

# Best-of-Class Embedded Software Development Tools

A compiler tuned for a specific processor architecture automatically produces tight, fast code.

by Jay Gould  
Embedded Partners Program Manager  
Xilinx, Inc.  
[jay.gould@xilinx.com](mailto:jay.gould@xilinx.com)

Xilinx Platform FPGAs introduce a completely flexible and programmable platform for creating custom and upgradeable embedded solutions. However, using high-performance processor cores can be a challenge. To maximize your productivity, you need best-of-class embedded software development tools.

Time-to-market pressures and product differentiation goals often create conflicts with engineering schedules. That's why more companies are moving away from home-grown tool environments and their associated support problems. In this competitive climate, it's usually better for you to use the best, commercially available tools – and focus your engineering resources on unique, value-added product design.

## **Virtex-II PRO Requires Embedded Software Tools**

The term “embedded software tools” most often applies to the tools required to create, edit, compile, link, load, and debug high-level language code (usually C/C++) for execution on a processor engine. The processor could be hard or soft; 8-, 16-, 32-, or 64-bit; high or low performance, and so on, but the basic development flow is generally the same. With Virtex-II PRO™, you can target design modules for either silicon hardware in FPGA logic gates, or as software applications run on processor engines like the embedded IBM PPC405 hard core. Since hardware engineers, software engineers, firmware engineers, system architects, and others may all target the Virtex-II PRO, Xilinx has a “market leader” tools strategy to appeal to these different camps. This strategy also has the added advantage of appealing to the largest installed base of embedded users.



Xilinx could have created new embedded software tools from scratch, (in fact, we employ more software engineers than most “software” companies), but instead Xilinx chose to launch the Virtex-II PRO with “Xilinx versions” of established third-party tools. Therefore you don’t have to embrace completely new development methodologies and you can port existing designs into the Virtex-II PRO fabric. With tens of thousands of engineers already using these tools, using a complementary model is far more constructive than creating a new technology.

For an embedded processor core to run machine code, the algorithm must be entered in an HLL (high level language) such as C or C++ rather than in an HDL (hardware description language). A compiler is used to translate that HLL design into specific (PPC405) binary code that can be executed on that particular processor.

Bad compilers produce poorly optimized, bloated code that takes up a lot of memory and runs slowly. A best-of-class compiler is one which has been tuned for a specific processor architecture and automatically produces tight,

fast code. This saves memory for the design and spares you days of hand-optimizing, trying to manually accelerate your code. For the integration and debugging stages, a software debugger is run on a host computer or workstation, and controls the program execution of the embedded target over a hardware connection probe. With a Virtex-II PRO and the PPC405, this communicates directly with the processor core using a JTAG port.

### Partnering with Wind River Systems

Xilinx worked with Wind River Systems, the market leader in the embedded software industry, to provide a robust set of software tools for targeting the PPC405 in Virtex-II PRO FPGAs. Wind River Systems has a

commanding market share with their broad range of development tools, Real Time Operating Systems (RTOSs), and middleware solutions. A specific Virtex-II PRO version of the Wind River tools (compiler, software debugger, and JTAG run control hardware probe) have been created for Xilinx distribution via an OEM agreement.

The Wind River tools are optimized for the PPC405. The Virtex-II PRO versions of these tools are created with some basic design size limitations so that Xilinx can package a lower-price entry point tool suite through the Xilinx sales channel. You

