ENABLING REAL-TIME NETWORKING,
ENERGY-EFFICIENT MOTORS, AND
EMBEDDED PROCESS INTEGRATION
USING XILINX FPGAS AND ZYNQ AP SOCS

XILINX INDUSTRIAL AUTOMATION SOLUTIONS

Industrial Automation Challenges

- High energy costs are driving up demand for power conservation intelligence for automation systems

- Complex computations are exceeding the performance of typical processors, DSPs, and ASICs

- Changing connectivity standards and industrial networking models require flexible interfacing

- Machine Vision requires real time processing power and bandwidth for increasing resolution images at high frame rate

- Functional Safety standard IEC61508 is becoming a stringent design practice in Industrial Systems

Xilinx Solutions

- High-performance, high-capacity devices that boost integration and lower BOM costs

- Power of programmability, to protect investments, enable rapid prototyping, and streamline enhancements after deployment

- All Programmable SoCs, combining FPGA and ARM® processing system in a single low-cost, high-performance foundation for complex tasks

- State-of-the-art IP and system-level designs

- Design tool suite, development platforms, and partner ecosystem solutions to shorten time to deployment

Today's highly automated industrial processes are increasingly impacted or restricted by the high cost of energy, the computational limitations of traditional designs, inadequate connectivity options, and network bandwidth. Industrial engineers need a more flexible development infrastructure, with the ability to build in more functions, higher processing speeds, and versatile, high-performance interfaces—while also reducing costs.

Xilinx offers engineers advanced programmable devices with performance and levels of integration that go well beyond typical microprocessors, DSPs, and ASICs for industrial applications. The processing power and versatility of Xilinx FPGAs and All Programmable SoCs overcome previous limitations to meet the requirements of current and future machine vision, industrial networking, motor control, and other emerging applications such as Human Machine Interface and safety monitoring solutions. Designs can be quickly adapted to evolving standards and processing requirements, for refining analysis capabilities to keep pace with market requirements, and to add features and functions long after initial deployment.

XILINX DEVICE FAMILIES FOR INDUSTRIAL AUTOMATION

DEVICE	FEATURES	APPLICATIONS
Spartan®-6 FPGAs	• Low-cost and high-performance • Flexible I/O standards for improved connectivity • Hardened memory controller, system monitor, DSP, RAMs	• Industrial Networking • Motor Control • Machine Vision • Safety (machine and process monitoring)
Zynq™-7000 All Programmable SoCs	• Highly integrated, single-chip platform: FPGA logic plus ARM dual-core Cortex™-A9 MPCore™ processing system with AMBA AXI4 interfaces • Integrated NEON™ single/double-precision floating-point processor (800MHz); ADS feature, timer, interrupt controller • Hardened memory controller • Integrated peripherals: CAN, USB, Tri-mode Gigabit Ethernet, SD-SDIO, UARTs, analog-to-digital converters and more • Open Source Linux and industry-standard software programming environment	• Machine Vision • Embedded Processing Platform • Motion Control • Programmable Logic Controller (PLC) • Human Machine Interface (HMI)

⟨ XILINX®

Innovation Enablers for Industrial Automation

Motor Control

Motors account for more than 66% of the electrical power consumed at industrial sites. Xilinx FPGAs give designers the processing power required for Field Oriented Control (FOC) and other algorithms that can boost motor efficiency. In addition to driving up performance, Xilinx Zynq-7000 devices can also lower motor control costs with greater on-chip integration of system components and DSP capabilities, high reliability, and ease of solution customization using familiar software programming constructs. The tight coupling of the processing system and programmable logic delivers high bandwidth and low latency, which enable the single device to support motor control as well as real-time networking interfaces.

SINGLE-CHIP MOTOR CONTROL
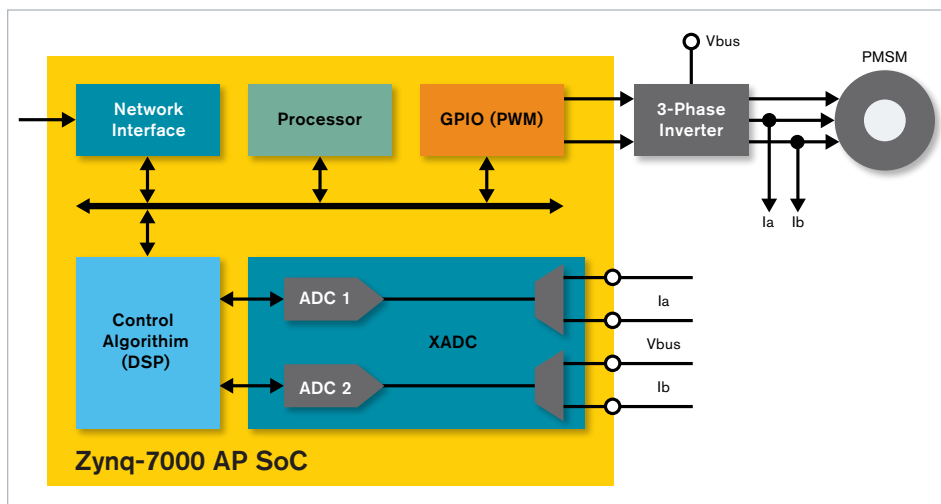
Xilinx devices enables high-performance, single-chip motor control.

