White Paper Summaries

WP100 **Xilinx at Work in Set-Top Boxes** **CPLD and Spartan-II FPGAs**

This White Paper gives an overview of different set-top box technologies and how Xilinx high volume programmable devices can be used to implement complex system level glue in a variety of set-top box designs. It concentrates on set-top box technology used to receive television over satellite, cable and terrestrial channels. The Xilinx device families targeted at these high volume applications include XC9500™ and Coolrunner™ CPLDs and Spartan™ FPGAs.

WP102 **Xilinx at Work in Digital Printers** **CPLD and Spartan-II FPGAs**

This white paper focuses on the market size for the various printer technologies, both by performance and geographic region. It then discusses the basics of the technologies, to give a view of their capabilities, limitations and future directions. A functional block diagram is provided which shows the presence of several important application specific standard products (ASSP) providers. It will then focus on exactly where Xilinx XC9500XL CPLDs and Spartan FPGAs play a vital role in this important market, then take a look into the future direction it is headed with Internet influence and the new photographic quality printers and MFPs. Finally, a set of additional resources is provided for further study.

WP103 **Xilinx High Volume Programmable Logic Applications in Internet Audio Players** **CPLD and Spartan FPGAs**

This paper provides an overview of Internet audio technologies and how Xilinx high-volume programmable devices can be used to overcome some of the significant challenges facing the designers of portable players. The Xilinx device families targeted at these high-volume applications include CoolRunner™ CPLDs and Spartan™ FPGAs. Detailed information describing these families can be found on the web at www.xilinx.com.

WP104 **Xilinx High-volume Programmable Logic Applications in Satellite Modem Designs** **CPLD and Spartan FPGAs**

This paper gives an overview of satellite modem technologies and how Xilinx high-volume programmable devices can be used to implementing complex system level glue in satellite modem designs. The Xilinx device families targeted at these high-volume applications include XC9500 CPLDs and Spartan™ FPGAs. Detailed information describing these families can be found on the web at www.xilinx.com.

WP105 **CoolRunner XPLA3 CPLD Architecture Overview** **CoolRunner XPLA3 CPLDs**

This document describes the CoolRunner™ XPLA3 CPLD architecture.

WP106 **The Spartan-II Family – The Complete Package** **Spartan-II**

The Spartan™-II Family, Combined with a Vast Soft IP Portfolio is the First Programmable Logic Solution to Effectively Penetrate the ASSP marketplace.

Spartan-II FPGAs offer more than 100,000 system gates at under $10 and are the most cost-effective PLD solution ever offered. They build on the capabilities of the very successful Virtex family and supports all the associated features, including SelectIO™, BlockRAM™, Distributed RAM, DLLs, and support clock speeds up to 200 MHz. Spartan-II extends the Spartan family focus in competing against ASICs and is uniquely poised to penetrate the ASSP marketplace.

WP107 **Inverse Multiplexing for ATM (IMA) Solutions with Spartan-II FPGAs** **Spartan-II**

Early deployment of IMA technology meeting the IMA v1.0 standard began in late 1997 but due to different interpretations of this specification, true multi-vendor interoperability was not really possible until the completion and acceptance of the IMA v1.1 specification in 1999. Throughout this period, the changes to the applicable technical standard and the lessons learned through inter-vendor testing required the flexibility of FPGA and software implementations of IMA. At present, stability in standardization plus large scale IMA deployment have set the stage for the introduction of standard silicon IMA products. But IMA is still an emerging technology with limited test equipment support and compliance test suites. That combined with different line card architectures (partitions and sizes) and non-T1/E1 IMA applications, suggests that IMA will remain somewhat of a moving target for some time to come. An FPGA based IMA solution with efficient partitioning of hardware and software functions provides the necessary scalability and flexibility to handle all of these applications and allow for tracking of new standards. With the introduction of the Spartan-II family of devices and the IMA-8 and other Xilinx based IMA core solutions, an FPGA based IMA implementation is simple and economical.

WP108 **CoolRunner XPLA3 Clocking Options** **CoolRunner CPLDs**

This document gives a detailed description of the CoolRunner ® XPLA3 clocking options.

