FPGA & SOC TECHBYTES

July 2022 | Issue 21

Welcome to the July 2022 edition of the FPGA and SoC TechBytes newsletter. Not only do we provide the industry's lowest-power, most reliable and secure FPGAs but we are also committed to supplying FPGAs for extended periods of time, in many cases for over 20 years from their introduction.

In this issue, we have an update on the new VectorBlox™ SDK PolarFire SoC FPGA EAP and the latest information on the latest release of SmartHLS, version 2022.1.1 We have news about our upcoming Mi-V Summit and the FPGA security tools we use in Industry 4.0. Lastly, we'll inform you about our upcoming PolarFire® SoC Smart Embedded Vision (SEV) kit. Please read on to learn more and thank you for choosing us as your FPGA vendor.

Mi-V Virtual Summit Conference 2022

Mi-V VIRTUAL SUMMIT CONFERENCE JULY 20-21 2022 RISC-V

The Mi-V Virtual Summit 2022 is now open for registration. This is an excellent opportunity for you to learn all about our new RISC-V-based SoC FPGA, PolarFire SoC FPGA, and solutions from Microchip and our Mi-V ecosystem partners.

The Mi-V Virtual Summit Conference is a technology showcase of solutions developed by Microchip and our ecosystem partners for RISC-V-based products. The event will consist of keynote speeches covering industry trends in RISC-V, semiconductors, tools and IoT and presentations and demonstrations covering artificial intelligence and imaging solutions, IoT, advanced security, operating systems and RTOS, development tools, hardware and design services.

Attend the Mi-V Virtual Summit live on July 20 and 21, 2022 with an interactive Q&A session; the sessions will also be available for on-demand viewing.

Register now for free.

Mi-V Summit Conference Partners

DIGITAL CORE TECHNOLOGIES QUALITY BY DESIGN
EMDALO TECHNOLOGIES
ENCLUSTRA FPGA SOLUTIONS
Green Hills SOFTWARE
CodeTinker
0x5 HEX-Five® Security
IAR SYSTEMS
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PQSHIELD
SIEMENS
SUNDANCE DSP INC
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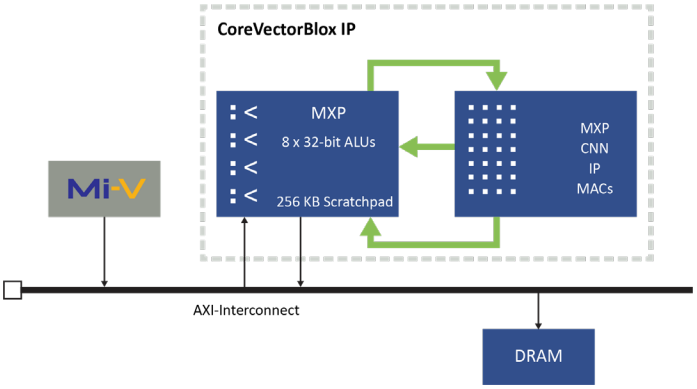
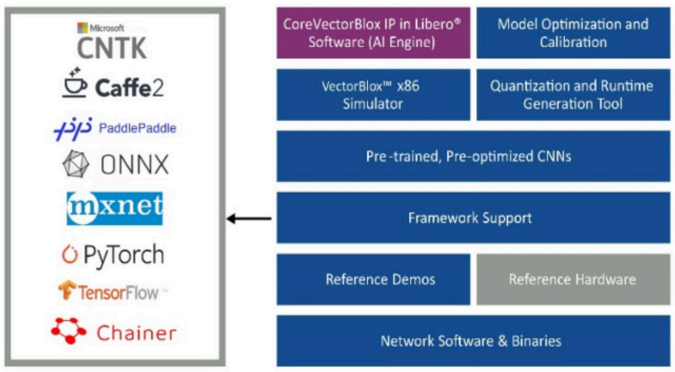
VectorBlox Accelerator SDK for ML Early Access Program (EAP) for PolarFire SoC FPGA



VectorBlox Accelerator Software Development Kit (SDK) for PolarFire FPGAs and PolarFire SoC FPGAs offer 2–3× more power-efficient inference in mid-range FPGAs. It enables machine learning inference in applications that are thermally constrained, operate in battery power or are expected to be in environments that are susceptible against single event upsets, like in low-orbit aerospace.



