

Configure and Build the Embedded Nucleus PLUS RTOS Using Xilinx EDK

Nucleus PLUS RTOS for MicroBlaze and PowerPC 405 processors is now automatically configurable using XPS MLD technology.

by Gordon Cameron
Business Development Manager
Accelerated Technology, Mentor Graphics
gordon_cameron@mentor.com

Accelerated Technology's Nucleus™ PLUS real-time operating system (RTOS) is already available for both the Xilinx® MicroBlaze™ 32-bit soft processor core and the IBM™ PowerPC™ 405 core integrated into Virtex-II Pro™ devices. This deterministic, fast, small footprint RTOS is ideal for "hard" real-time applications.

With the release of the Xilinx Platform Studio EDK 6.3i, configuration of this leading royalty-free RTOS on your newly designed system is as easy as selecting from a pull-down menu. Instead of spending hours modifying your target software to work with your new hardware configuration, you can configure the target software automatically in minutes, without the error-prone possibilities of configuring by hand. This is especially valuable during the earlier design phases when the hardware may be changing frequently. This process was enabled by one of the underlying technologies of Xilinx Platform Studio EDK, called micro-processor library definition, or MLD.

MLD Technology

The Xilinx Platform Studio EDK development system is based on a data-driven code base that makes it extensible and open. MLD is one example of this underlying capability. It was created specifically to allow you to easily create and modify kernel configurations and associated board support packages (BSPs) for partner-supported RTOSs like Nucleus PLUS and its extensive middleware offering.

MLD has two required file types: the data definition file (.MLD) and data generation file (.Tcl). The .MLD contains the Nucleus user-customization parameters, while the .Tcl file is a Tcl script that defines a set of Nucleus-specific procedures for building the final software system (see Figure 1).

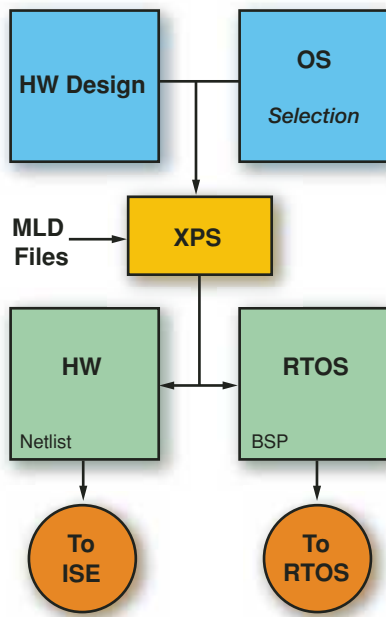


Figure 1 – Outline of an MLD-enabled system design

Installing MLD files in XPS

The installation CD of Nucleus PLUS installs the RTOS, associated drivers, and the two Nucleus-configured MLD files that enable you to use MLD technology within the Xilinx Platform Studio EDK. The default install path for the MLD files is the `\nucleus\bsp` sub-directory, located in `\edk_user_repository`.



Figure 2 – The hardware design is complete and ready to configure the software.

Accelerated Technology supplies these files and the associated installer as an evaluation disk, included in the latest release of Xilinx EDK 6.3i. Accelerated Technology has also established a website to support and distribute this evaluation. This site contains updates, evaluations, reference designs, and documentation for all of the Accelerated Technology Xilinx offerings and will be updated regularly with new middleware implementations that you can add to the automatic configuration of your application. The website is located at www.acceleratedtechnology.com/xilinx/.

To get up and running quickly with your first Nucleus-based system, the installation also includes a sample pre-built reference design with a compiled Nucleus PLUS demonstration. The pre-built reference designs currently support the Memec™ design-based DS-KIT-2VP7FG456 and DS-KIT-V2MB1000 FPGAs. This is the fastest method to employ for a sample Nucleus-based, MLD-enabled Xilinx system.

Use of Xilinx's Base System Builder is also well documented inside the application notes accompanying the installation. With the Base System Builder, you can build a variety of system core configurations to work with the Nucleus PLUS RTOS (see Figure 2).

If you have received your EDK 6.3i update recently or have purchased a seat, please check the contents for this evaluation. After running the Nucleus PLUS evaluation disk installer, the necessary files will be placed into the Xilinx EDK 6.3i and the support of Nucleus PLUS will be automatically added.

The elements of Nucleus PLUS modified by the data generation file (.Tcl) for specific hardware configuration are:

- The number and type of devices used by the hardware designer
- Memory map information
- Locations of memory-mapped device registers
- Timer configuration
- Interrupt controller configuration

Once you have installed these, you can use Xilinx Platform Studio EDK with Nucleus now visible in the RTOS pull-down selection menu. See Figure 3a for the PPC405 and Figure 3b for the MicroBlaze processor.

Evaluating Nucleus PLUS in EDK

The Accelerated Technology Nucleus PLUS evaluation software provided in the EDK Platform Studio 6.3i shipment includes a limited version (LV) of Nucleus PLUS. This is a fully functional version of the RTOS compiled into a library format (rather than the normal source code distribution) with the single restriction that it will stop working after 60 minutes, facilitating evaluation of its full functionality. When you purchase a full license of Nucleus PLUS from Accelerated Technology, you receive the full source code and, obviously, the 60-minute run time restriction is lifted.

The LV version of Nucleus PLUS is configured to execute from the off-chip SRAM or SDRAM module. Once you have a full license to the RTOS, you can configure it to run from any memory in your system.