WP109 **HDLC Controller Solutions with Spartan-II FPGAs** **Spartan-II**

Using the Spartan™-II Family in combination with a Soft IP to effectively penetrate the HDLC Controller market in place of the traditional ASSP. The Spartan-II product family brings the density, extensive features, high performance and low cost which makes it the preferred HDLC Controller solution within different data networking applications. A Spartan-II FPGA based HDLC Controller solution with efficient partitioning of hardware and software functions provides the necessary scalability and flexibility to make it the first PLD to effectively penetrate the ASSP marketplace.

WP110 **Reed-Solomon Solutions with Spartan-II FPGAs** **Spartan-II**

This paper explains the theory behind Reed-Solomon error correction, and discusses how a variety of practical Reed-Solomon encoding/decoding solutions can be implemented using Xilinx Spartan™-II family FPGAs.

WP111 **Spartan-II Family as a Memory Controller for QDR-SRAMs** **Spartan-II**

The explosive growth of the Internet is boosting the demand for high-speed data communication systems. While RISC CPU speeds have exceeded clock rates of 500 MHz, static memories have been unable to keep up the pace. In order to increase memory bandwidth significantly for future high-performance communication applications, Cypress Semiconductor, Integrated Device Technology, Inc. and Micron Technology have jointly defined and developed a new SRAM architecture referred to as the Quad Data Rate™ (QDR™) SRAM technology. This architecture is aimed at the next generation of switches and routers that operate at data rates above 200 MHz, and will serve as the main memory for lookup tables, linked lists, and controller buffer memory. This partnership of the three companies enables customers to choose these new SRAMs from multiple sources. Data throughput of 11.592 Gbits/s is possible, which is about four times the performance of comparable SRAMs in today's market. Any new SRAM architecture requires supporting circuitry for both interfacing and control. FPGAs are ideal to implement the control and interface logic, which ties the CPUs to the QDR SRAMs. The Spartan™-II FPGA, with its unique and extensive features is an ideal memory controller interface for the QDR SRAM. Spartan-II FPGAs offer more than 100,000 system gates at under $10 and are the most cost-effective programmable logic devices (PLD) solution ever offered. It uses a leading 0.18 µm, six-layer metal process. The Spartan-II family addresses low cost and fast time-to-market, but more importantly integrates powerful new system-level features that provide an attractive solution for today's system level designer. They build on the capabilities of the very successful Virtex family and incorporate all the associated features, including SelectI/O, BlockRAM, Distributed RAM, Delay-Locked Loops (DLLs), clock speeds up to 200 MHz, and aggressive power management. The Spartan-II family offers a solution with high performance at a low cost, hence expanding the time-to-market advantage that PLDs traditionally offer. It also increases the value of the ASSP by allowing end users to customize their solutions.

WP114 **High-performance Spartan-II 8-bit Microcontroller Solution** **Spartan-II**

Using the Spartan™-II Family in combination an 8-bit microcontroller Soft IP to effectively penetrate Industrial instruments and Consumer Applications.

High-performance 8-bit microcontrollers are deployed in a number of applications such as data networking, telecommunications, consumer products, computer peripherals, automotive systems and aerospace designs. The 8051 microcontroller IP in a Spartan-II FPGA shows the advantages of using programmable logic devices (PLDs) as 8-bit microcontrollers. The Xilinx Spartan-II 8-bit microcontroller solution is ideal for applications in which cost and integration within a system is critical. With the flexibility to allow integration of other IP on the FPGA fabric, the Spartan-II family presents an ideal embedded solution. This positions the Spartan-II family uniquely in being able to compete with stand-alone ASSPs. This white paper presents a brief history, the market space for 8-bit microcontrollers, the Spartan-II 8-bit microcontroller solutions, 8051 IP solutions, applications and the Spartan-II FPGA advantage.

WP115 **Data Encryption using DES/Triple-DES Functionality in Spartan-II FPGAs** **Spartan-II**

Today's connected society requires secure data encryption devices to preserve data privacy and authentication in critical applications. Of the several data encryption types, Data Encryption Standard (DES) and its variant Triple-DES (TDES) have emerged to be the most commonly used in varying applications. The Spartan™-II devices with their extensive features and cost effectiveness compete effectively against ASICs and ASSPs. Through the value proposition of the DES/TDES IP in a Spartan-II FPGA, the programmable ASSP message is further confirmed. There is an immense value in integrating critical IP solutions like Discrete Cosine Transform/Inverse DCT (DCT/IDCT) and DES within a Xilinx FPGA to enhance performance and security in communication applications. A FPGA-based DES/TDES solution provides the necessary scalability and flexibility to handle all these applications and allows for tracking of new standards.

