

THE 32ND ANNUAL MICROPROCESSOR DIRECTORY

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Charting your course

FOLLOW THE SILICON-BREAD-CRUMB TRAIL IN THIS DIRECTORY
TO FIND THE PERFECT DEVICE FOR YOUR PROJECT.

Welcome to the 32nd EDN Microprocessor/Microcontroller Directory. The number of companies and devices the directory lists continues to grow, and, once again, we've expanded the company roster and table of devices by at least 10%. This continuing growth is a testament not only to the variety of processors available, but also to the tremendous variation among requirements, features, and the increasing range of applications for which designers are using microcontrollers.

Is this growth in processor options a precursor to an industrywide consolidation? Not likely. Successful microcontroller offerings and embedded-system-application designers stress the optimum balance of processing performance, power consumption, and bill-of-materials costs, which vary so significantly across the growing range of embedded-system applications that few microcontroller-product families are in direct competition. Some of the companies participating in this year's directory have for years been selling processor product lines but only recently began making them available to the engineering public.

This directory aims to provide designers and system architects enough visibility into processor options to quickly narrow the list of candidate processors for each project. This print version offers an abridged, high-level overview of this year's participating companies and their products; the online version is complete. The device tables, due to their size, are available exclusively at www.edn.com/050804cs as a set of PDF files that you can view or print across two pages. The tables list only software-programmable processors, including cores and programmable-logic devices with embedded cores. The directory does not include DSPs; EDN lists DSPs in its annual DSP Directory, which it publishes six months out of phase with this one.

We welcome your feedback, because it can help us to make next year's directory more useful to you. Send your feedback to mpdirectory@edn.com. As always, if this directory helps you choose a processor, please let the vendor know how you found its part. And if you cannot find your favorite processor company or device, please let both the company and EDN know that you missed reading about it in the directory.

► ACTEL CORP

Actel offers processor cores as part of its DirectCore product offerings, which range from the 8-bit 8051 to the 32-bit ARM7. The company sources, verifies, and supports these IP (intellectual-property) processor cores and maintains them as pre-implemented, synthesizable building blocks for use with Actel FPGA devices. Actel and ARM collaborated to develop and offer an ARM7 family microprocessor for use with Actel's FPGA devices to support applications ranging from high-volume-consumer to high-performance, high-reliability products. Actel will deliver the "soft" ARM7 family core with a license-free business model.

Designers can use the Core8051 8-bit microcontroller core in Actel's nonvolatile, single-chip FPGAs, including ProASIC3, ProASIC Plus, Axcelerator, SX-A, and RTSX-S. The Core8051 executes all ASM51 instructions—most in one clock cycle.

Designers can combine the Core8051, available in RTL (VHDL or Verilog) or netlist form, with other Actel DirectCore IP products. Actel's Platform8051 development kit includes a development board, IP cores, software, and FPGA tools that enable designers to design, configure, and program Core8051 designs into Actel FPGAs.

► ADVANCED MICRO DEVICES

AMD (Advanced Micro Devices) continues to broaden its x86 and Alchemy product offerings. Its x86-based product line spans the embedded-system market, targeting enterprise-class servers and workstations, and it extends the x86 ISA (instruction-set architecture) across 32- and 64-bit PC, server, and workstation platforms with the AMD64 technology. Subsequent enhancements of the AMD Athlon and AMD Opteron processor lines extend 64-bit x86 computing to the embedded-system market. The ÉlanSC5220 x86 controller covers the data-communications, telecommunications, and information-appliance markets. AMD devices also target PDAs, Web tablets, portable and wired Internet-access devices, and gateway applications with MIPS-based Alchemy microprocessor offerings.

The AMD Geode processor family delivers optimized x86 performance with reduced power consumption targeting broadband multimedia, set-top boxes, tablet PCs, HDTVs, kiosks, network appliances, and thin-client applications. Each Geode processor uses a nomenclature that identifies a performance-power rating to assist designers in selecting a processor with the optimum mix of power and performance. For example, the recently introduced AMD Geode LX 800@0.9W processor can run a

full-featured Windows or Linux operating-system application at less than 1W in a fanless environment. AMD added the Alchemy Au1200 processor to the AMD Alchemy line to better target low-power, high-performance PMP (personal-media-player), automotive, and DMA (digital-media-adaptor) applications.

► ALTERA

Altera continues to improve its integrated-product portfolio. HardCopy II uses a fine-grained collection of Hcell transistors. It builds on the company's line of structured-ASIC offerings and supports seamless migration from FPGA to ASIC implementations and provides the density, cost, performance, and power benefits of ASIC technology. Altera's Stratix II EP2S180 device, its largest and fastest FPGA, uses a new logic structure that enables a faster memory-core frequency. The new EPM-2210 device is the largest member of the Max II family of low-cost, high-density, and high-performance CPLDs.

The Nios II family of embedded processors features a general-purpose RISC CPU architecture to address a range of embedded-system applications. The Nios II family comprises three cores—fast (Nios II/f), economy (Nios II/e), and standard (Nios II/s)—each targeting a specific price and performance range. The Nios II processor works with all the latest Altera FPGA families. Developers can use a Nios II processor to augment an external processor by offloading tasks to maintain overall system performance.

► ANALOG DEVICES

Analog Devices offers high-performance semiconductors for signal-processing. The 16/32-bit embedded Blackfin processor targets the computational demands and power constraints of embedded audio-, video-, and communications-system applications. Blackfin uses a 32-bit RISC microcontroller-unit programming model based on an SIMD (single-instruction-multiple-data) architecture to deliver signal-processing performance and power efficiency. In January 2005, Analog introduced the network-enabled ADSP-BF534, BF536, and BF537 processors, as well as the BF566-eM30 eMedia Platform, which targets IP set-top boxes, triple-play devices, portable and networked media players, and automotive-safety/driver-assistance systems.

The ADuC702x precision analog-microcontroller family combines on a single chip embedded precision analog functions and digital programming. Featuring ARM7-based programmability, the ADuC702x is the newest addition to the company's

MicroConverter series—a portfolio of 8052-based devices. MicroConverter products target high-precision measurement and control and data-acquisition systems with basic digital-programming needs. The precision analog microcontrollers integrate a 32-bit RISC core and flash memory with precision data-conversion technology that supports as many as 16 channels of fast, 12-bit-accurate analog-to-digital conversion and as many as four 12-bit DACs.

► APPLIED MICRO CIRCUITS CORP

Since acquiring a portfolio of products associated with IBM's 400 PowerPC processors less than a year ago, AMCC (Applied Micro Circuits Corp) has introduced new processors to its portfolio of ASSP (application-specific standard products). The PowerPC 440SPe targets RAID (redundant-array-of-independent-disks) controllers and SAN (storage-area-networking) equipment by supporting three independent PCI Express interfaces and one PCI-X Version 2.0 interface. The 440GR processor targets low-power applications, such as line-card system control and multiradio devices. The 440EPx and 440GRx include an optional integrated security accelerator or Turbo Security Engine that provides IPsec (Internet Protocol security) and SSL (Secure Sockets Layer) acceleration supporting bandwidth of more than 500 Mbps. AMCC's Turbo Security Engine secures communications protocols over wired or wireless networks, supports VPNs (virtual private networks), and provides secure Internet-based transaction processing.

