UltraSCALE⁺

16nm Technology and Portfolio Announcement Backgrounder

Introduction

Building on the success of Xilinx's 20nm UltraScale™ family, Xilinx has introduced the new 16nm UltraScale+™ family of FPGAs, 3D ICs and MPSoCs, combining new memory, 3D-on-3D and multi-processing SoC (MPSoC) technologies, delivering a generation ahead of value. In addition, to enable an even higher level of performance and integration, the UltraScale+ family also includes a new interconnect optimization technology, SmartConnect. These devices extend Xilinx's UltraScale portfolio - now spanning 20nm and 16nm FPGA, SoC and 3D IC devices - and leverage a significant boost in performance/watt from TSMC's 16FF+ FinFET 3D transistors. Because the family is built on the proven 20nm UltraScale architecture, Vivado® design tools, and 16nm FF+ technology from the #1 service foundry in the world, TSMC, Xilinx provides both the lowest risk and the highest value FinFET based programmable technology.

Optimized at the system level, UltraScale+ delivers value far beyond a traditional process node migration; providing 2–5X greater system level performance-per-watt over 28nm devices, far more systems integration and intelligence, and the highest level of security and safety.

The newly extended Xilinx UltraScale+ FPGA portfolio is comprised of Xilinx's market leading Kintex® UltraScale+ FPGA and Virtex® UltraScale+ FPGA and 3D IC families, while the Zynq® UltraScale+ family includes the industry's first all programmable MPSoCs. With this portfolio, Xilinx addresses a broad range of next generation applications, including LTE Advanced and early 5G wireless, terabit wired communications, automotive ADAS, and industrial Internet-of-Things (IoT) applications.

UltraScale+ FPGAs & 3D ICs

Xilinx has chosen the industry's highest performance 16nm FinFET+ technology and partnered with the number one service foundry in the world, TSMC, that is on track to deliver over 50 tape-outs of 16nm FF+ in 2015. Based on the FinFET to planar improvements alone, UltraScale+ FPGA-based systems can see a 2X increase in system performance/watt.

UltraScale+ products attack the number one bottleneck for processing-intensive functions, which is the memory interface. These new memory enhanced programmable devices include UltraRAM, delivering up to 432Mb of capacity. UltraRAM provides optimal system power, flexibility and predictable performance while also replacing external memory allowing for total system BOM cost reduction. Typical designs will see at least a 25% improvement in system performance / watt from the use of UltraRAM while memory intensive designs could see far higher levels of performance, power and BOM cost savings.

Xilinx has developed the next advancement in tool driven interconnect optimization technology designed specifically for FPGAs, SmartConnect. This technology attacks the IP interconnect bottleneck at the system level by automatically optimizing the interconnect for the specific design's requirements around throughput, latency, and area while providing the optimal performance/watt. SmartConnect also intelligently bridges different interface types to match the interconnect to the specific application requirements. This technology alone provides a system level 20-30% increase in performance per watt and area savings.

The high end of the UltraScale+ portfolio leverages the combined power of 3D transistors and the third generation of Xilinx 3D ICs. Just as FinFETs enable a non-linear improvement in performance/watt over planar transistors, 3D ICs enable a non-linear improvement in system integration and bandwidth/watt over monolithic devices.

UltraSCALE™ — New at 20nm

Security
- AES-GCM Mode
- Greater Key Protection
- New Authentication Schemes

Next Gen SSI Technology
- Virtual Monolithic Die

Block RAM
- Hardened Data Cascading
- Improved Power
- Improved Performance

DSP
- Floating Point Optimizations
- Fixed Point Optimizations

Transceivers
- 16G and 28G Backplane
- 32.75G Chip-to-chip
- Fractional PLL (16nm)

Enhanced at 16nm

DDR4
- 2,400 Mb/s (20nm)
- 2,666 Mb/s (16nm)

