Advancements in FPGAs and Development Boards Look to Accelerate Time-To-Market

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To evaluate a device and develop an application, field programmable gate array (FPGA) based development or evaluation boards are a great platform. From engineers and hobbyists who want to start with FPGAs to professionals looking for mid- or high-end boards for their prototyping and designing needs, there is a plethora of products out there.

In today's market, the changing system-level requirements crop the need for device-level changes. Hence, the addition of new features to evaluation and development boards have become a necessity, feels Sachin Gupta, product marketing engineer, SoC product-line marketing, Microsemi. He says, "Given the current scenario, where cyber weapons are trying to break into embedded designs more aggressively, the challenges set before us to countermeasure and protect data and designs from these attacks are higher than ever."

He adds, "Other traditional security concerns are protection of design from

Latest FPGA Developments Boards, SoC Kits and Modules in the Market

Company	Product	Features
Avnet	Artix-7 50T FPGA Evaluation Kit 	• Customisable development kit perfect for embedded designers looking for a flexible, low-power platform • Packages features like 256MB DDR3 SDRAM, 32MB of QSPI flash, 32KB of I2C EEPROM, dual 10/100 Ethernet interfaces, six Digilent compatible Pmod interfaces enabling 48 user I/O pins • Solution for designers interested in exploring MicroBlaze soft processor or Artix-7 FPGAs in general
BittWare	A10PL4 	• Arria 10 GT/GX low-profile PCIe board with dual QSFP and DDR4 • Features Altera Arria 10 GT/GX FPGA, PCIe x8 interface supporting Gen1, Gen2 or Gen3, dual QSFP cages for 2x 100GigE, 2x 40GigE, or 8x 10GigE and memory up to 32GB of DDR4 SDRAM with ECC (x72) • Configuration via protocol (CvP) supported
BittWare	Block diagram A10P3S 	• Arria 10 GT/GX/SX 3/4-length PCIe board with quad QSFP, DDR4 and QDR-IV • Features Altera Arria 10 GT/GX/SX FPGA and SoC, PCIe x8 interface supporting Gen1, Gen2 or Gen3, four QSFP cages for 4x 100GigE, 4x 40GigE, or 16x 10GigE and board management controller for intelligent platform management
Embest	Lark Board 	• Based on Altera's Cyclone V SoC, Lark Board is designed for development of high-volume applications including automotive, medical equipment, video surveillance and industrial control • Features a 5CSXFC6D6 SoC FPGA, 1GB DDR3 SDRAM to each of the HPS and FPGA as well as 4GB eMMC flash, Transflash card slot for mass storage, several standard I/O interfaces including PCI Express, Gigabit Ethernet, USB2.0 Host ports, UART, JTAG and 3G SDI
Pro Design	Zynq XC7Z045 	• Combines a user FPGA with an ARM core processor (dual ARM Cortex-A9 MPCore with CoreSight) and several onboard peripherals such as USB 2.0 OTG, gigabit Ethernet or ARM JTAG debug • Includes 1GB onboard DDR3 and dual quad-SPI flash memory • Allows maximum point-to-point speed of up to 1.2Gbit/s over the standard FPGA I/O and up to 12.5Gbit/s over high-speed serial transceivers
Scarab Hardware	miniSpartan6+ 	• Features Spartan6 LX9 FPGA from Xilinx, an onboard USB JTAG programmer to power and program the FPGA with any open source programmer, like the one inside Scarab IDE • Also includes an onboard USB interface that powers the board and allows communication with the PC at speeds up to 480Mbps, HDMI port, 8-channel analogue-to-digital converter running at 1MSPS with 8-bit resolution and memory of 32MB of SDRAM, 64Mbit of SPI flash and a microSD card interface
Terasic	SoCKit development kit 	• Built around Altera Cyclone V SoC FPGA, which combines the latest Cortex-A9 embedded cores • Includes hardware such as high-speed DDR3 memory, video and audio capabilities, Ethernet networking and an onboard HSMC connector with high-speed transceivers, which allows for an even greater array of hardware setups

theft, cloning and over-building, to name a few."

Let us take a look at the advancements and additions, which are not only making today's FPGA development boards cost-effective and powerful, but also flexible to work with.

Advancements in FPGA based systems

FPGA platforms are currently being used for high-performance cloud computing, network processing, signal processing, low-latency and data acquisition applications. Dhiraj Kumar, director, Systems Engineering, Argus Technologies, says, "The adaptation of advanced process technologies (15nm) by FPGA vendors has resulted in the launch of Virtex UltraScale, Arria 10 and Stratix 10 products that support a multi-node portfolio to address a wide set of applications on FPGA platforms."