AMCC's 400-series portfolio, which it built on the PowerPC architecture, comprises the S-, G-, and E-series product categories. I/O-centric S-series products feature PCI Express and PCI-X interfaces targeting storage and networking applications. S-Series devices support DDR667 SDRAM and RAID XOR. Gigabit Ethernet-centric G-Series devices offer high integration and support for DRAM, PCI, and optional security; they target applications requiring control-plane processors. E-Series products target imaging, wireless-access, and industrial-control applications; they support low-cost embedded-system control and include FPUs, Ethernet, USB, PCI, and DDR SDRAM.

► ARC INTERNATIONAL

ARC International offers two families of 32-bit processor cores. ARC 600 cores target battery-operated and cost-sensitive products in the embedded control-, consumer-, networking-, and automotive-system markets. ARC 700 cores deliver the computing power for graphics, media, and packet



processing; they also target high-end embedded-system platforms using OSs such as Linux.

ARC's configurable processor technology enables SOC (system-on-chip) designers to optimize a processor core for their applications, in die area, power, and performance of critical code. Designers can remove core features by using the ARChitect configurator tool's drag-and-drop GUI. Configurable items include caches, interrupts, DSP options, timers, debugging components, type and size of core registers, bus widths, and instruction-set options.

Using ARChitect's extension wizard, designers can add custom instructions, registers, and logic to reduce the number of cycles that critical code requires.

► ARM

ARM licenses IP (Intellectual property) for the development of 32-bit RISC-microprocessor-based SOCs (systems on chips), and ARM-powered microprocessors target automotive, consumer-entertainment, imaging, networking, storage, security, and wireless applications. ARM offers a range of processor cores, including the ARM7, ARM9, ARM10, ARM11, ARM Cortex-M3 processor, and MPCore multiprocessor families. ARM offers the SecurCore technology targeting secure applications, such as smart cards and SIMs (subscriber-identity modules), and the OptimoDE Data Engine signal-processing technology and MBX 2-D- and 3-D-graphics-accelerator cores, which it developed with Imagination Technologies. ARM offers supporting software, such as TrustZone technology for data security, Jazelle Java acceleration software, Swerve 3D, and Intelligent Energy Manager.

The ARM Cortex processor family offers high performance at the lowest cost and power consumption; all Cortex cores implement the Thumb-2 instruction set to address the increasing performance and cost demands of various markets. The ARM Cortex family of processors consists of the A, R, and M intelligent computer architectures. The ARM Cortex-A series targets demanding consumer-entertainment and wireless products running complex operating systems and implementing sophisticated user interfaces. The ARM Cortex-R series focuses on the application needs of real-time systems. ARM Cortex-M devices provide the benefits of 32-bit development to the microcontroller market. The ARM Cortex-M3 processor, the first core available from the ARM Cortex family, targets the requirements for high system performance in extremely cost-sensitive embedded-system applications, such as

microcontrollers, automotive-body systems, white goods, and networking devices.

► ATMEL

Atmel offers six flash-based microprocessor architectures: the 4-bit automotive and RF Marc 4; the high-performance, low-power 8/16-bit RISC AVR; the AT89 single-cycle CISC 8051; the 32-bit ARM7, ARM9, and ARM11 microcontrollers; and the PowerPC and SPARC architectures. Flash densities for Atmel microcontrollers reach 256 kbytes; SRAM reaches 32 kbytes. Packages offer pin counts of eight to 256 pins. Ultralow-power devices are available with as little as 100 nA of standby power. ROMless, ROM, and OTP (one-time-programmable) devices are available for volume production.

Atmel develops platform ASICs and ASSPs (application-specific standard products) based on its microprocessor families. Its 8051-based ASSPs include CANs (controller-area networks), MP3, smart-card readers, USB host/client, and Web-embedded TCP/IP. AVR-based ASSPs include the Z-link ZigBee-specific baseband controller and the TPM (Trusted Platform Module), which provides hardware-based security for laptops, PCs, and network servers.

New offerings include the AT89LP single-cycle, 20-MIPS 8051, which drops into MCS-51 sockets and targets increasing performance requirements in legacy 8051 products, principally in the Asian market. The FPSLIC (field-programmable system-level IC) II is a 20-MIPS AVR RISC processor, integrated with a dynamically reconfigurable FPGA fabric and supported by design tools that allow multiple interfaces, operators, or peripherals to share the same silicon at different times during runtime. FPSLIC II's dynamic, runtime reconfigurability allows it to execute more functions at a lower silicon cost and with less power consumption than a conventional FPGA.

The 32-bit, ARM7-based AT91SAM7 family targets 8- and 16-bit designs that need 32-bit performance, more memory, and supervisory functions, but its price is comparable with 8/16-bit devices and development tools. The AT91SAM7 provides features for real-time 8- and 16-bit designs, including power on reset, brown-out detection, watchdog timer, RC oscillator, and bit-manipulation capabilities.

► BROADCOM

Broadcom provides a family of high-performance, low-power, integrated SOC (system-on-chip) processors targeting data-networking and communications applications, as well as security, storage, 3G wireless infrastructures, and high-density computing. The new Broadcom broad-

band processors integrate as many as four 64-bit MIPS processor cores onto a single die. This configuration achieves higher aggregate performance than multiple discrete cores and dramatically reduces board space and power dissipation.

CMP (chip multiprocessing), an advanced technique in CPU design, integrates two or more processor cores into one chip to enhance computing performance. CMP scales system performance by sharing the workload across multiple cores and relies on high-speed, on-chip interconnects and high-bandwidth pipes to memory and I/O. A benefit of CMP is power efficiency, especially because the classic technique of scaling performance by increasing core frequency has reached the point of diminishing returns. Power and leakage are formidable challenges as designs become more complex with increasing numbers of transistors on one die.

Broadcom manufactures its family of dual- and quad-core processors based on the BCM1250's multicore architecture. The memory-controller design addresses bandwidth and efficient channel usage. The controller supports DDR-400 and DDR2-800 for a peak bandwidth of 100 Gbps, supporting higher data-plane-forwarding performance. Configurable as two 64-bit-wide channels or four 32-bit-wide channels for improved memory usage, the memory controller supports as much as 16 Gbytes of memory with 1-Gbit DRAM technology.

► CAMBRIDGE CONSULTANTS

Cambridge Consultants, a 250-person, multidisciplinary organization, provides product-design services for high-precision analog, mixed-signal, and RF on CMOS. It also offers software and silicon IP (intellectual property) for its 16- and 32-bit XAP processor cores and the APE datapath signal-processing engine. The 16-bit-Harvard-architecture XAP1 and XAP2 cores target projects requiring low power and low gate count. XAP1 is a 3000-gate core featuring an 18-bit instruction word for programs running from on-chip ROM. The 12,000-gate XAP2 supports both 16-bit program and data memories as large as 64k words.