We will release the EAP for VectorBlox SDK supporting PolarFire SoC FPGAs in two parts. This announcement is related to part one of the release and will support:

- SDK with model optimization and calibration tools to convert CNNs from FP32 to INT8, a bit-accurate simulator and selected pre-trained, pre-optimized CNNs
- Hardware support for Icicle kit running Yocto Linux® that utilizes MSS LPDDR4 and a bare-metal CPU implementation instead of the fabric DDR4 and soft Mi-V microcontroller (MCU) used in earlier releases with PolarFire FPGAs

We will offer part two of the release, which will support fabric DDR4, in December 2022. This release will support the PolarFire SoC video kit.

Please write to vectorblox@microchip.com to be part of the EAP.

Programmable Security for Low-Power Industry 4.0 Applications

Security is a big concern across the medical, industrial, automotive and communications segments. Industries are adopting intelligent networking of machines and processes to optimize processes and flows on connected, smart machines and systems. These systems are susceptible to malicious attacks, unknown software bugs and remoteness that can even cause physical security issues and must be protected from unauthorized access or illicit control.

The newest chapter in industrial development, commonly known as the Fourth Industrial Revolution (or Industry 4.0), establishes a new epoch of innovation and development, but also significantly increases the security vulnerabilities in a smart factory or an automated manufacturing site. Employing a single software-based security approach is insufficient to achieve adequate security levels within the current Industry 4.0 landscape for lack of longevity, programmability, efficient power consumption, form factor and more. Defense-in-depth security mechanisms must be adopted, fortifying hardware with layers of security.

Our PolarFire SoCs and PolarFire FPGAs pave a path for truly flexible and secure systems. Our FPGAs integrate side channel-resistant cryptographic accelerators, including anti-tamper countermeasures to protect customers' intellectual property, and offer a trusted supply chain management to deliver a secure platform for developing secure systems.

Learn more about our secure FPGAs and SoC FPGAs and read an article about programmable security from Electronic Products magazine.

Intelligent Embedded Vision at the Edge with PolarFire SoCs and PolarFire FPGAs

With the ever-burgeoning IoT, an increasing number of commercial and industrial applications are relying on the connected web of sensor-based, digital and mechanical machines to monitor and control tasks. At the core of the IoT are wireless-enabled embedded systems, real-time analytics and machine learning inference. Edge computing demands strict power and footprint budgets with extreme reliability requirements.

Our FPGAs present a cost-optimized and powerful platform for meeting the following edge computing requirements for intelligent vision systems:

1. Power efficiency with two times more performance per watt
2. Smaller form-factors as small as 11 × 11 mm
3. Exceptional reliability with zero configuration upsets
4. Military-grade security with cyber and anti-tamper security

Our PolarFire SoCs and PolarFire FPGAs integrate camera sensor interfaces like MIPI® and SLVS, an image signal processing unit and transport interfaces like CoaXPress®, HDMI®, 10 GigE vision, SDI and wireless connectivity. They suit embedded vision and deep learning inference applications and they can seamlessly support and integrate diverse protocols and interfaces with minimal developer effort as part of a total system solution.

Our VectorBlox accelerator SDK for PolarFire FPGAs includes video, imaging and machine learning IP plus the tools for accelerating designs that require high performance in low-power, small form-factors.

Coming Soon, Stay Tuned

The PolarFire SoC Smart Embedded Vision development platform is our latest addition to our diverse portfolio of secure, reliable and power-efficient vision solutions.

The development platform is a full-featured RISC-V SoC FPGA kit that supports dual 4K MIPI CSI-2 cameras, HDMI 2.0 with FMC-based expansion towards CoaXPress 2.0, 6/12G SDI, 1/2.5/5 10G USXGMII and USB 3.1 Gen 1 and Gen 2 protocols. It also includes a USB 2.0, SD™ card, eMMC, PCIe® Gen 2×4 endpoint or root port and a mikroBUS™ connector that facilitates our Trust&GO platform for cloud connectivity.

Learn more about our PolarFire SoC video kit.

