

Development Kits Accelerate Embedded Design

A single Virtex-4 FX12 Development Kit supports both PowerPC and MicroBlaze processor design.



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Do you always have the best balance of processor, performance, IP, and peripherals on your first embedded application design partition? Would experimenting with customizable IP and a choice of hard- and/or soft-processor cores give you a better feel for the best fit to your embedded application before committing to devices and hardware? Programmable platforms allow powerful customization of processor-based systems, but which one do you start with? Why not utilize a development kit that supports it all?

Ideally, modern development kits provide a comprehensive design environment with everything embedded developers require to create processor-based systems. They should include both the hardware platform and software tools so that you can get started creating modules to prove out a design concept before the time-con-

suming task of building custom hardware. By starting with a “working” hardware platform, embedded teams can evaluate the merits of one processor core versus another, begin writing application code, and even experiment with IP peripherals before prematurely committing to a specific hardware design.

A development kit should provide a stable hardware evaluation environment, complete with all required cables and probes, so that you can focus on your own application and not worry about debugging problems with a new board or broken connection. Imagine the time-to-market advantages of being able to immediately write, test, and debug code on a working reference board well in advance of any custom hardware being ready.

Processor “P” or Processor “M”?

Choosing the most appropriate processor for a specific embedded application is always a design concern. A processor used on a previous project may not be a good fit for the next project. Requirements for performance, features, size, and cost may

change wildly from one product to the next. Having multiple processor core choices and the flexibility to change the design after the development cycle has started is highly desirable.

Xilinx offers system developers the choice of high-performance, “hard” PowerPC™ or flexible “soft” Xilinx® MicroBlaze™ processor cores for embedded designs. The PowerPC cores provide high performance because they are hard-immersed into the Virtex™-4 FPGA device fabric. They also have additional performance-enhancing features, such as integrated 10/100/1000 Mbps Ethernet and Auxiliary Processor Unit (APU) controllers.

The 32-bit RISC MicroBlaze soft IP processor can be instantiated in any of the Xilinx Platform FPGAs because it is built like a macro out of FPGA elements. Although the hard PowerPC processor will always be faster and smaller by nature, the MicroBlaze soft-processor core has the flexibility to instantiate at any time during the design cycle. MicroBlaze cores can also be used as complements to PowerPC cores in Virtex-4 platforms, often provid-

ing workload distribution to optimize total system performance.

With a unified strategy of supporting both processors with the same IP library and design tool suite, you have the power to choose the best processor/IP configuration for any given design requirement. With this scenario, you do not have to throw away good work or start a design over again with different tools or IP libraries just because a processor change has been made.

Best of Both Worlds

The Virtex-4 FX family of FPGAs combines the best of both hard- and soft-processing options with a unique format for the embedded industry. For example, the powerful Virtex-4 FX12 device implemented on the Xilinx ML403 development board (Figure 1) offers an immersed PowerPC core at a value price point. This same device and board can easily support the addition of MicroBlaze soft-processor designs, creating one unique platform supporting two core options.

Engineers researching the appropriate processor choice for their next project can now experiment with a broader set of processor and IP offerings while making their decision. With a single tool suite and IP library supporting both processor options, you can really do an apples-to-apples evaluation of the benefits versus your own design requirements for the best fit.

The ML403 development board provides a rich set of features, including peripherals, memory, audio, video, and user interfaces, enabling you to easily and cost-effectively prototype your embedded system design. The actual board itself includes:

- Memory interfaces for DDR SDRAM, ZBT SRAM, and flash
- Audio and video interfaces
- Numerous user interfaces: dual PS/2, IIC Bus, RS-232, USB, and tri-mode Ethernet
- Multiple FPGA programming modes: Platform Flash, the System ACE™ solution, Linear Flash, and PC4
- Support for multiple clock sources and differential clock inputs

The Virtex-4 FX device also supports an APU controller that provides a high-bandwidth interface between the PowerPC 405 core and co-processors to execute custom instructions in the FPGA fabric. Additionally, the ML403 showcases the FX12 implementation of two fully integrated 10/100/1000 Ethernet MACs for system communication and management functions. These FX capabilities enable developers to optimize their designs for high performance.

Completely Integrated Development Kit

The Xilinx PowerPC and MicroBlaze Development Kit Virtex-4 FX12 Edition integrates a complete environment for embedded development. The kit supports both the PowerPC 405 immersed hard processor and the MicroBlaze soft processor

for Virtex-4 FX12 designs. The kit comprises the following contents (Figure 2):

- Virtex-4 FX12 development board – ML403
- Platform Studio embedded tool suite and Embedded Development Kit (EDK)
- ISE™ (Integrated Software Environment) FPGA tools
- JTAG probe, Ethernet, and serial cables
- ChipScope™ Pro Analyzer (Evaluation Version)
- Reference designs

In addition to the ML403 board, the kit showcases the IEC DesignVision award-winning Xilinx Platform Studio (XPS) embedded tool suite. XPS is the integrated development environment that includes the design GUI, automated configuration wizards, compiler, and debugger. XPS is built on the Eclipse framework and supports the GNU tool chain. Design wizards automate the process of configuring the processor-based system, connect and customize the IP, and organize the project. Additionally, Platform Studio can automatically generate example test code, software drivers, and even BSPs for some of the most popular RTOSs.