Cambridge Consultants recently announced the XAP3 ASIC processor core, a 32-bit soft RISC core featuring high code density with options for synthesis to ASIC or FPGA devices. The XAP3a is a 40,000- to 50,000-gate, two-stage pipeline Von Neumann processor with a new ISA (instruction-set architecture) that delivers high code density and operating-system support.

► CAVIUM NETWORKS

Cavium Networks offers silicon for security, network-services, and embedded-processing applications. Cavium Networks' Nitrox and MIPS64-based Octeon families of processors and accelerator boards offer flexible, scalable, and highly integrated platforms delivering 50-Mbps to 10-Gbps performance. The company's products target networking equipment that includes routers, gateways, network appliances, wireless-LAN access/aggregation points, and storage-networking devices.

The Octeon multicore MIPS64 processors address the needs of networking equipment ranging in performance from 200 Mbps to 10 Gbps. The Octeon family offers a scalable, software-compatible processor line with two to 16 MIPS64-based cores in one chip and power ranging from less than 5 to 29W. Octeon devices include hardware acceleration essential for Level 3 to Level 7 applications, which includes packet processing, TCP, multicore scaling, compression/decompression, pattern matching, and encryption.

The Nitrox Soho Secure Communication Processor family targets wired and wireless broadband gateway for the SOHO (small-office/home-office), and SME markets, with performance requirements ranging from 10 to 200 Mbps. The highly integrated, MIPS-32-based Nitrox SOHO-processor SOC (system-on-chip) products include IPsec (Internet Protocol security) and SSL (Secure Sockets Layer) acceleration.

► CIRRUS LOGIC

Cirrus Logic's EP93xx ARM9-based embedded processors target applications such as point-of-sale terminals, medical instrumentation, security and surveillance, process monitoring, and digital entertainment. These processors include WinCE, NET board-support packages and Linux kernel ports with Cirrus Logic's ARM third-party program support.

MaverickKey technology, which is standard on all Cirrus ARM9-based embedded processors except the EP9301, comprises the MaverickKey digital-rights-management tool and the MaverickCrunch advanced, mixed-mode, math coprocessor. MaverickKey technology allows designers to assign hardware IDs to protect against design piracy as products enter manufacturing. The MaverickCrunch engine greatly accelerates the single- and double-precision integer and floating-point processing capabilities of the ARM920T processor core.

► CRADLE TECHNOLOGIES

Cradle's new MDSP (multiprocessor-DSP) family, the CT3600, comprises three mem-

bers. The CT3600 family provides flexibility for designers to choose a device that best fits their media-processing application.

With as much as twice the computational elements and 1.5 times the operating frequency of the CT3400, the CT3600 family leverages the same MDSP architecture its predecessor uses and scales the performance and throughput by as much as four times. Power consumption is 1 to 5W, depending on device size, application, and operating frequency.

The CT3600 family extends the performance and scalability of the CT3400. The new family comprises two computational Quads, adding memory and processing power to the architecture. Cirrus removed the I/O Quad as a separate block, instead dividing the I/O-pin groups into two sets, each being associated with a compute Quad.

The CT3600 product family integrates as many as 16 loosely coupled SIMD (single-instruction multiple-data), 32-bit DSP engines; eight general-purpose CPUs; 144 programmable I/O pins; and a three-tiered memory hierarchy system to accelerate and integrate multimedia infrastructure processing.

The CT3400, with eight DSP cores and six general-purpose processors, runs at 230 MHz and can deliver more than 29,000 MMACS. Each DSP core has its own local instruction memory and data-register file (128 32-bit registers), allowing the cores to operate mostly autonomously. The compute Quad provides 64 kbytes of shared data memory and 32 kbytes of instruction cache, used by the four general-purpose processors.

► CYAN TECHNOLOGY

Cyan Technology's low-power, 16-bit, embedded-communications, flash-based eCOG1k microcontroller implements a 25-MHz RISC Harvard architecture that includes internal flash memory, RAM, and cache. The external-memory interface supports addressability of 32 Mbytes of external memory. Additional features include a Smart Card interface, a 12-bit A/D converter; a temperature sensor; and a proprietary-port configurator. Cyan's CyanIDE development software includes a full ANSI unlimited-C compiler, simulator, debugger, and peripheral-configuration software. Users can select those peripherals they need and connect them to a choice of pins. The peripheral-register setup code is automatically generated in assembly language. All Cyan development software is downloadable and free.

► CYBERNETIC MICRO SYSTEMS

Cybernetic Micro Systems produces a line of ASICs to interface to a variety of periph-

erals that would be difficult to control from a general-purpose computer. These chips provide a programmable interface to the low-level functions of the peripheral. The 100-pin, 8-bit P-51 microcontroller either sits between the host computer and the peripheral device or becomes the peripheral device. With a dual-port RAM interface on the host side (PC104/ISA format), the P-51 looks like memory to the host but has the intelligence and capability of an 8051, including a special square-root function, for the peripheral application.

► CYPRESS MICROSYSTEMS

Cypress MicroSystems' field-programmable, mixed-signal PSOC (programmable-system-on-chip) arrays target embedded-control functions in consumer, industrial, office-automation, telecom, and automotive applications. PSOC devices integrate an 8-bit processor core with programmable blocks of analog and digital logic in eight- to 100-pin devices in DIP, SSOP SOIC, MLF, and TQFP packages. All PSOC devices are dynamically reconfigurable during runtime, enabling designers to create system functions that can achieve more than 120% usage of the die.

The new CY8C24x94 family adds full-speed USB to the conventional PSOC features to create an economical full-speed USB microprocessor. It targets consumer electronics, HIDs (human-interface devices), and home and industrial automation. The CY8C21x23 and CY8C21x34 families are Cypress' smallest and least costly PSOCs with four digital and four analog configurable peripheral blocks. The general-purpose CY8C21x34 microcontroller supports capacitive touch-sense applications with no external components. These PSOC families target consumer and industrial-control applications, such as CapSense; fan controllers; battery chargers; security sensors and control; large sensor arrays; and smart temperature, pressure, and flow sensors.

The CYWUSB6953 PROC (programmable radio on chip) incorporates a PSOC device and wireless-USB technology in one integrated device. In addition to standard PSOC resources, the PROC includes a DSSS (direct-sequence spread-spectrum), 2.4-GHz radio system.

The CY8C42xxx family features a new high-voltage PSOC that can operate at a drain-to-drain voltage of 2.5 to 36V. In addition to the standard PSOC resources, it adds linear and switching control loops and high-voltage I/O, improves analog absolute accuracy, and is available with and without integrated FETs. The high-voltage PSOC targets power supplies, battery chargers, and white-LED drivers.