SmartHLS v2022.1.1 Release

Join us in evaluating the SmartHLS SoC flow that targets PolarFire SoC FPGAs, which is now available through the Early Access Program (EAP).

We released version 2022.1.1 of the SmartHLS design suite on June 16, 2022. It is now available on our SmartHLS compiler web page. Starting with this release, we are supporting SoC embedded acceleration flow for PolarFire SoC FPGAs. We're offering this flow through an EAP. We will enable this flow only for customers in the program. If you would like to take advantage of the SmartHLS SoC flow, send an email to SmartHLS@microchip.com.

Version 2022.1.1 of SmartHLS includes

- Generation of software drivers capable of controlling SmartHLS accelerators from the application processor in the SoC design
- Generation of a reference SoC design implementing the user's code that targets the PolarFire SoC Icicle Kit
- Automatic programming and cross-compiling user software for a generated SoC design (or a base SoC project) to an attached icicle kit
- Direct support for AXI4Target and AXI4Initiator interface types
- Support for multiple top-level functions which generates multiple accelerator IPs within one SmartHLS project
  - A separate accelerator IP will be generated for each function marked with #pragma HLS function top (see this article on setting custom top-level functions)
- Support for linking software libraries that you can use in a software testbench in SW/HW co-simulation or host software running on RISC-V processor

For more additional details on the features and enhancements contained in this release, refer the release notes.

PolarFire SoC FPGA Icicle Kit Now Supports GNOME OS

Customers often require support to bring up new boards and architectures on Linux. The specialty of our Mi-V ecosystem partner Codethink is board bring-up and they perform work around Board Support Packages (BSPs), often for upcoming prototypes and commercial hardware.

GNU Network Object Model Environment (GNOME) Operating System (OS) is a free and open-source desktop environment for Linux operating systems that makes Linux operating systems easy to use for non-programmers.

Codethink helps our clients apply open-source best practices for commercial devices and the company provides Linux kernel and BSP assistance to device manufacturers and platform providers. Their work includes kernel configuration

and tuning, driver development, tools development, back/forward porting of changes and upstreaming and BSP updates and long-term production lifetime maintenance.

Their strong interest in the future of Free and Open Source Software (FOSS) technologies and RISC-V in general led them to direct their research and development budget towards supporting GNOME OS on our PolarFire SoC FPGA boards as a first step in their involvement in the Mi-V ecosystem.

If you want to try this work yourself, you can check the step-by-step guide.

Using GNOME OS to leverage Freedesktop Software Development Kit (SDK) simplifies the process of creating an SD™ card image by merging the PolarFire FPGA BSP and RISC-V-based root file system with GNOME OS to produce this Proof of Concept (PoC).

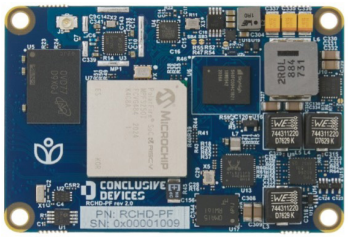
If you need assistance in porting GNOME OS on PolarFire SoC FPGA, get in touch with Codethink.

Industrial Control Systems (ICSs) and Operational Technology (OT) Supervising System on the Palm of Your Hand

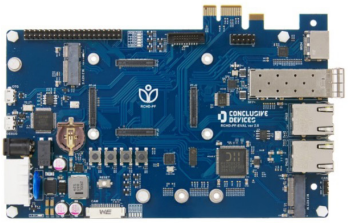
ICS and OT are often forced to make concessions regarding security and updates to deliver critical functionality without interruptions. Keeping them secure, bug free and failure resistant is no easy feat. Fortunately, thanks to their advancements in secure and efficient System-on-Chip (SoC) design, Conclusive Engineering developed a small form-factor device dedicated to the task: the Orchid family RCHD-PF System on Module featuring the PolarFire SoC FPGA that integrates a real-time and Linux-capable RISC-V processor with the PolarFire FPGA fabric in a single, secure, tamper-proof package.

Smarter Reliability Thanks to Hardware Supervisors

Conclusive Engineering has been pondering a smarter solution: a device capable of becoming a supervisor of existing systems and a remote terminal unit or a fully featured SCADA node capable of performing various tasks as a power-efficient edge compute module with a low thermal footprint.