Motor Control Applications
- Electric Drives and Servo Systems
- Energy and Power Systems and Inverters
- Assembly Machinery and CNC
- High Performance Stepper
- Multi-Axis Motion Control

Benefits of Designing with Xilinx Platforms
- Over 15X faster loop time compared to MCU
- High performance (precision, efficiency, lower Total Harmonic Distortion)
- Advanced modulation schemes (SVPWM & RPFM)
- Integration of networking and other custom features

Industrial Networking

Xilinx devices support a broad range of interfacing capabilities and a large number of IOs, making them the platform of choice for implementing today's industrial networking protocols. The flexible IOs and logic blocks available in FPGAs also allow customer to implement their own proprietary networking protocols. The high-throughput devices can also support multiple protocols in one device, for connectivity solutions that can scale from one standard to another.

INDUSTRIAL NETWORKING WITH XILINX DEVICES
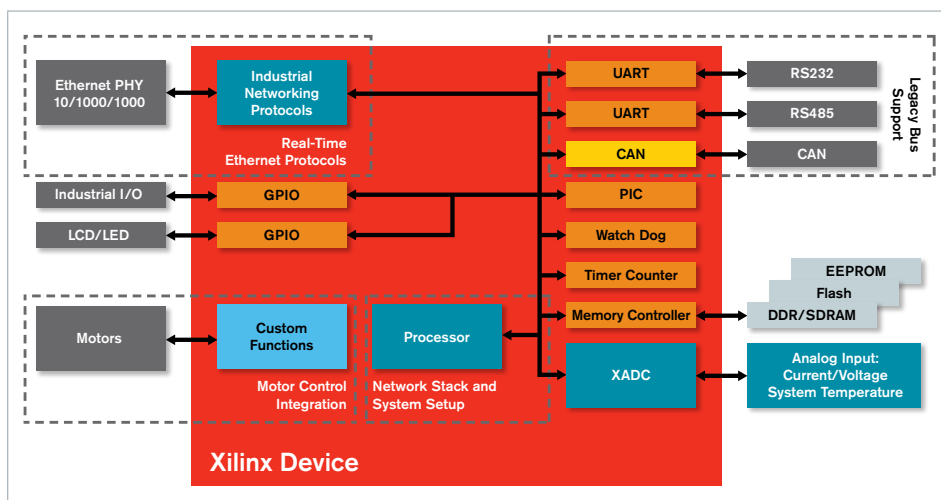
Xilinx FPGAs simplify bridging between Industrial Ethernet, traditional fieldbuses, and custom applications.

Industrial Networking Applications
- Module-to-module (e.g., motor to sensor)
- Peer-to-peer (e.g., between PLCs)
- LANs, site-to-site (Ethernet)

Benefits of Designing with Xilinx Platforms
- Flexible interchange of networking standards
- Integration of custom functions
- High IOs and throughput
- Supports legacy and advanced protocols
- Reference designs for Industrial Ethernet standards:
  - EtherCAT
  - PROFINET RT/IRT
  - POWERLINK
  - SERCOSIII
  - Ethernet/IP
  - Mechatrolink
  - CCLink

Machine Vision

To guide robotics or automate inspections for quality control and item tracking, machine vision solutions must process high-resolution, high-frame-rate images in real time. Xilinx Spartan-6 FPGAs, with high numbers of IOs and support for multiple imaging standards, are often used to interface to the sensor via LVDS signals. Xilinx FPGAs also support an industry standard connectivity, for high-speed data transfer. The 1G Ethernet camera interface is compliant with GigE Vision, the emerging de facto standard for high-performance (1,000 Mbps) machine vision, and provides a seamless path to 10G Ethernet as systems evolve. Furthermore, other camera protocols such as Camera Link and CoaXPress are also supported in Xilinx FPGAs.

Zynq-7000 AP SoCs provide a processor platform to implement software algorithms and the image processing capabilities to accelerate functions in real-time using FPGA gates.