► DALLAS SEMICONDUCTOR MAXIM INTEGRATED PRODUCTS

Dallas Semiconductor offers four families of 8051-instruction-set-compatible microcontrollers that combine internal and I/O options with proprietary core designs to provide high-performance 8051 derivatives. Devices include one-clock/machine-cycle parts that can achieve operating speeds approaching 33 MIPS. The memory configurations for these devices are ROM-less, EPROM, and in-system-programmable flash memory ranging to 64 kbytes. The secure microcontrollers target applications demanding protective measures against IP (intellectual-property) theft. These devices employ encryption techniques that support ATMs, point-of-sale terminals, and data-logging applications.

The network microcontrollers provide low-cost connections for networking applications and include a built-in Ethernet MAC (media-access controller), complete TCP/IP-address stacking in ROM, CAN (controller-area networking), and parallel and serial ports. The devices use a microcontroller core running at 75 MHz with an extended 22-bit addressing range. The mixed-signal microcontrollers feature 12-bit analog-to-digital conversion and dual 8-bit PWM channels that are combinable to 16 bits, as well as multiple serial ports and extended parallel I/O.

► EM MICROELECTRONIC

EM Microelectronic's microcontrollers target applications that need ultralow current consumption, such as toothbrushes, shavers, scales, radio-controlled clocks, toys, headphones, TMPS (temperature-monitor power supply), metering, heat cost allocation, HVAC, smoke detectors, insulin pumps, security, sports, computer peripherals, and termination lines in communication. Product offerings include ROM or flash memory; as many as four multiplexer LCD drivers; an RC oscillator, a crystal oscillator, or both; EEPROM; an ADC; and high-drive outputs.

During the previous year, EM Microelectronic introduced the 8-bit, CoolRISC-based EM6812 family of microcontrollers, which targets industrial, consumer, computer peripherals, and automotive applications. The EM6812 consumes 0.15 mA in sleep mode, 0.8 mA in standby mode, and 120 mA in active mode; it operates at 2 to 5.5V. It has a function for fast wakeup from standby mode and operates at as much as 10 MHz (RC) or on a 32-kHz crystal oscillator. Additional features include a single-slope ADC, on-chip brownout detection, power-check functions at start-up, and flash read monitor.

► FREESCALE SEMICONDUCTOR

The 32-bit ColdFire processor family targets markets that require control, connectivity, and security in an integrated device. Building on its 68K legacy, Freescale expanded the ColdFire-processor family to meet the needs of the low-end, 32-bit-system market. The two new 32-bit families, MCF520x and MCF521x, enable designers to reduce memory, power dissipation, system-board size, and system costs.

Freescale's 32-bit PowerQuicc line consists of integrated communications processors based on the PowerPC core that provide data- and control-plane processing for wireless and wire-line infrastructure, enterprise networking, home and SOHO (small-office/home-office) networking, and pervasive computing.

Freescale's high-performance PowerPC processors with Altivec technology also support these applications. Freescale designed its new MPC8360E PowerQuicc II Pro communications processor family with Quicc Engine technology to reduce the cost of developing packet-based networking and wireless equipment. Freescale's latest PowerPC processors, including the MPC-7447A and 90-nm MPC7448, deliver gigahertz-class performance at less than 10W.

The company introduced the MAC7100 family for designers who need 32-bit performance for cost-sensitive automotive-body, -chassis, and -safety applications. Freescale's 16-bit, single-chip, 10/100-Mbps MC9S12NE64 Ethernet device can replace multichip Ethernet offerings. Freescale introduced the single-core MPC5200-B telematics- and automotive-infotainment processor, boasting 885 MIPS and capable of handling audio compression decoding and encoding and video decoding.

► FUJITSU MICROELECTRONICS AMERICA

Fujitsu's 32-, 16-, and 8-bit microcontrollers include general-purpose and application-specific versions, targeting automotive, communications, computer-peripheral, industrial, and consumer applications.

Fujitsu's premier FR60 Lite series provides 32-bit performance at 16-bit prices for mobile devices and consumer products, with versions that include LCD controllers and feature power requirements as low as 1 mA/MHz. The newest FR60 Lite versions, the MB91F267 and MB91266, incorporate multifunction timers for inverter control of motors in advanced air conditioners, refrigerators, washing machines, vacuum cleaners, and other appliances. Inverter equipment inputs a dc that the system changes into ac. The 32-bit RISC core in the FR60Lite series meets power

requirements of less than 2 mA/MHz. The RISC core completes basic instructions in one clock cycle with an optimized pipeline.

Fujitsu's new family of microcontrollers, the MB9140x series, targets network-enabled household appliances. These 32-bit microcontrollers incorporate networking-security features, onboard ROM and RAM, and support for IPv6. The MB9140x supports IPv6 and includes encryption circuitry supporting the AES (Advanced Data Encryption Standard), DES (Data Encryption Standard), and 3DES (Triple DES). The encryption circuits are 150 to 200 times faster than software-based encryption and are complemented by authentication circuitry. The series also supports the MD5 (Message Digest 5) and SHA1 (Secure Hash Algorithm 1) authentication standards, key exchange methods DH 1/DH 2, and the IKE (Internet Key Exchange) protocol with a hardware engine.

The newest members of Fujitsu's 8-bit F2MC-8FX series, the MB95F118 and MB95F108H, integrate 60-kbyte dual-operation flash, a LIN (local-interconnect network), multiple PPGs (programmable pulse generators), and a 10-bit ADC. The instruction-cycle time is as fast as 100 nsec.

► GOAL SEMICONDUCTOR

Goal Semiconductor offers a range of 8-bit microcontrollers targeting embedded data-acquisition systems. Its latest family of high-performance microcontrollers is 8051-compatible and operates at 40 MIPS. The VRS2000, the first family in this new series, includes an advanced hardware-arithmetic unit and flash programming, debugging, and emulation with a JTAG interface. The VRS2000 provides a one-chip platform for applications from industrial control and instrumentation to portable and medical devices.

Goal's other products include mixed-signal and low-cost industry-standard flash 8051 microcontrollers for embedded systems in industrial, consumer, instrumentation, automotive, and communication markets. The Versa Mix family of integrated, mixed-signal 8051 microcontrollers targets signal-conditioning, data-acquisition, processing, and control applications. Features for these devices include a hardware multiply-accumulate unit, an ADC, an op amp, a current source, digital potentiometers, and communication interfaces. The Versa microcontroller series of low-cost, 8-bit, 8051-based microcontrollers are cost-efficient drop-in replacements for industry-standard devices. The VRS1xx family of Versa microcontrollers features ISP/IAP (in-system-programming/in-application-programming) capability.