Figure 1 – ML403 development board



Figure 2 – Virtex-4 FX12 PPC/MicroBlaze Development Kit

XPS is fully aware of the ML403 development board and, unlike “universal” tools, automatically populates the GUI with the feature options supported by that board. Intelligent tools automate the flow, reduce learning curves, and accelerate the design process. Users are amazed that they can create a basic embedded system using Platform Studio’s automated flow in less than 15 minutes.

EDK bundles the XPS tool suite with the impressive embedded IP library and MicroBlaze processor license. This is a one-time license; there is no royalty to be paid for MicroBlaze designs shipped. The IP library supports the CoreConnect bus, bridge, and arbiters, and offers a large peripheral catalog including more than 60 memory controllers, Ethernet, UARTs, timers, GPIO, DMA, and interrupt controllers, as well as many other cores.

ISE FPGA tools are the design utilities employed for the FPGA implementation, including entry, synthesis, verification, and place and route. This design flow can be invoked directly from the Platform Studio IDE.

Target boards need a connection for the various kinds of communication coming from the host computer where tools are executed and design files created. The most common method of connection to an embedded target board is through an industry-standard JTAG probe. Xilinx offers a choice of either parallel or USB for JTAG probes; this single connection can be used for both FPGA download/debugging and embedded software download/debugging. This capability reduces your need for multiple probes and the inconvenience of constantly swapping probes. The FX12 kit also includes Ethernet and serial cables.

One unique, powerful feature that Xilinx offers is “platform debug” – the integration of the embedded software debugger and hardware debugger. By integrating the cross-triggering of both hardware and software debuggers, embedded engineers can now find and fix system bugs faster. Can’t detect the problem when the software goes off into the weeds? Have the software debugger cross-trigger the hardware debug-

ger so that you can examine the state of the hardware. Alternatively, if you locate a problem after a hardware event, cross-trigger the software debugger to step through the code that is executing at that time. The FX12 kit includes an evaluation version of the Xilinx ChipScope Pro hardware debugging tool to encourage you to explore the merits of platform debug.

Pre-Verified Reference Designs

The last and critical ingredient of the integrated development kit that can really jump-start your entire design process is a collection of reference designs or reference systems. By including pre-verified or pre-existing working example designs with the kit, you can unpack the box and have the basic system up and running in minutes. Reference designs can prove that the hardware and connections are working before you start creating new code or IP, and prevent you from mistakenly debugging your design when what you really have is a bad board or cable.

These reference systems also act as examples for the broad set of features on the ML403 platform, such as Ethernet, DDR memory, video, and audio functions. You can use these examples as templates to get your own design features modeled, or run as-is if your custom board targets the same feature.

The FX12 Development Kit includes boot-able eOS (embedded operating systems) or RTOS examples for Wind River Systems’ VxWorks and MontaVista embedded Linux from a Compact Flash device. The ML403 board is supported by other third-party embedded RTOS or hardware/software design tool partners as well.

Sample reference systems include:

- PowerPC Reference System with VxWorks and Linux
- MicroBlaze Reference System
- DCM Phase Shift Using MicroBlaze Reference System
- UltraController-II Reference Design
- Gigabit System Reference Design (GSRD)
- APU Co-Processing Acceleration

These reference systems can save you days and even months of development time compared to manually generating every design module yourself. Leveraging existing examples jump-starts your design cycle.

Conclusion

A complete development environment of hardware board, design tools, IP, and pre-verified reference designs can dramatically accelerate embedded development. Additionally, for a quick, out-of-the-box experience, the ideal development environment also provides all of the extra JTAG probe, serial, and Ethernet cables. Intelligent, award-winning design tools that are “platform aware” make the kit easy to use, providing wizards that help you configure the system by automating the flow for the known features on the development board.

The programmable platform and intelligent XPS tools provided with the PowerPC and MicroBlaze Development Kit enable you to craft embedded systems with the optimal combination of features, performance, area, and cost. You can choose the most effective processor core for the target application, customize IP, optimize the performance, and validate the software on a development board before your own hardware is even back from the shop.

Engineers need options and flexibility when trying to satisfy all of their project requirements. The Xilinx Virtex-4 FX12 Development Kit uniquely offers two processor cores for easy evaluation in a single, integrated environment. A single IP library and common tool suite unifies the design environment for both cores, providing total embedded architecture flexibility. The inclusion of numerous pre-verified reference designs empowers you to jump-start the development cycle so that you can spend more time adding value to your end application.

To learn more about the low-cost Virtex-4 FX12 Development Kit supporting both PowerPC and MicroBlaze processor cores, please visit www.xilinx.com/embdevkits. A good starting point to learn about all of our embedded processing solutions is www.xilinx.com/processor. 