He adds, "Further advances in FPGA architecture and Session Initiation Protocol (SIP) technology are able to address device-level input and output (I/O) bottlenecks and optimisation of sequential applications to offer platform-level integration of heterogeneous technologies with remarkable speed-ups."

FPGA providers are keen on achieving higher road maps in a shorter time period. At a utilisation rate of 60 per cent, single FPGA devices can hold up to 20 million application-specific integrated circuit (ASIC) gates, informs Sudharsan Palanikumar, senior analyst, Femto Logic Design Pvt Ltd. He says, "The key advantage of an FPGA based system is that it can achieve higher speeds without any hassles."

He adds, "The new era of FPGA systems can hold up to 100 million gates that help bring down the size of a larger application considerably."

Today's FPGA boards are also increasingly focused on high-speed communication infrastructure such as multi-gigabit serial transceivers, integrated computing and digital signal processing (DSP) resources to cater to the growing communication, medical and aerospace markets, informs Anoop Jose, manager - research and development, Numato Systems Pvt Ltd. He says, "This change is very visible in the new FPGA offerings from various leading companies. Some top-of-the-series devices offer serial bandwidth in excess of 5Tb/s."

He adds, "A large number of FPGAs offer integrated PowerPC/ARM hard processor units and a large array of DSP slices to cater for the ever-growing demand for signal processing and communication." Although, a fair amount of development boards are slowly showing up in the market. These facilitate easy FPGA based solution development using the above-mentioned technologies.

Current FPGA platforms are able to offer much better performance than some of the fastest graphics cards available today, addressing central processing unit (CPU)/graphics processing unit (GPU) markets as well, informs Kumar. He says, "High-end FPGAs are playing a dominating role in military and aerospace communications infrastructure and advanced radar applications."

Additions in FPGA developments boards

With over 15 years of experience of creating FPGA based development boards, Avnet had introduced their Mini-Module series designed as a systems on module (SoM) more than ten years ago. It allowed an engineer to simply use the development board as part of the final product.

A few years ago, Xilinx introduced Zynq-7000, an all-programmable system on chip (SoC), which was a hybrid chip having both a processing system as well as FPGA programmable logic, informs Bryan Fletcher, global technical marketing director, Avnet Electronics Marketing. He says, "With the added sophistication of this device, we recognised that many engineers would appreciate having a Zynq based SoM that could easily be adopted into their systems."

Adding to that, Fletcher says, "Currently, we have four Zynq based SoM product families, which will enable companies to reduce risk and increase their time-to-market."

Another addition features new SoC FPGAs, that is, FPGAs with hard processors built-in. "While these are

Developments in pipeline for the future

"Altera is working on development kits based on Stratix 10—a new family of 14nm FPGAs built on FinFET technology with integrated ARM A53 hardened quad-cores."

—Natarajan M.M., vice president for South Asia of Arrow Asia-Pacific components business

"Xilinx has developed their latest FPGA families, UltraScale 16nm and 20nm. Avnet is actively working with this new silicon technology, and we are excited to introduce these new products based on this technology in the near future."

—Bryan Fletcher, global technical marketing director, Avnet Electronics Marketing

"Our exclusive manufacturing partnership with Intel opens up avenues for innovations and enables us to provide a greater degree of integration. With multi-die 3D integration of static random access memory (SRAM), dynamic random access memory (DRAM) and ASICs in our generation 10 portfolio, capabilities and options are endless."

—Prasad Reddy, FAE manager, South Asia Pacific, Altera

"Quad Small Form Factor Pluggable+ (QSFP) interface and VPX (an American National Standards Institute standard) would be incorporated in future products."

—Bailey Hsu, director - Marketing Division, Terasic

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SoCs, FPGAs and the need for SoC based FPGAs

There is a great saying, "Advancement in recent trends would not halt for any man." Difficulties in fabricating integrated circuits (ICs) for FPGA based prototyping boards have become more complex due to size, in which porting 100 million ASIC gates takes months and also needs several programmable devices. Keeping all hurdles apart, FPGA providers are keen on delivering higher-grade FPGAs in terms of capacity and I/Os.

In a parallel track, SoC projects are growing much faster. Adding an extra grade of complexity to the system, processor sub-systems in SoC designs are developed using virtual platforms, which gives developers/customers the option to switch between various processor configurations based on the end user requirement. From a designer's perspective, complexities in developing these systems are tricky. When such systems are sent for verification, it takes enormous time and engineering resources (hardware and software tools). In certain cases, modular-verification methods fail abruptly for larger design files and sophisticated design constraints.

As we see it, the need for developing independent sub-systems for the Internet of Things (IoT) architecture demands pure SoC based FPGAs for fixed general-purpose control sub-systems and data-acquisition sub-systems. There is always a recognisable demand for FPGA based prototypes systems, but the time-to-market makes these a secondary choice by developers. In complex sub-systems, the design demands careful portioning and timing optimisation steps, where FPGA based prototypes take a much longer time to become available until silicon is back.