► HYPERSTONE

The Hyperstone family of 32-bit single-core, RISC/DSP processors perform parallel RISC- and DSP-instruction execution. They achieve fast execution of RISC/DSP instructions with the use of an ALU for normal RISC-instruction execution, and a separate DSP-instruction execution unit. The devices execute RISC and DSP instructions transparently to the user and with a high degree of parallelism, sharing a set of registers. All instructions, including those performing DSP functions, use RISC principles based on the load/store architecture. Instructions are variable in length to be memory- and speed-efficient. The E1-32XSR/XSUR processor cores target low-cost, compact, and energy-efficient designs.

During the previous year, Hyperstone introduced the HyNet32S networking processor, a cost-effective version of the HyNet32XS that the company also bases on a core similar to the E1-32XSRU RISC/DSP processor core. It can operate at a maximum clock rate of 200 MHz and includes a YuV interface for CCIR656-compliant video input, as well as 10/100-Mbps Ethernet support. The HyNet32S employs four internal buses with a six-channel DMA controller to complement internal RAM, boot ROM, dual instruction/data caches, an MMU, and a time-processor unit.

► INFINEON TECHNOLOGIES

Over the previous year, Infineon introduced its first 8-bit microcontroller with on-chip flash; six new 16-bit microcontrollers for automotive and industrial applications; and three TriCore-based microcontrollers, including the first with embedded flash. Infineon's processors are available as stand-alone devices and embedded-processor cores. The devices in the 8-bit C500 and C800 families are compatible in architecture and software with the 8051 microcontroller. The XC866 is a warp core-based device with on-chip flash, an ADC, and a motor-control unit that targets industrial-motor-control, automotive-body, and consumer drives.

The 16-bit C166 family of microcontrollers targets industrial-control, automotive-electronics, PC-peripheral-control, and consumer-electronics applications. The XC164CM provides double the performance at the same clock speed as earlier generations of the C166. The XC164N/D/S device families offer a scalable peripheral set, including a CAN (controller-area network), an ADC, and motor control for industrial applications. The XC167CI/CS/CS family of microcontrollers features large embedded flash memory to support applications such as electronic power steering.

The XC164S/D/N peripherals include capture/compare, CAN controller, and MAC (multiply-accumulate) units for robotics, networked systems, and other industrial-control applications.

The TC1100/TC1115 TriCore microcontrollers target robotics and industrial-networking applications, as well as industrial high-performance electrical-motor drives. The TC1796 is the first broadly available TriCore-based microcontroller with embedded flash memory; it targets automotive-engine, transmission-control systems, as well as industrial-drive applications. The C166S and TriCore-based TC-1MP synthesizable cores are available in the Synopsys DesignWare Star IP (intellectual-property) program. The Linux-capable TC1130 microcontroller targets industrial and communications applications. The TC1796 meets automotive-power-train and control needs.

► INFRANT TECHNOLOGIES

Infrant's highly integrated NSPs (network-storage processors) target NAS (network-attached-storage) and media-server-appliance applications. The NSPs enable efficient network-storage devices by integrating Gigabit Ethernet, multiple Serial ATA hard-disk interfaces, and hardware-based RAID (redundant array of inexpensive disks) 0/1/5 redundancy into a single device.

Infrant's second-generation NSPs, the IT3102 and IT3107, target the home-media-server and SOHO (small-office/home-office) NAS markets. The IT3102 embeds two channels of Serial ATA controller, and the IT3107 integrates four. In addition to hardware RAID 0/1/5, the IT3100 supports X-RAID, Infrant's patent-pending expandable RAID technology that enables expansion of the NAS array from one to four drives.

► INTEGRATED DEVICE TECHNOLOGY

The IDT (Integrated Device Technology) Interprise family of integrated communications processors delivers data processing at line-rate speed with processing headroom for value-added features. IDT based the processor cores on the 32-bit MIPS ISA (instruction-set architecture). Interprise processors and their development tools facilitate designs for SOHO (small-office/home-office) routers, Ethernet switches, WAPs (wireless-access points), VPN (virtual-private-network) equipment, and more.

IDT's RC32434 Interprise integrated communications processor, operating as fast as 400 MHz, targets the digital home network, which includes multimedia applications, such as media servers, media adapters, and IP (Internet-Protocol)-based network appliances. The integrated nonvolatile

RAM and an authentication unit for security functions enable digital-content-protection applications and identification storage.

The RC32365 Interprise processor integrates a hardware-accelerated IPsec (IP-security) engine that improves the operating frequency by 20%, to as much as 180 MHz with 70 Mbytes/sec of IPsec throughput. IDT has introduced enhanced versions of the RC32332 and RC32333 processors that offer power reduction.

► INTEL

Intel offers an extended family of network and communications processors targeting applications with increasing processing demands created by faster line speeds and deeper packet-inspection requirements of content-based services, as well as to support multiple protocols and evolving industry standards. The IXP460 and IXP465 network processors, the latest additions to the IXP4XX product line, offer a higher speed Intel XScale core, expanded connectivity options, and enhancements of end-system reliability and security. The IXP2325 and IXP2350 network processors target network-access and -edge applications by combining data-plane- and control-plane-processing capabilities in a single chip; they are the first network processors Intel has built on 90-nm process technology.

Intel's 64-bit-capable low-voltage Xeon processor operates at 2.8 GHz and has a 800-MHz system bus. It targets storage applications, such as controllers for storage networks. The new processor features Intel EM64T to extend memory addressability of storage systems beyond 4 Gbytes, which eliminates performance penalties associated with large storage applications, such as database programs. Additional introductions include the Pentium M processor 760, Celeron M processor 370, and Celeron M processor ultra-low-voltage 373.

► MICROCHIP TECHNOLOGY

Microchip bases its PIC microcontrollers, which enable designers to migrate from six- to 84-pin devices among all families with little or no code changes, on the PIC RISC architecture.

Major 8-bit PIC-microcontroller introductions from Microchip this year include the PIC10F, with flash memory, in a six-pin, SOT-23 package. The company integrated two low-pin-count PIC microcontrollers with the Keeloq cryptographic peripheral targeting secure-data-transmission and authentication applications, such as battery-clone elimination. The PIC16F785 makes it easier for power-supply designers to use the programmability of digital control in power-conversion applications by



integrating analog building blocks.

Microchip brought many high-memory/high-pin-count, 8-bit PIC18F microcontrollers to production, including two general-purpose families with 40-MHz operation at 5 and 3V, 128 kbytes of flash, and peripherals in 80-pin packages. Function-specific PIC18Fs include a full-speed USB 2.0 family. An expansion of the CAN (controller-area-network) family combined the ECAN (enhanced-CAN) module and Nanowatt Technology power management inside a 28-pin CAN microcontroller with 64 kbytes of flash memory. The company added eight members to the LCD PIC microcontroller family, including a 28-pin device and programmable 80-pin microcontrollers that can drive 192 segments.

Microchip also introduced wired and wireless embedded-connectivity products. The PICDEM Z 2.4-GHz demonstration kit supports the ZigBee wireless protocol with development hardware and Microchip's free ZigBee stack, which works with PIC18s. The 28-pin ENC28J60 Ethernet controller can connect to any microcontroller via an SPI serial interface (rather than PCI or ISA). Microchip also offers a free TCP/IP stack for all PIC18s.