RCHD-PF SoM



RCHD-PF-EVAL Evaluation Board

The result of their work is RCHD-PF, a diminutive System-on-Module (SoM) designed with OT and transportation applications in mind. Its intended use is the debugging of constantly online systems that feature machine computer interfaces, the debugging log collection, analog data processing, the matching of system events to analog outputs of the steering system and its sensor readouts. However, due to the device's processing power, it can also work both as a debugger, a supervising system, a remote terminal unit, visual processing unit, or a multipurpose node, and depending on workload, it can perform several of those tasks at once.

The security of such operation is possible via application domain separation. Since Conclusive Engineering provides full-stack embedded custom turnkey solutions, this board comes with a huge variety of software, including bare metal, FreeBSD, Linux-based operating systems, seL4, Zephyr, FreeRTOS and other operating systems with necessary kernel and driver modifications to make the system excel in its intended application. Additionally, the board's security is outstanding—it can work in environments directly accessible by an adversary and is safe against code tampering or extraction of secrets. It's especially important in cases of legacy systems; properly designed tests running on RCHD-PF can detect misbehavior of the supervised system to detect and prevent the consequences of execution of a compromised code. To increase its security, it can be fully air gapped from the supervised system, making sure that no write access is possible to the SoM. The swappable nature of the SoM can provide in-place upgrades of OT equipment and quick rollback without exceeding allowed downtime that is often measured in minutes on a monthly or a yearly basis.

RCHD-PF supports a whole range of our PolarFire SoCs that utilize the FCVG484 socket, delivering FPGA variants up to 254K LUTs. The FPGA is capable of machine vision and up to dual 4K video processing. The on-board RISC-V processor is working at 667 MHz, delivering around 2030 CoreMark® performance and being up to 55% more efficient than the nearest comparable non-RISC-V solution. The SoC has the typical tamper-proofing of the PolarFire FPGA family, including differential power analysis and Physically Unclonable Functions (PUFs), that make the properly configured SoC impervious to the most sophisticated and costly tampering attempts from a well-equipped adversary.

Feel free to contact Conclusive Engineering for more information on their website or Linkedin page.

Compact and High-Performance TySOM-M Embedded Development Board Based on PolarFire SoC FPGA Devices.

With the increasing adoption of RISC-V cores into a wide range of applications that require low power and high security, having a high-performance and versatile FPGA development platform with hardened RISC-V cores is highly critical. Aldec, an EDA pioneer and a member of our Mi-V ecosystem, has developed and produced TySOM-M, a Linux®-capable multi-core RISC-V-based platform featuring the PolarFire SoC FPGA MPFS250T-FCG1152 device. The board includes multiple peripherals with dual-FMC connectivity to support various applications without having to develop custom hardware.

This compact board (144 mm × 100 mm) is suited for the development/prototyping of secure and power-efficient designs targeting Software Defined Radio (SDR), Machine Learning (ML), Internet of Things (IoT), industrial automation, automotive, aerospace and defense, wireless access networks and cellular infrastructure.

The Board Support Package (BSP) includes reference designs, an MSS configuration, an HSS configuration, an Aldec meta layer for Yocto Project and a bare-metal application, all of which can be used to build a custom design.

Chipset/SoC

- PolarFire SoC MPFS250T-FCG1152
- Multi-core RISC-V processor
- SiFive E51 Monitor core (1 × RV64IMAC)
- SiFive U54 application cores (4 × RV64GC)
- FPGA: 254K logic cells, 17.6 Mb RAM

Memory

- 16 Gb FPGA DDR4 ×32
- 16 Gb MSS DDR4 ×36 with ECC
- 64 Kb EEPROM
- microSD™ socket
- SPI Flash memory
- eMMC

Interfaces

- 2× Ethernet
- 1× USB 2.0
- USB to UART
- HDMI OUT
- PCIe ×4 Gen 2 root
- CAN
- PMOD connector
- 2× FMC connector (HPC, LPC) Vita 57.1 compliant
- 4× user dip switches
- 4× user LEDs
- Temperature and accelerometer sensor
- Current and voltage monitor