WP116 **Xilinx Spartan-II FIR Filter Solution** **Spartan-II**

Traditionally, digital signal processing (DSP) algorithms are implemented using general-purpose programmable DSP chips for low-rate applications. Alternatively, special-purpose, fixed function DSP chipsets and application-specific integrated circuits (ASICs) are used for high-performance applications. Technological advancements by Xilinx in Field Programmable Gate Arrays (FPGAs) in the past 15 years have opened new paths for DSP design engineers. The FPGA maintains the high specificity of the ASIC while avoiding its high development cost and its inability to accommodate design modifications after production. Highly adaptable and design-flexible, FPGAs provide optimal device utilization through conservation of board space and system power—important advantages not available with many stand-alone DSP chips. The fast pace of twenty-first century computing demands solutions that target aggressive time-to- market windows of opportunities. Spartan™-II is effectively taking over many traditional ASSP markets. Unlike typical ASSP solutions, Xilinx Spartan-II allows designers to respond quickly and economically to the emergence of new, more efficient IP core algorithms. Xilinx Spartan-II FPGAs provide digital designers with a potentially unlimited array of highly reconfigurable solutions. When the design demands more than 100 MIPS, when time-to-market is critical, or when design adaptability is crucial, Spartan-II is the best solution. The most common digital building blocks, like serial peripherals, DMA controllers, PCI controllers, and synthesizable processors, are all readily realizable using a Spartan-II device. In fact, all the most basic operations performed by analog or digital electronic devices—filtering, amplification, modulation, storage, and computation—can be implemented with Spartan-II.

WP118 **Using CoolRunner CPLDs in Smart Card Reader Applications** **CoolRunner CPLDs**

This document presents the different types of smart cards and their applications and discusses the variety of smart card readers available and what functions they can perform. An illustration of the elements that form a typical smart card reader and how and where CoolRunner devices can be used to undertake some of these tasks is described herein.

WP119 **Fast Zero Power (FZP™) Technology** **CoolRunner CPLDs**

This white paper provides an overview of the patented Fast Zero Power (FZP™) technology used in Xilinx CoolRunner . CPLDs.

WP120 **Xilinx High-Volume Programmable Logic Applications in Satellite Modem Designs** **Spartan, XC9500**

This paper provides an overview of satellite modem technologies and standards, and discusses how the Internet is driving the deployment of this technology. The major functional building blocks of a satellite modem are detailed, including an overview of the Application Specific Standard Products (ASSPs) that are typically used to implement the satellite interface. Finally, the paper illustrates how a Spartan device is used to implement complex system glue in a generic USB-interface satellite modem design. The Xilinx device families targeted at these high volume applications include XC9500 CPLDs and Spartan ® -II FPGAs. Detailed information describing these families can be found on the web at www.xilinx.com.

WP122 **Using the CoolRunner XPLA3 Timing Model** **CoolRunner CPLDs**

This document describes how to use the CoolRunner ® XPLA3 timing model.

WP123 **Using FPGAs with ARM Processors** **FPGAs**

This white paper discusses interfacing Xilinx FPGAs with off-the-shelf ARM processors. It covers some of the available ARM Application Specific Standard Products (ASSPs) and describes some of the Xilinx plus ARM development systems currently available for engineers to evaluate. Techniques and features that improve design performance are also included to help achieve maximum throughput.

WP128 **Introduction to Home Networking** **Spartan-II**

Once connected, consumers find innumerable uses for their home networks. Sharing in-home appliances to provide faster Internet access has proven to be the main motivator for consumers installing a new home network. Telecommuters, knowledge workers, students, and families are some of the groups of people that are at the forefront of the home networking revolution. The ultimate goal of a home network is to provide access to information, such as voice, audio, data, and entertainment between different digital devices around the house. Home networking allows users to communicate and interact anywhere at anytime. This new and emerging technology will bring the Internet to the hands of the consumers, to every appliance in the house, and help interconnect people across the globe. It allows access to homes via the Internet when one is away, enabling security and energy management. Home networking is really a three part equation offering entertainment, information, and automation services that are distributed between appliances in the home.