The dsPIC family of DSCs (digital-signal controllers) features a DSP engine with 30-MIPS nonpipelined performance implemented with a C-compiler-friendly microcontroller architecture and design environment. The 20 dsPIC30FXXXX 16-bit flash DSCs target motor-control, power-conversion, sensor, and general-purpose applications.

Microchip entered 18 dsPIC DSCs into volume production this year, including one it offers in a 636-mm QFN package. This family spans 18 to 80 pins. Microchip offers new software libraries for the dsPIC, many free or available for a one-time fee.

► MIPS TECHNOLOGIES

MIPS Technologies offers processor architectures and cores targeting digital consumer and business applications. The company licenses its 32- and 64-bit RISC IP (intellectual property) to semiconductor companies, ASIC developers, and system OEMs. Core families include the MIPS 32 4K, 4KE, M4K, 4KsD, 24K, 24KE, and Pro Series processor cores.

MIPS Technologies recently introduced the MIPS32 24KE family of cores—the first to integrate the MIPS DSP ASE (application-specific extension), which the company announced last year. The 24KE core family leverages the high-performance 24K microarchitecture, adds DSP functions, and reduces overall SOC (system-on-chip) die area, cost, and power consumption. The 24KE Pro family supports the CorExtend

capability and includes features such as ultrafast multiplication, intelligent caches, and floating-point support, making it suitable for interactive television, set-top boxes, DVD, and other performance-driven applications.

► NATIONAL SEMICONDUCTOR

National Semiconductor's CP3000 connectivity-processor family combines a RISC core with on-chip SRAM and flash memory, hardware-communications peripherals, and an expandable external bus to target embedded-system-communications applications, such as vehicle-network gateways, hands-free car kits, and industrial/medical instrumentation and control. National Semiconductor's single-chip CP3000 processors feature Bluetooth-lower-link-controller, USB, CAN (controller-area-network), Access.bus, Microwire/Plus, and Advanced Audio interfaces.

The COP8 flash microcontrollers feature an 8-bit core and as much as 32 kbytes of onboard flash that designers can use as data or program storage and work for more than 100,000 delete/write cycles. The devices offer virtual-EEPROM functions, in-system programming, and integrated analog- and mixed-signal functions for stand-alone and Internet-controlled applications.

► NEC ELECTRONICS AMERICA

NEC Electronics America's 8-bit K0 and K0S families, also available with embedded flash memory, provide low power consumption and integrate peripherals such as LCD drivers and controllers. The microcontrollers target consumer appliances and industrial-control applications. The 32-bit V850 family delivers 32-bit-processing performance, low-voltage operation, DSP functions, and on-chip peripherals targeting consumer-electronics and other embedded-system applications. The 64-bit VR Series MIPS-based microprocessors provide high-performance and scalability targeting embedded systems from Internet and digital consumer devices to servers and switches.

Over the past year, NEC expanded its 32- and 8-bit microcontroller offerings. The company introduced to the V850 family the V850E2/ME3, a 32-bit microcontroller for use in inverters, industrial equipment, printers, and digital consumer products. On the 8-bit side, NEC announced the 78K0/Fx series of microcontrollers for automotive-body applications and the 8-bit 78K0/Kx2 series, featuring embedded flash memory, for use in home appliances, consumer-electronics products, industrial equipment, and sensor applications.

► NETSILICON

NetSilicon offers processor families based

on the ARM 7 and ARM9 cores. It bases the NS9750 and NS9775 on the ARM 926EJ-S core. The NS9750 integrates Ethernet, USB, PCI, LCD, 1284, and serial I/O. The NS9775 is a high-performance color-laser-printer processor and integrates Ethernet, USB, and PCI to improve the cost performance of color laser printers.

► OKI SEMICONDUCTOR

Oki's Advantage microcontroller family comprises ARM-core based products ranging from the ML671000 with a built-in USB controller to the high-performance, 120-MHz ARM946E-based 6200 Series with instruction and data cache. Oki's 4060, 4050, 675K, and 674K series ARM7 Advantage microcontrollers offer variations in frequencies, memory sizes, cache, features, and packages. Devices in Oki's 675K series have an operating frequency of 60 MHz and 8 kbytes of unified cache; the 674K series operates at 33 MHz. The pin-compatible 675K and 674K series are available with ROMless, 256 and 512 kbytes of flash for easy performance, and memory upgrades.

Oki Semiconductor added a small ARM microcontroller to its product family. Oki's new 4060 series includes a 4.84×5.09-mm, 64-pin wafer-chip-size package with embedded flash, ADC channels, selectable clock gears, and standby modes drawing 25 mA from one 2.5V supply. QFP and BGA packages are also available.

The 6200 series features an ARM9 core with an integrated USB 2.0 and PHY (physical layer) on one chip. The 6200 series, with its ARM946ES core, comprises the ML696201 (ROMless) and the ML69-Q6203, which includes 512 kbytes of flash memory. These products feature a high-speed USB 2.0 interface with on-chip MAC (media-access-control) and PHY layers, Ultra-DMA66 hard-drive controller (ATA), NAND flash, and a Smart Media controller.

► PHILIPS SEMICONDUCTORS

Philips Semiconductors offers 8-, 16-, and 32-bit devices targeting low- to high-end applications in the consumer, communications, computing, medical, connectivity, and automotive industries. The latest offering from Philips is the LPC3000 family of microcontrollers, a 90-nm ARM9-family-based 32-bit microcontroller that Philips based on its Nexperia platform. The LPC3000 family runs at 1V at speeds to 200 MHz. The LPC3000 family features a USB, a real-time clock, a NAND-flash interface, Ethernet, and a vector floating-point coprocessor for full support of single- and double-precision calculations.

Philips based the LPC2100 family on a 1.8V ARM7DMS-S core. The devices

operate as fast as 60 MHz and include a host of peripherals, such as multiple serial interfaces, a 10-bit ADC, and external-bus options. It bases the LPC700 family, targeting applications that demand low-voltage, high-integration, and low-cost, on a high-performance, six-clock 80C51 that executes instructions at twice the rate of the standard 80C51. The LPC900 family targets applications that demand low voltage, high integration, and low cost over a range of performance requirements.

► PMC-SIERRA

PMC-Sierra's MIPS-based processors target metropolitan transportation, storage-area networking, wireless equipment, VOIP (voice over Internet Protocol), Internet-routing equipment, and enterprise switches, as well as multifunction- and laser-printer applications. The PMC-Sierra family of 64-bit, integrated 1-GHz dual- and single-CPU core devices deliver high performance, low latency, and low power with integrated standard interfaces, including PCI, DDR1 and DDR1 memory controller, Gigabit Ethernet, and HyperTransport. Pin-compatible devices from 250 to 900 MHz enable seamless performance scalability.

