ENEA

Customer Case Study

High-Performance Operating System for Semiconductor Manufacturing Equipment

DSP real-time operating system used in industrial processing control application

The Problem

The customer, a vendor of semiconductor manufacturing equipment, needed a high-performance RTOS for a new control unit based on a multicore DSP design. The RTOS had to deliver very high performance and low latency to accommodate advanced control algorithms for the various processing stages in wafer fabrication.

The Solution

Enea delivered:

- Enea OSEck, a high-performance real-time operating system for multicore DSP systems
- A low-latency IPC mechanism interconnecting the DSP cores
- In-house services capability to address unique requirements for customized hardware and software
- Board support package for the custom hardware
- Development tools
- Training and workshops including a technical evaluation
- Long-term support and maintenance

A major vendor of semiconductor manufacturing equipment in Asia set out to develop a new smart control unit for use in their high-end products. The customer's product range includes both front-end and back-end IC manufacturing equipment, as well as specialized equipment of various kinds.

Increasing complexity in process control

Manufacturing silicon wafers requires a very high level of precision in many of the fabrication steps in order to ensure high output quality and yield. As circuit complexity has increased and new technology nodes have brought process shrink-downs, the need for control systems to provide better precision has grown. Advancements in automation has reduced manual handling throughout the manufacturing process, improving the precision in which chemical, mechanical and photolithographic process are carried out. Automating manufacturing steps has also helped reduce costs by decreasing the idle time in processes, improve utilization of equipment, and by reducing waste and inventory.

The advanced control systems used for efficient management of the wafer manufacturing processes rely on digital signal processing to achieve the precision needed for high yields.

The increasing requirements call for more capable process control with higher computing performance in new equipment compared to previous generations. This was why the customer designed a new control unit. Their previous control units used single DSP configurations, but for the new generation they wanted a platform with multicore DSPs supported by an FPGA to gain additional processing power.

Needs for a high-performance multicore real-time operating system

The step from a single DSP configuration to a multi-core DSP solution required a more advanced operating system, one that could scale up performance and facilitate real-time communication between cores and with the FPGA and the peripherals.

Apart from Enea's runtimes, none of the other investigated operating systems had the feature set or performance the customer needed, or the APIs that would allow an easy implementation.

Especially the inter-process communication (IPC) mechanisms posed a challenge to the customer. Efficient IPC between threads and processes on different cores is not trivial to implement. A bad or less than optimal implementation may introduce additional latencies resulting in poor performance. This constituted a large risk for the customer, as they did not

have any expertise in developing runtime systems for multicore platforms.

What the customer needed was an operating system that could scale performance over the DSP cores and provide efficient IPC while supporting Ethernet, SRIO, PCI-E and TI Hyperlink for communication.

In addition to the features and characteristics of a commercial real-time operating system, the customer looked for a long-term partnership with a vendor that could support their project from its initialization to deployment, and maintain the product throughout its entire lifecycle. Being able to extend the lifecycle of semiconductor manufacturing equipment is critical due to the very high capital investments it takes to develop a new generation.

A commercially supported and professional operating system would also help the team keep their focus on application development and help keep the projects' time schedule, instead of investing time in cumbersome work with implementing operating system features.

Enea delivers DSP real-time operating system

After extensive evaluation, the customer choose Enea OSEck for their project. Enea OSEck is a compact version of Enea OSE real-time operating system, with a micro kernel especially developed for use in DSPs. Enea OSEck offered the features, performance, support and ease-of-use the customer was looking for.

Enea OSEck leverages the computing performance of the DSPs through small footprint, low interrupt latency, and highly efficient system calls, allowing the DSPs to spend more time executing the application. In other words, it computes more data with less hardware resources compared to the alternative real-time operating systems the customer investigated.

The easy-to-use API provided by Enea OSEck makes it possible for developers to quickly learn the programming model, shortening the time it takes to become productive and reducing the risk for an implementation that may need extensive debugging and profiling, or in the worst case rewriting.

For example, IPC in Enea OSEck is very simplistic to use with a send and receive model transparent to programmers, efficiently sending a message between processes on different cores using only a single system call.

Enea accelerates development work

During the evaluation process, Enea provided technical advice, training and pre-sales support, helping the customer up to speed, accelerating development work, and allowing them to focus on their application development. To further speed up their project, Enea developed a board support package for the custom board, with production-grade support for peripherals and communication with the FPGA over SRIO and PCI Express.

Enea could also provide the customer with professional development tools. Enea Optima is a suite of ready-to-use open source based tools including compiler, debugger, and advanced profiling tools.

The customer required their supplier to provide long-term support and maintenance to protect their investment in the design throughout its lifecycle. Having provided real-time solutions for over 50 years, Enea offered the stability and expertise the customer was looking for.

Conclusion

The customer needed a high performance real-time operating system optimized for multicore DSP systems. Their limited expertise in developing runtimes and their requirements for performance led them to choose Enea OSEck. Enea delivered a solution including runtime, a BSP for their custom board, training, and long-term support and maintenance. The customer now benefits from an advanced operating system that allows them to focus on the application development, saving time and avoiding risks, and a partnership with a leading expert in embedded real-time control systems.

Enea Runtime Solutions for Industrial IoT

Enea's operating system and database solutions are used in many different industrial control systems, including:

- Industrial robotics
- Semiconductor Manufacturing Equipment
- Oil and gas pumps
- Industrial Safety Manager
- Processing control
- SCADA systems
- Industrial automation

More information and contact:

More information about our products and services for industrial applications is available at:

www.enea.com/industrial-iot