WP129 **Introducing Xilinx and Programmable Logic Solutions for Home Networking** **Spartan-II**

Xilinx has been successful in the communications and networking markets because of the dynamics in these markets. With evolving standards and specifications, the need for programmable logic solutions is being further enhanced. The consumer market is seeing a recent flux of digital convergence. The coming of broadband access, the Internet, multiple PCs, and other information appliances is bringing applications such as streaming video, MP3 files, etc. to the homes of the consumer. Xilinx Spartan™-II FPGAs, with their high-densities, performance features, and low cost, help reduce the customer's time needed to build products. With the Xilinx Online solution, FPGAs can be reprogrammed with the updated specifications. The eSP: Home Networking program helps system designers and ASIC/FPGA designers understand the technology and market dynamics to make the right decisions in this marketplace.

WP130 **Broadband Access** **Spartan-II**

The Internet continues to expand at an enormous rate, and the worldwide modem market will continue to be buoyed by this growth as the default solution for residential Internet access. Cable and xDSL modems will continue their strong movement into the residential marketplace. The worldwide use of computers and new appliances that allow people to access the Internet from the comfort of their homes are the major driving forces behind the development and implementation of broadband technologies. The spread of broadband connections that provide lighting-fast Internet services is seen as a key factor in encouraging the proliferation of home networking technologies. Today, applications such as Internet access and high-speed remote access to storage media require more data capacity than traditional telecommunications services can provide. Replacing copper wiring with fiber optic cabling is one way of delivering this capacity to your home, but the associated technology is expensive.

WP131 **Media (Residential) Gateways** **Spartan-II**

The primary function of the media gateway is to provide broadband connectivity to the home through cable, xDSL, satellite, and wireless. Secondly, media gateways will provide home networking capabilities by distributing broadband access throughout the home using technologies such as HomePNA (phonelines) or wireless LANs. The demand for greater Internet bandwidth is driving the need for digital modem solutions. This white paper looks at utilizing an existing PC to provide media gateway type services. Companies like IBM and Ericsson are strongly promoting this concept.

WP132 **Information (Internet) Appliances** **Spartan-II**

Market researchers predict that information appliances will out-ship consumer PCs by 2002 in the U.S. High-volume information appliances will be products such as digital TV, DVD players, digital cameras, and handheld devices. Semiconductors enable new devices and players, but technology is increasingly becoming invisible. In the future, more functionality will be available at lower price points. Information appliance products will evolve to deliver Web content. Brands will change from “device only” to service, solutions or customer relationship provider such as financial institutions. The digital consumer revolution and the Internet are forcing broadband into the home. Such an evolution will fuel the demand for a variety of different information appliances in the current years. Xilinx programmable logic products (Spartan™-II FPGAs, CoolRunner™, and 9500 CPLDs) ported with intellectual property (IP) provide solutions like ASSPs, but with increased flexibility. FPGA logic not used from the IP can be programmed with other IP cores—such as embedded solutions. Other features within the Spartan-II FPGAs provide system integration, and the reprogrammability enables time-to-market and flexibility at low costs. Xilinx Online™ allows time-in-market as specifications in emerging technologies keep evolving.

WP133 **Home Networking Using “No New Wires” Phoneline and Powerline Interconnection Technologies** **Spartan-II**

In the context of a home networking environment, “no new wires” is the term applied to a suite of technologies that use existing wiring systems to distribute high-speed data and video throughout your house. Phoneline and powerline systems are the two dominant “no new wires” technologies.

WP134 **Home Networking Using "New Wires" — IEEE 1394, USB, and Fast Ethernet Technologies** **Spartan-II**

With the proliferation of digital television more and more people around the world are beginning to distribute audio and video signals around their homes. A number of interconnection technologies are available to meet the requirements of in-home video and multimedia distribution, namely IEEE 1394, USB, and Ethernet. While the IEEE 1394 and USB seem similar, they are intended to fulfill different bandwidth and cost needs. The 1394 standard can move more data in a given amount of time, but is more expensive than USB due to its more complex protocol and signalling rate. Applications that are best suited for 1394 are disk drives, high-quality video streams, and other high-bandwidth applications; all higher end consumer devices. USB is appropriate for middle and low bandwidth applications such as audio, scanners, printers, keyboards, and mice. USB and 1394 are complimentary technologies. 1394 is for devices where high performance is a priority and price is not, while USB is for devices where price is a priority and high performance is not. For the home networking purists, Ethernet equipment offers inexpensive and proven products that can be bought at retail in both kit form or a la carte. Ethernet technology can reliably and efficiently network all the Internet appliances (PCs, printers, game consoles, digital televisions, security cameras, and much more) at home. Xilinx solutions enable these evolving technologies in consumer devices today.