The Multi-Service Processor family, PMC-Sierra's newest MIPS-based offering, targets VOIP-terminal applications, such as wired and wireless terminal adapters, home gateways, and voice-enabled routers.

► QUICKLOGIC

The QuickMIPS family combines an embedded-processor subsystem and programmable logic on a single die. QuickLogic develops intellectual property and software to target applications that distribute digital media over Internet Protocol networks, including in-car infotainment, digital signage, overhead projectors, and medical imaging. QuickLogic offers modules, such as video compression/decompression, encryption, and digital-rights management. This device architecture provides opportunities for designers to make trade-offs in implementing system functions in hardware for improved performance or in software for increased system flexibility. QuickLogic's Vialink technology helps protect user-developed IP in the programmable logic from tampering.

► RABBIT SEMICONDUCTOR

Rabbit Semiconductor offers low-EMI microprocessors for embedded control, communications, and Ethernet connectivity. The Rabbit 3000/2000 processor families feature a glueless architecture and Dynamic C development software. The high-perform-

ance, 8-bit Rabbit 3000 processor features LQFP or TFBGA packages, clock speeds as high as 55.5 MHz, ultralow-EMI communication capabilities, support for TCP/IP, 1.8 to 3.6V operation, and 5V-tolerant I/O.

► RENESAS TECHNOLOGY

Renesas Technology's product portfolio includes 8- to 32-bit microcontrollers and microprocessors targeting embedded-system applications. More than 150 microcontroller offerings operate from 1 to 80 MHz with on-chip flash memories of 8 kbytes to 1 Mbyte. For home appliances, such as white goods, Renesas offers low-power, cost-sensitive 4- to 16-bit microcontrollers in the R8C/Tiny, H8/Tiny, R8/SLP, 740, and 4500 series. Devices in the SuperH and M16C/M32R families target automotive, in-car-navigation, and industrial applications. For PC/server applications, the 16- and 32-bit microcontrollers in the H8 family balance function and performance. The M16C and M32 families target consumer applications, and Renesas' AE series chips smart-card platforms have 68 kbytes of EEPROM and a 1024-bit encryption coprocessor.

Renesas introduced three new groups of devices in the low-pin-count, small-package R8C/Tiny series that suit cost-sensitive applications; these 16-bit microcontrollers feature clock oscillators, power-on-reset and low-voltage-detect functions, and 10-bit ADCs. They can act as the main processors in appliances or as subprocessors in large systems. Two 32-bit, 50-MHz microcontrollers, the H8SX/1653F and H8SX1651, have a serial communication interface that handles both asynchronous and clock-synchronous data transfers and enables them to target PC peripherals and point-of-sale terminals.

Targeting automotive systems, M16C/29 microcontrollers offer as much as 128 kbytes of flash memory and a CAN (controller-area-network) Version 2.0B interface; they produce low levels of EMI and withstand high levels of EMI from external sources. For in-vehicle navigation and infotainment systems, the SH7080 32-bit RISC microprocessor uses a 400-MHz SH-4A CPU core that delivers 720-MIPS, 2.8-GFLOPS performance. It supports advanced functions, such as speech recognition and synthesis without an external DSP.

► SAMSUNG ELECTRONICS

Samsung's S3C2410 and S3C2440 minimize system cost and eliminate the need to configure additional components by featuring common peripherals for mobile-system applications, such as wireless handheld devices, smart phones, and GPS (global-positioning-system)-enabled portables.

These processors feature a 16/32-bit ARM920T RISC core. Samsung developed the processors using CMOS-standard cells and a memory compiler, and both adopt the AMBA (Advanced Microcontroller Bus Architecture). Both processors include a built-in NAND flash boot loader, and they support WinCE, Palm, Symbian, and Linux operating systems.

► SHARP MICROELECTRONICS

Sharp's ARM-based, 16- and 32-bit BlueStreak microcontrollers range from ARM7 devices for cost-conscious applications, to high-performance ARM9 devices for media-rich environments. The 16/32-bit ARM7 BlueStreak microcontrollers feature on-chip SRAM, a color and gray-scale LCD controller, CAN (controller-area-network) 2.0B, and a low-voltage detector that enables them to target applications such as GPSs (global-positioning-systems), PDAs, printers, copiers, security-control panels, and smart appliances. The 32-bit series of BlueStreak microcontrollers feature cache, an MMU, a color-LCD controller, SRAM, a DMA controller, infrared support, pulse-width modulators, and an on-chip PLL. The ARM9 LH7A400 and LH7A404 add USB and MMC to target handheld devices, such as GPSs, games, PDAs, and pocket PCs.

► SILICON LABORATORIES

Each of Silicon Laboratories' 8-bit mixed-signal microcontrollers integrates high-performance analog peripherals; a high-speed, pipelined 8051 CPU; ISP (in-system-programmable) flash memory; and on-chip JTAG-based debugging. All of Silicon Labs' processors feature in-system debugging, eliminating the need for an emulator.

Silicon Labs' single-chip USB products integrate a full-speed USB 2.0 function controller and on-chip clock recovery. Silicon Labs' single-chip CAN (controller-area-network)-bus products integrate a CAN 2.0B controller and high-performance ADCs. The precision mixed-signal microcontroller family combines high-precision analog data converters from 10 to 24 bits of resolution with a high-throughput 8051 CPU targeting analog and computationally intensive applications. Silicon Labs' small-form-factor family of microcontrollers packs the benefits typical of the company's microcontroller line into small micro leadframe packages.

Over the past year, Silicon Labs announced the CP2102, a small and highly integrated, single-chip USB-to-UART bridge. The CP2102 simplifies the upgrade from RS-232 to USB by including royalty-free drivers that eliminate the need for additional software. Silicon Labs also announced its entry into the short-range-

wireless market with the 802.15.4 and ZigBee development kits. Silicon Labs' ZigBee-ready devices leverage precision mixed-signal microcontrollers that combine high-precision analog peripherals and a high-throughput 8051 CPU with flash memory targeting wireless automation, industrial, medical, and residential-monitoring and -control applications.

► SILICON STORAGE TECHNOLOGY

Silicon Storage designs and manufactures various densities of flash-memory components, flash mass-storage products, and flash microcontrollers targeting the digital-consumer, networking, wireless-communications, and Internet-computing markets. SST's flashFlex51 family of 8-bit, Superflash CMOS microcontroller products implements the 8051 architecture and instruction set. These microcontrollers include in-application-programming and hard- and soft-lock security features. The flash-Flex51 microcontrollers target the high-reliability, high-flexibility, low-voltage, and low-power requirements of today's computer peripherals, communication equipment, digital consumer/appliances, and networking applications.

► STMICROELECTRONICS

STMicroelectronics offers 8-, 16-, and 32-bit microcontrollers and microprocessors, including a family of ARM7-based microcontrollers, and application-specific devices for motor control, USB, and CAN (controller-area-network) applications. The 8-bit portfolio includes the "bulletproof" ST6 family, the 8051-based microPSD family, and the ST7 family. Other devices include the ST7MC, for controlling three-phase brushless motors, and a 3V version of the ST72324 general-purpose microcontroller. New devices include a turbo-plus version of the microPSD. The ST9 family represents high performance at low costs for 8- and 16-bit-device applications.