MACHINE VISION CAMERA SOLUTION
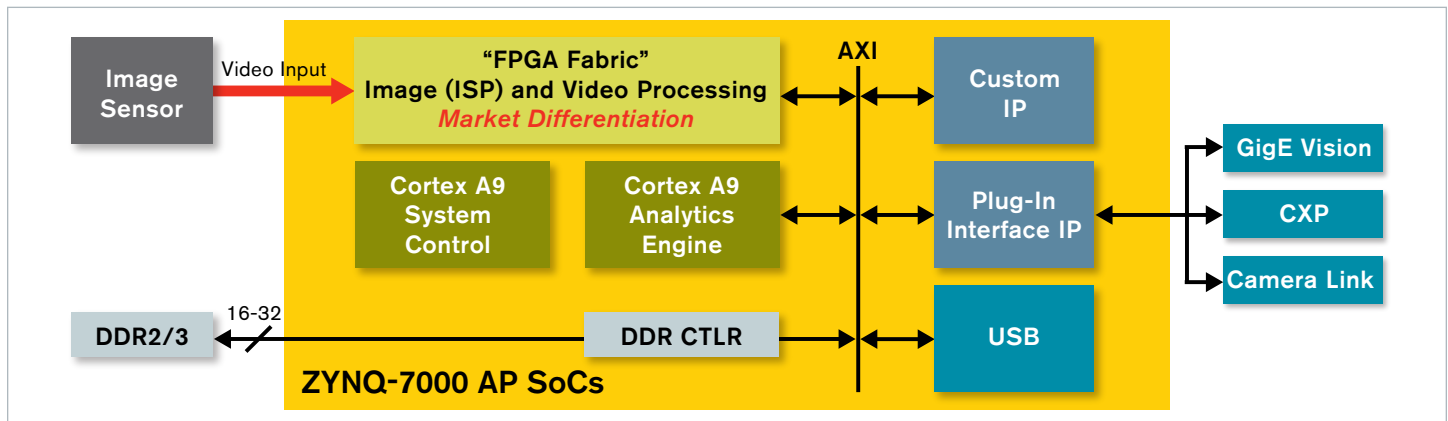
Xilinx devices are the essential components in machine vision for interfacing with sensors and transmission.

Machine Vision Applications

- Intelligent Vision Systems
- Line Scan Cameras
- Defect Detection & Object Traction
- Vision guided Robtics

Benefits of Designing with Xilinx Platforms

- Flexible Real-Time Processing Power
- Advanced camera interface, up to 100 HD frames/second
- BOM reduction
- Providing friendly C environment along with hardware acceleration in FPGA (Zynq-7000 AP SoCs)

Safety

Xilinx FPGAs and associated IP let designers cost-effectively and flexibly combine analog and digital components and subsystems to implement advanced safety functions. The capacity of the Xilinx devices make it possible to monitor the general health and operation of manufacturing equipment and introduce a highly integrated function in accordance with emerging safety standards such as IEC61508, the leading Functional Safety Standard for systems containing electrical, electronic, and programmable systems. The low-latency interfacing capabilities can elevate employee safety by enabling the rapid detection of dangerous situations. While auditing data from a wide range of sources, including analog sensors, FPGAs provide the performance required to process and analyze the data in real time, to determine when a particular specification is operating outside of a pre-defined tolerance level.

Safety Applications

- Monitoring processes and equipment
- Automated system shut-down when threshold is exceeded
- Detecting dangerous situations
- Data auditing from wide range of sources

Benefits of Designing with Xilinx Platforms

- Isolation Design Flow and Design Preservation Methodologies using Xilinx ISE tools
- Accurate FIT rate calculation
- Basic SEU detection
- Integrated BRAM ECC
- On-chip system monitoring
- Fail-safe design redundancy

Industrial Automation Development Kits and Platforms

Xilinx development kits and platforms speed start-up and design with a comprehensive environment for rapid prototyping. The resulting automation system designs can be brought to market faster and remain on the market longer.

ZYNQ-7000 AP SOC INTELLIGENT DRIVES PLATFORM

The **Zynq-7000 AP SoC Intelligent Drives Platform** provides the necessary hardware, design tools, motors, IP cores and reference designs for industrial embedded control systems. The platform is ideal for designs requiring single-chip, high performance motion control and/or industrial networking capability. For more information visit: **www.xilinx.com/intelligentdrives**

SPARTAN-6 FPGA MOTOR CONTROL DEVELOPMENT KIT

The **Avnet Spartan®-6 FPGA Motor Control Development Kit** is an ideal platform for designers seeking to design advanced motor control systems. Stepper, Brushed DC (BDC), Brushless DC (BLDC), and Permanent Magnet Synchronous Motors (PMSM) can be driven by the FMC module, under control of the Spartan-6 LX75T FPGA on the baseboard. The included reference designs provide great demonstrations for an out of the box experience. For more information, visit: **www.em.avnet.com/spartan6motor**

SPARTAN-6 FPGA INDUSTRIAL ETHERNET KIT

The **Spartan-6 FPGA Industrial Ethernet Kit** is a comprehensive design environment for rapid prototyping and development of leading edge industrial applications in connectivity, motor control, and embedded processing. This kit includes a daughter card supporting multiple real-time industrial Ethernet protocols such as EtherCAT, PROFINET RT/iRT, POWERLINK, SERCOS III, and legacy serial connectivity standards. For more information, visit: **www.xilinx.com/s6iek**

SPARTAN-6 FPGA INDUSTRIAL VIDEO KIT

The **Spartan-6 FPGA Industrial Video Processing Kit** offers a comprehensive design environment for the rapid prototyping and streamlined development of high-resolution video conferencing, video surveillance, and machine vision systems. Designed specifically for industrial imaging, this kit enables developers to build camera and imaging applications supporting improved image resolutions, meeting evolving image processing and interface requirements. For more information, visit: **www.xilinx.com/s6ivk**

Take the NEXT STEP

Contact a local sales representative for more information, or visit **www.xilinx.com**.

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