Nucleus PLUS is a scalable RTOS – only the software you use in your design is included in the downloaded code. This may be contrasted with other larger, more static systems, which consume far more system resources. In some circumstances, the whole RTOS and application can fit in the on-chip memory, thus achieving high performance and low power consumption. Even with larger applications, which may utilize extensive middleware, the efficient use of the relatively small amount of on-chip memory means that the size of the kernel footprint is an important consideration.

You can configure other components of the Nucleus system by hand to work in this environment, such as networking, web server, graphics, file management, USB, WiFi, and CAN bus. Future releases of Nucleus will move these products into full integration with Xilinx Platform Studio EDK and MLD technology.

Nucleus PLUS and Xilinx Devices

As we have said, the process of creating a working BSP for Nucleus PLUS begins with configuring the hardware platform using Xilinx Base System Builder or the supplied sample reference designs. Then you can go to the Project > Software Platform Settings menu item and select the operating system you want to use from the list. Choosing the Nucleus option (Figure 3 a/b) will make available the specific software settings for the RTOS under each of the tabs on the Software Platform Settings menu (Figure 4 shows the user enabling the cache on the PowerPC).

Note that in the LV version most of the software options are disabled, but can be changed in the full version. Once you are satisfied with the software settings, you can use the Generate Netlist and Generate Bitstream commands and download the hardware configuration onto the FPGA using Xilinx XPS or ISE tools.

You can now execute the Tools > Generate Libraries and BSP commands to configure Nucleus PLUS. The application software can be linked with the RTOS. Now you are ready to switch over to the GDB debugger and download the combined RTOS and application image to the FPGA.

Advanced Software Tools

Up to this point, we have bypassed many aspects of application software design, assuming that you have code ready to compile and link and download to the FPGA. In fact, as systems become ever more complex, both hardware and software designers require advanced state-of-the-art tools to help them complete their projects within budget and on time.

The Xilinx EDK-configurable version of Nucleus PLUS uses the standard GNU suite of tools supplied with the Xilinx EDK package. This is more than adequate for many projects for getting systems up and running, but advanced application development often needs more. Accelerated Technology can provide a complete range of tools that encompass all phases of the software design process.

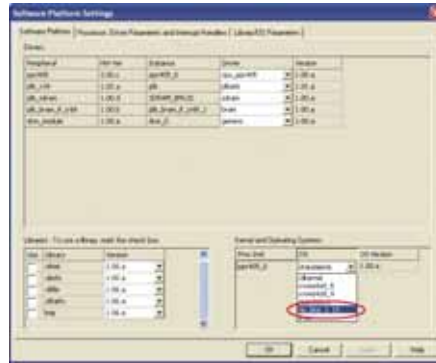


Figure 3a – After installing Nucleus PLUS in EDK, Nucleus appears as an option in the drop-down menu choosing which operating system to use with the PowerPC 405 processor.

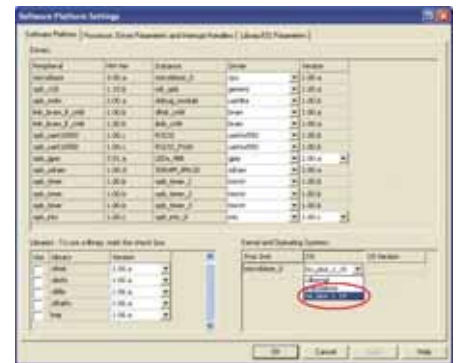


Figure 3b – Nucleus appears as an option in the drop-down menu choosing which operating system to use with the MicroBlaze soft-core processor.

- If code footprint or performance is important, then consider the highly optimizing Microtec compiler for PowerPC Virtex-II Pro devices. This ensures that the code that is shipped is the same as the code that is debugged – a goal not achieved by many compilers.
- Application debugging often needs RTOS awareness, advanced breakpoints, and debugging of fully optimized code. These features are available on PowerPC Virtex-II Pro devices with the industry-standard XRAY debugger.
- To bring software development forward in time so that it can be started before the hardware is complete, software teams can use our advanced prototyping products Nucleus SIM or Nucleus SIMdx. These tools allow the development of the complete application software in a host-based environment.
- UML enables software teams to raise their level of abstraction and produce models of their software. Nucleus BridgePoint enables full code generation by using the xtUML subset of UML 2.0.
- You can verify software/hardware interaction in the Mentor Graphics® Seamless® co-verification environment, which allows combined hardware and software simulation for PowerPC Virtex-II Pro devices.

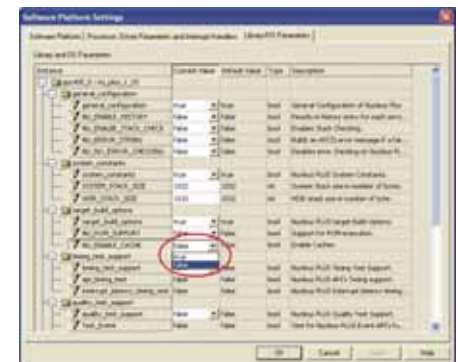


Figure 4 – Enabling the cache in the RTOS configuration parameters

These tools, when combined with the Nucleus PLUS RTOS, are ideal for helping you maximize the functionality and efficiency of your designs.

Conclusion

The latest EDK-configurable Nucleus PLUS RTOS brings a new dimension to systems incorporating high-performance embedded processors from Xilinx. Its small size means that it can use available on-chip memory to minimize power dissipation and deliver increased performance, while its wealth of middleware makes it ideal for products targeted at the networking, telecommunications, data, communication, and consumer markets.

Making this solution easy to configure within Xilinx EDK allows you to easily exploit the benefits of this powerful product. For more information, visit www.acceleratedtechnology.com or www.mentor.com.