The debugging feasibility into the hardware is quite a tough task when compared with simulation and software based emulation. In such cases, hardware probes can be inserted, which, in turn, reduces the speed grade of the system. Hence, FPGA based prototypes have come to the limelight by adoption at the final stages of development, during which register-transfer level (RTL) has already been verified and deemed stable.

—Contributed by Sudharsan Palanikumar, senior analyst, Femto Logic Design Pvt Ltd

> The new era of FPGA systems can hold up to 100 million gates that help us to bring a larger application into a handful size of device

really cool, these are also fairly complicated to work with and definitely not a recommended starting point for beginners. These are great because FPGAs and processors are generally good at things the other is bad at," says Justin Rajewski, CEO, Embedded Micro. So, having both can be helpful.

He adds, "Beginners can experiment with our Mojo board, where they get to program the Arduino (ATmega32U4) and the FPGA (XC6SLX9), as it aims to simplify getting started with FPGA and digital designing."

Talking from Terasic's point of view, Bailey Hsu, director - marketing division, Terasic, notes, "Latest improvements in our FPGA based development boards are covered in two different directions. One is smaller in size but performs faster, which can be seen in DE5-Net kits scheduled to be available around the third quarter of 2015. Other is cheaper but more versatile displayed in DE0-Nano-SoC boards."

He adds, "We are currently developing platforms with VPX and high-frequency trading (HFT) and will focus more on these two fields in future."

Altera too offers more solution-centric development boards for applications from audio/video, military solutions, 40G/100G applications, to name a few, informs Prasad Reddy, FAE manager, South Asia Pacific, Altera. He says, "With the addition of high-speed mezzanine card (HSMC) connectors, designers can leverage pluggable solution-specific daughter cards from both Altera and our partners to address specific solution needs."

Although this is not a new area, there have been significant additions with respect to the compatibility of expansion boards with FPGA and SoC based development boards. Natarajan M.M., vice president for South Asia of Arrow Asia-Pacific components business, says, "The new-generation FPGA boards are equipped with HSMC/FPGA mezzanine card (FMC) connectors, allowing add-on kits from third-party boards to be plugged on base boards designed on FPGAs."

On similar lines, Fletcher says, "Two expansion standards that we have seen the most are FMC and Digilent-compatible peripheral module (Pmod). An FMC has many I/Os than Pmod, which means, it has the ability to contain much more circuitry."

He adds, "Pmods are smaller and lower in cost. We have even adapted Pmod standard to pass high-speed differential signals for embedded touch displays."

FPGAs fuelling faster time-to-market, high-priority applications

Adding support for various configurations of external daughter cards, network processing and industrial control modules have enabled users to use a common platform for applications having varied signal acquisition, interfacing and performance targets. With reusability being a much sought-after requirement today, supporting the use of a common FPGA based prototyping environment for different designs has significant cost and time-to-market advantages.

Kumar says, "FPGA with DSP features is another area that is enabling applications requiring comprehensive signal processing."

He adds, "Integration of configurable SoC blocks to FPGA architecture is another area that has resulted in quick turnaround of prototyping complex systems and sub-systems in an FPGA."

Kumar informs, "Though low-power FPGA architectures are enabling handheld applications such as mobile computing and wearable medical electronics, the industry expects better performance and power ratio than available today to really tap into this market." He adds, "High-performance FPGA architecture from Xilinx/Altera,

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on the other hand, is driving data centres and cloud computing applications."

Today's FPGAs are employed in diverse fields

FPGA support on open source, embedded Linux platforms is driving new applications that were earlier developed using microcontrollers (MCUs) or network processor based solutions instead of FPGAs, feels Kumar. He says, "Since today's FPGAs are capable of integrating complex SoCs with highly concurrent, heterogeneous computing and stringent time constraints, FPGA tools and methods to support these applications are equally critical."

FPGA solutions are increasingly used in a variety of industries including automotive, broadcast, compute and storage, consumer, industrial, medical, military, test and measurement and wireless. Each of these market segments has specific needs in terms of product complexity, performance and power, informs Reddy. He says, "Altera has taken its approach of providing a tailored solution to different markets to the next level and rolled out Generation 10 product portfolio to address the needs of different market segments."

In every quarter, millions of FPGA devices are shipped out of factories for software-development applications and sub-system validation/s. Palanikumar says, "You can also see that developers are interested to choose FPGAs to design their prototypes of pre-silicon deliverables due to their moderate portability in nature. These are chosen for this prototyping objective for their ease-of-integration methods in software development processes for demonstration."