Enhanced at 16nm

Integrated Packet Processing
- 100G Ethernet MAC with RS-FEC
- 150G Interlaken

Enhanced at 16nm

UltraSCALE⁺™ — New at 16nm

I/O Interfacing
- High-density I/O
- MIPI D-PHY

UltraRAM
- Massive Capacity for SRAM Replacement

PCI Express®
- Gen3 x 16
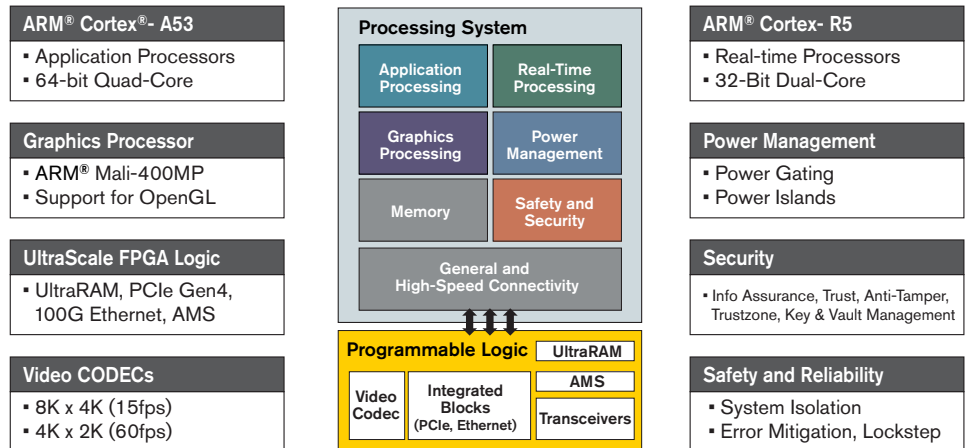- Gen4 x 8

XILINX

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Zynq UltraScale+ MPSoCs

Xilinx is introducing another industry first in the area of heterogeneous MPSoCs, with the All Programmable UltraScale MPSoC architecture. The UltraScale MPSoC architecture provides processor scalability from 32 to 64 bits with support for virtualization, a combination of soft and hard engines for real time control, graphics/video processing, waveform and packet processing combined with the next generation interconnect and memory, advanced power management, and technology enhancements that deliver multi-level security, safety and reliability. These new architectural elements are coupled with the Vivado® Design Suite and abstract design environments to greatly simplify programming and increase productivity.

The new Zynq UltraScale+ MPSoCs deploy all of the UltraScale+ FPGA technologies mentioned above in addition to providing unprecedented level of heterogeneous multi-processing, deploying the 'the right engines for the right tasks'. These new devices deliver approximately 5X system level performance/watt relative to previous alternatives. At the center of the processing-subsystem is the 64-bit quad-core ARM® Cortex®-A53 processor, capable of hardware virtualization, asymmetric processing, and full ARM® TrustZone® support.

The processing sub-system also includes a dual core ARM Cortex-R5 real-time processor for deterministic operation, ensuring responsiveness, high throughput, and low latency for the highest levels of safety and reliability. A separate security unit enables military-class security solutions such as secure boot, key and vault management, and anti-tamper capabilities—standard requirements for machine-to-machine communication and industrial IoT applications.

For complete graphics acceleration and video compression/decompression, the new device incorporates an ARM® Mali™-400MP dedicated graphics processor as well as a H.265 video codec unit, combined with support for Displayport, MIPI D-PHY and HDMI. Finally, a dedicated platform and power management unit (PMU) has been added that supports system monitoring, system management and dynamic power gating of each of the processing engines.

ARM® Cortex®- A53
- Application Processors
- 64-bit Quad-Core

Graphics Processor
- ARM® Mali-400MP
- Support for OpenGL

UltraScale FPGA Logic
- UltraRAM, PCIe Gen4, 100G Ethernet, AMS

Video CODECs
- 8K x 4K (15fps)
- 4K x 2K (60fps)

Processing System

Application Processing	Real-Time Processing
Graphics Processing	Power Management
Memory	Safety and Security

General and High-Speed Connectivity

Programmable Logic | UltraRAM
Video Codec | Integrated Blocks (PCIe, Ethernet) | AMS | Transceivers

ARM® Cortex- R5
- Real-time Processors
- 32-Bit Dual-Core

Power Management
- Power Gating
- Power Islands

Security
- Info Assurance, Trust, Anti-Tamper, Trustzone, Key & Vault Management

Safety and Reliability
- System Isolation
- Error Mitigation, Lockstep

Conclusion

The new 16nm UltraScale+ family of FPGAs, 3D ICs and MPSoCs combines new memory, 3D-on-3D and multi-processing SoC (MPSoC) technologies to deliver a generation ahead of value. Because the family is built on the proven 20nm UltraScale architecture, Vivado design tools, and 16nm FF+ technology from the number one service foundry in the world, TSMC, Xilinx provides both the lowest risk and the highest value FinFET based programmable technology.

To learn more visit www.xilinx.com/ultrascale.

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