create a generic base on which to build further products in the future. These will include additional radiotherapy systems and a number of other products that will make complex procedures faster and more effective.

As an example of measures to aid code portability between systems, the Portable Operating System Interface (POSIX) is an open operating interface standard that places certain requirements on aspects of the OS such as signals, calls and management of processes and threads. Since LynxOS-SE and other LynxOS derivatives are POSIX-conformant, supporting the POSIX.1 standard in its entirety, this provides Elekta engineers with the basis to port software quickly between platforms in future projects.

This flexibility and portability has allowed Elekta to consider the latest addition to the LynxOS family, LynxOS-SE version



6.0, which includes new features to support emerging 64-bit multi-processing architectures. "This is important to us as we plan our future product strategy," explains Adrian Smith. "Medical control systems can be highly processing-intensive, and they have historically required several processor boards. Multi-processing will offer significant design flexibility.

"Building our software development strategy on the LynxOS family will allow us to take full advantage of multi-processing in future products, both to reduce the number of boards and to increase the performance of our systems."

LynxOS-SE is available both as a stand-alone OS, as used by Elekta, or as a para-virtualized guest operating system running on top of the LynxSecure virtualization platform. The user interface or LynxOS-SE and any applications running on top of LynxOS-SE remain unchanged between the stand-alone version and the virtualized version, allowing for seamless migration to a virtualized medical platform.

### **Virtualization for medical device platforms**

Elekta's platform is typical of today's state-of-the-art medical device systems and uses a single operating system, typically a real-time operating system (RTOS).

However, as systems grow in complexity and feature set, developers may find advantages in using a general purpose operating system (GPOS) such as Linux® or Windows® for their user-interface and connectivity to medical networks. In this case, the ideal scenario would be to use both a general purpose operation system for communications with the outside

world and the RTOS for real-time functions such as patient monitoring.

Let's look at a practical application of this technology. When monitoring vital signs such as EKG and blood oxygenation during a patient's hospital stay, numerous sensors must be attached to the body. To help untether patients, the wires could be eliminated by using Bluetooth wireless biometric sensors communicating to a single workstation.

Within that workstation would be a virtualized environment running one or multiple virtual machines dedicated to the real-time monitoring and analysis of the patient. The heart rate sensor would report its data in one VM while the blood oxygenation sensor would connect to another VM, and so on. Each of these VMs would run either an RTOS or a GPOS like Linux, with real-time scheduling and determinism guaranteed by the underlying separation kernel. The information from all of the patient sensors could then be graphically portrayed for visual monitoring in a familiar Windows environment running in another VM, all running on the same workstation.

This could be done using virtualization to run multiple operating systems on the same physical platform. Virtualization works by abstracting the underlying processing cores, memory, and devices. This is done by running virtual machines (VM) on top of an embedded hypervisor, with each VM running its own OS and related applications.

A hypervisor is a software layer that either resides directly on the hardware (type 1 hypervisor) or hosted on top of a conventional operating system running on the hardware platform (type 2).

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**— Adrian Smith, Elekta  
Product System Engineer  
(Linear Accelerators)**

A secure virtualization platform is one that combines a type 1 hypervisor with a small separation kernel to provide secure isolation of the virtual machines and offer real-time performance and determinism when required.

To show how these technologies can be used, LynuxWorks and Portwell, Inc. teamed up to create a proof-of-concept (PoC) wireless sensor platform for hospitals based on Intel® technology, very much like the example above. The platform uses the Portwell WADE-8067, an Intel Core™2 Duo processor-based Mini-ITX board.

Running on the board, LynxSecure from LynuxWorks provides state-of-the-art software virtualization technology that

makes it possible to securely run both a Linux operating system and an unmodified Windows operating system in parallel on the platform.

## Conclusion

"LynuxWorks provided us with a stable, fast, POSIX-compliant RTOS with a multicore roadmap and quality developer tools. This has allowed us to further enhance our strategy to deliver solutions

that are always the safest and best performing on the market, and to introduce new products quickly at competitive prices," concludes Adrian Smith.

Looking forward to the next generation of multi-core, multi-OS medical platforms, the PoC demonstrates a means whereby medical equipment manufacturers can quickly port legacy wired sensor applications to a new wireless multi-core platform.

## Secure virtualization and wireless body area networks

A recent advance in medical electronics has been the application of Bluetooth technology to wireless medical systems. A patient can wear wireless sensors which monitor the patient's condition in real time and which stream the collected data to a doctor, a database or other medical equipment.

The LynxSecure separation kernel and hypervisor has been used on a Portwell Mini-ITX board with Intel® Virtualization Technology to create a proof-of-concept platform that achieves multiple biomedical monitoring, display and communication functions.

The design securely connects more than 25 wireless biometric sensors to the network, with secure virtualization from LynxSecure keeping system components separate from each other. The Bluetooth networking stack resides in its own secure partition, isolated from other system software.

For more information, visit the Intel Embedded Community web site at <http://www.lynuxworks.com/solutions/medical/intel.php>.



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