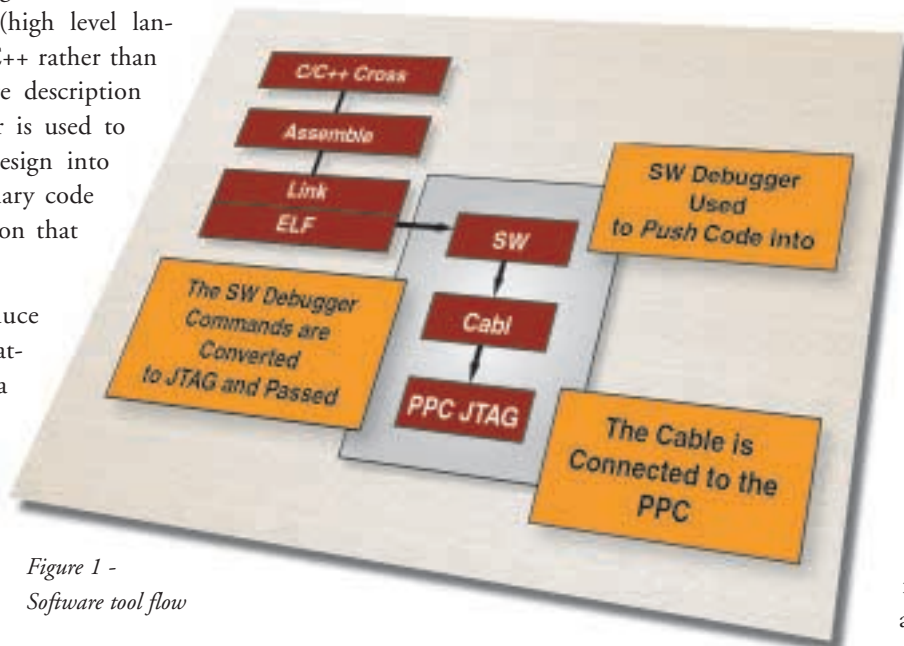


Figure 1 -  
Software tool flow

can buy the unrestricted versions (or upgrades) from the Wind River sales channel. Wind River already supports the PPC405 and will also offer numerous other embedded tools.

Wind River makes numerous tools themselves and have a huge partnership program where third parties build other tools to integrate within the Wind River Tornado IDE (integrated development environment). This opens the market to numerous other software tool suppliers who can specialize in niche areas, providing extra value to end users. Wind River owns multiple Real Time Operating Systems (RTOSs), but their main market focus is on an RTOS product called

VxWorks, which is also the market leader.

The Wind River OEM tools for Virtex-II PRO and PPC405 include:

- Diab XE – compiler
- SingleStep XE – software debugger
- visionPROBE II XE – JTAG run control hardware connection probe

“XE” stands for “Xilinx Edition”.

### Optimized Compilers Provide High-Performance Code

The Diab C/C++ Compiler consistently scores high in the annual market research results for best compilers. The fact that Diab is highly optimized for the PowerPC and has long been a market leader made it a perfect fit for the Virtex-II PRO and embedded PPC405 core.

A compiler turns high level language into machine executable code for a processor. Providing fine grained control of the compiler options, Diab is a full featured product which allows you to balance speed, code size, and memory usage for your applications. At the

front end of the Diab product is a language parser which creates a language-independent representation of your code, and this unleashes the power of the five different back-end optimizer stages of the compiler. Diab provides optimization for global, code selector, code generator, peephole, and instruction scheduler stages as well as supporting architecture-specific features such as the SPRs/DCRs on the IBM 405 processor.

Both the Diab Compiler and the SingleStep Software Debugger are considered “best of class” products in the PPC embedded domain. The Xilinx PowerPC OEM software product is based on these top-of-the-line products.

### Debugging Embedded Software on the Real Target Hardware

SingleStep is a multi-windowed and full featured embedded software debugging tool that is far superior to command line tools. This product is ideally suited for board/hardware development, driver/firmware development, and software application debugging (thus reducing the requirements from two or more possible tools to just one). Software debuggers need to provide basic “run, start, stop” control to debug an embedded system, but SingleStep exceeds these expectations as one of the most feature rich embedded debuggers available.

SingleStep supports real-time target control, high-speed downloads, built-in hardware diagnostics and Flash memory programming. It provides a unique processor-specific register interface to enable configuring and initializing integrated peripherals, and a command line interface with scripting language to automate testing.

This debugger provides superior PPC405 support through hardware breakpoints – including four hardware instruction address, two data instruction address and two data value breakpoints – and a register window. In addition to on-chip trace, SingleStep provides visibility for instruction completion, branch taken, exception taken, data address compare, and other debug events.