WP135 **Wireless Home Networks — DECT, Bluetooth, HomeRF, and Wireless LANs** **Spartan-II**

A wireless home network is an intriguing alternative to phoneline and powerline wiring systems. Wireless home networks provide all the functionality of wireline networks without the physical constraints of the wire itself. They generally revolve around either IR or radio transmissions within your home. Radio transmissions comprise of two distinct technologies—narrowband and spread-spectrum radio. Most wireless home networking products are based upon the spread-spectrum technologies. To date, the high cost and impracticality of adding new wires have inhibited the wide spread adoption of home networking technologies. Wired technologies also do not allow users to roam about with portable devices. In addition, multiple, incompatible communication standards have limited acceptance of wireless networks in the home.

WP136 **Home Networking Middleware** **Spartan-II**

This white paper presents an overview of how home networking middleware supports the seamless convergence of broadcast and home network applications. The fusion between both of these technologies facilitates the deployment of a range of new entertainment services within the home. The OSGi specification provides a common foundation for ISPs, network operators, and equipment manufacturers to deliver a wide range of e-services via gateway servers running in the home or remote office. This white paper describes OSGi within the context of a home networking environment. It is a distributed, open networking architecture providing pervasive and peer-to-peer network connectivity to PCs, intelligent appliances, and wireless appliances. UPnP leverages Internet and Web components (like IP, TCP, UDP, HTTP, and XML) and enables seamless proximity networking in addition to control and data transfer among networked appliances in the home, office, and everywhere else.

WP137 **Intellectual Property (IP) Cores for Home Networking** **Spartan-II**

Spartan™-II FPGAs, programmed with IP cores, enable home networking products. Xilinx develops IP cores and partners with third-party IP providers to provide customers with a suite of cores to decrease the customer's time-to-market. While the FPGA plus IP core solution provides functionality and performance similar to ASSPs, they also provide an unparalleled flexibility. With increased densities, Spartan-II FPGAs provide embedded solutions—where the FPGA logic not used from IP can be programmed with other IP cores. Also, other features such as clock management, system I/O capabilities, and embedded memory provide system integration. This combined with the effective costs increases the value proposition of Spartan-II FPGAs, while reducing the overall solution cost. While reprogrammability reduces the customer's time-to-market and enables flexibility, the Xilinx Online™ program allows time-in-market as specifications in emerging technologies keep evolving.

WP138 **Voice-Data Convergence—Voice Over IP** **Spartan-II**

This paper gives an overview of voice-data convergence technologies and how Xilinx high volume programmable devices can be used to overcome some of the significant challenges facing the designers of these systems. The Xilinx products targeted at these high-volume applications include XC9500XL™ and CoolRunner™ CPLDs and Spartan™-II FPGAs. This appendix starts with an overview of voice-data convergence technologies and the benefits they bring to the users. We will then describe the product architectures that are used to implement VoIP gateways and IP phones. The final topic will be to show how Spartan-II devices can be used in these applications.

WP139 **FPGA Enabled Home Networking Technology Bridges—Connecting Disparate Technologies** **Spartan-II**

The digital age of consumer electronics is here and it is bringing with it faster computing at lower costs. The Internet revolution and distribution of broadband access to different digital consumer electronics and their interoperation introduces

a new wave of technology into your home. Home networking involves distribution of audio, video, and data around the home and ensures interoperability between various information appliances in your home. Home networking has four aspects, which include broadband access, residential gateways, a vast range of information appliances, and the technologies that bind them all—interconnectivity or home networking technologies.

WP140 **Physical Synthesis** **FPGAs**

In the domain of deep submicron (DSM) and nanometer ASIC technologies (180 nm and below), the traditional separation between logical (synthesis) and physical (place and route) design methods often causes a problem—designs cannot meet their realistic timing objectives; creating the well known “timing closure problem.” Timing closure is now considered the biggest area of difficulty for ASIC performance-oriented designs. The underlying reason is that circuit delays are dominated by net delays, which are influenced by the placement of the cells. The traditional fanout-based wireload models, for estimating interconnect delay during synthesis, are considered inaccurate and are the key factor causing the lack of timing predictability between post synthesis and post layout results. It is evident that synthesis and placement technologies must merge to create properly placed and routable designs that meet realistic performance goals.