### Connect Software Tools to the Embedded Hardware

To download new FPGA images or run the host debug software tools on the real embedded system, visionPROBE II provides a high-speed parallel connection

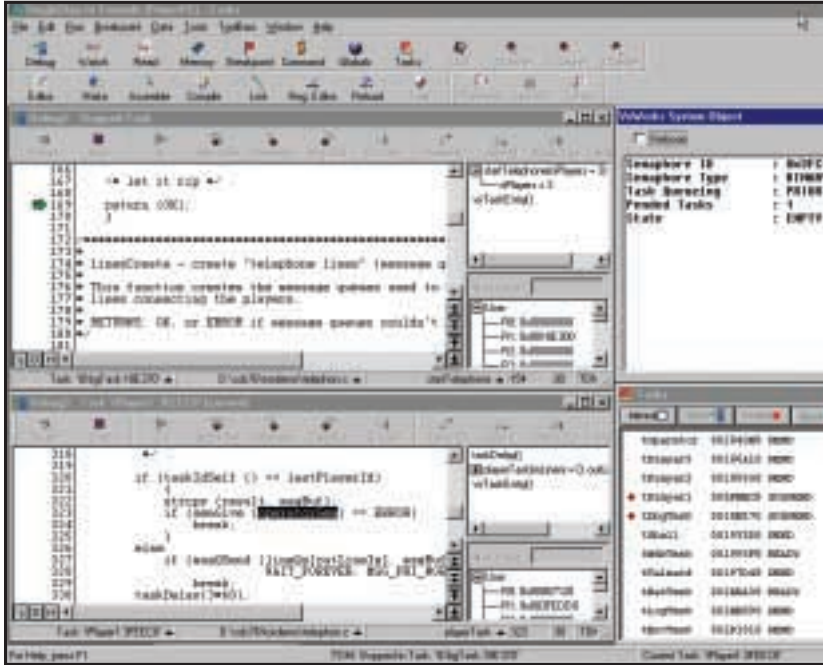


Figure 2 - SingleStep software debugger

between the SingleStep debugger on the host and the Virtex-II PRO target. This product allows JTAG run control of the target for system debugging and, via hardware caching logic, the visionPROBE II can execute high-speed downloads up to 400 KBps.

The probe facilitates register initialization, hardware diagnostics, Flash programming, and hardware breakpoints. Additionally, this one probe allows for FPGA image downloads and ChipScope™ operation on the same target without having to add or change cables.

### RTOS Validation

Xilinx will provide some validation support for Real Time Operating System (RTOS) environments. Depending on the complexity of your application, an embedded system design may or may not require a hard-real-time operating system. If you are experimenting with a gate-consuming protocol or algorithm, some simple C/C++ code targeted for a Xilinx MicroBlaze™ soft processor may be all that is required.

For other more complex applications, which have tight requirements for fast interrupts, maximum uptime and minimum latency, the PPC405 and a robust RTOS may be required.

### Wind River – VxWorks

Due to the close partnership with Wind River, Xilinx will validate that the Virtex-II PRO development boards, and our tools, will work seamlessly with the Wind River VxWorks RTOS. In fact, the entire support of the Virtex-II PRO will be validated in the Wind River environment, including the certification of a Xilinx “Board Support Package”

(BSP) that matches with our reference board. The certification is a formal process that is executed by Wind River and through which they publicly acknowledge a working configuration of our tools, boards, and devices.



### Conclusion

If full programmable embedded system design with the Virtex-II PRO is what you are after, adding the software development flow to your

FPGA logic tools is the next step. Rather than create a new methodology and introduce a new tool suite to a mature market, Xilinx has chosen to partner with the market leader to access the best-of-class tools for the PowerPC. Proven and established tools allow you to focus on adding value to your product design, without learning the nuances of immature or un-optimized tools. Read more about the Xilinx embedded software solutions at: [www.xilinx.com/processor](http://www.xilinx.com/processor)



Figure 3 - visionPROBE II