The company offers 16-bit devices with the ST10 family, which includes devices operating as fast as 50 MHz with a four-stage pipeline. The 32-bit STR-ARM family, based on the ARM7 core, supports the Thumb 16-bit ISA (instruction-set architecture) and features peripherals such as USB, CAN, and buffered SPI. The SH4-based ST40 is available as a standard product for high-performance applications. For x86 designs, the STPC is available in several configurations to provide PC-on-chip systems to take advantage of x86 software.

► STRETCH

The Stretch S5000 family of software-configurable processors, based on the S5 engine, boosts system performance by

enabling customized acceleration through the embedded programmable logic within the processor engine. The processors' design architecture and methodology merge the software model of general-purpose processors and the parallelism and flexibility of programmable logic to deliver customizable acceleration. The Stretch S5 engine, which powers every S5000 processor, integrates the Stretch ISEF (instruction-set-extension fabric) with the Tensilica Xtensa RISC-processor core. With Stretch's proprietary technology, developers use C/C++ to program the processor and "configure" the ISEF with custom instructions. Designers can tailor Stretch processors to address computationally intensive applications in markets such as high-end consumer electronics, medical imaging, telecom, networking, and military.

This year, Stretch completes the introduction of the S5000 family with the release of the S5620 and S5500 software-configurable processors. Based on the Stretch S5 engine, each processor incorporates a 300-MHz, 32-bit Xtensa core with integrated programmable logic; embedded memory; and peripherals targeting high-performance, computationally intensive applications. The S5620 offers performance enhancements to systems using PowerPC-based processors in applications in which computational-function offloading is critical.

► TENSILICA

Tensilica licenses the Xtensa V and Xtensa LX processor cores. The Xtensa V is Tensilica's configurable and extensible 32-bit RISC processor. The Xtensa 32-bit architecture features a compact instruction set for embedded-system designs. The basic architecture has a 32-bit ALU; as many as 64 general-purpose physical registers; six special-purpose registers; and 80 basic instructions, including compact, 16- and 24-bit, rather than 32-bit, RISC-instruction encoding.

Tensilica introduced the Xpres (Xtensa Processor Extension Synthesis) compiler for Xtensa LX only. The Xpres synthesis tool creates tailored processor descriptions for the Xtensa LX processor from native C/C++ algorithms. For small algorithmic kernels, the Xpres compiler explores potential configurations in just minutes. For large application programs, the Xpres compiler can explore millions of potential combinations of processor configurations in less than an hour. It supports fine-tuning-control options that are fully integrated into the Xtensa Explorer design environment.

The Xtensa LX adds I/O and computational performance to the basic Xtensa V architecture. It implements Tensilica's Flix

(flexible-length-instruction-extension) architecture, which is a configuration option that allows designer-defined instructions to comprise multiple independent operations bundled into a 32- or 64-bit instruction word. The LX seamlessly intermixes wide, 32- or 64-bit Flix formats with the base Xtensa instruction-set architecture's 16/24-bit instructions.

► TEXAS INSTRUMENTS

TI's MSP430 platform of ultra-low-power, 16-bit RISC microcontrollers targets battery-powered measurement applications and enables systems to simultaneously interface to analog signals, sensors, and digital components. The architecture features power consumption at 0.1 mA for RAM retention, 0.8 mA during real-time-clock mode, and 250 mA/MIPS while active. Key target applications include utility metering, portable instrumentation, and intelligent sensing.

The new MSP430F2xx microcontroller family provides twice the processing performance and half the standby power consumption of earlier devices. Devices feature a real-time-clock-standby mode of less than 1 mA with the ability to switch in less than 1 msec to a fully synchronized 16-MIPS active mode. Low-power standby current and instant-on active mode enable designs using smaller, lower cost batteries in applications such as portable medical instruments and security systems.

The new low-cost, signal-chain-on-a-chip MSP430F42x0 microcontroller targets high-precision sensing and measurement applications.

New, general-purpose TMS470 32-bit RISC ARM7TDMI-based microcontrollers feature single-cycle access to embedded flash at as much as 60 MHz in pipeline mode and support high accuracy for timing functions using a programmable, 32-channel, high-end timer. The TMS470 includes a leading multibuffered, 10-bit ADC with a 1.55-msec conversion time as well as enhanced CAN (controller-area-network) controllers that offload the CPU for a higher system performance.

► TOSHIBA AMERICA ELECTRONIC COMPONENTS

Toshiba offers highly integrated, 8-, 16-, and 32-bit CISC microcontrollers and a family of 32- and 64-bit MIPS-based RISC microprocessors.

Toshiba this year rounded out its microcontroller product offerings with low-power, LCD-type embedded flash microcontrollers targeting heating and metering applications. Toshiba announced the development of NANO flash in the 32-bit TMP19A43-

FDXBG, which combines high-density embedded memory with ultralow power consumption. Toshiba launched the TX4939XBG-400, its first embedded PCI-based processor using 90-nm process technology; it targets digital-consumer applications. Toshiba also introduced the TX9956CXBG; operating at 533 or 666 MHz, it targets multifunction printers and high-end set-top-box applications.

Continuing to execute on its strategy to offer focused platforms, Toshiba introduced the AVM49R TX System RISC multimedia reference platform for IP (Internet Protocol) set-top box, digital-multimedia appliances, and home gateways.

► TRANSMETA

Transmeta develops and offers computing technologies that improve performance, reduce power consumption, and control heat generation in electronic devices. The company deploys its technology and IP (intellectual property) through licensing, synergistic engineering services, and customized processor development, using a

unique partnership model. Transmeta's x86-compatible, software-based microprocessors target high-volume applications that demand high performance, energy efficiency, and x86-software compatibility. Transmeta also develops advanced power-management technologies for controlling leakage and increasing power efficiency in semiconductor and electronic devices.

The Efficeon processor targets power-efficient x86 applications by featuring a 256-bit-wide VLIW (very-long-instruction-word) engine that can execute as many as eight instructions per clock cycle; a 1-Mbyte L2 cache; and support for MMX (multimedia extension), SSE (streaming-single-instruction-multiple-data-extension), SSE2, and SSE3 instructions.

► UBICOM

Ubicom offers wireless-network processors that can implement communication and control functions in software, so that one processor can support many device interfaces and protocols. All IP2022 family products are deterministic and use an enhanced,

four-stage-pipelined Harvard architecture. The devices feature single-cycle instruction execution and a fixed, deterministic three-cycle interrupt response time.

On-chip program memory for the IP2022 family comprises reprogrammable flash with additional instruction SRAM to deliver fast access and high processor performance. Ubicom's previous-generation IP2022 processor runs at 120 MHz and targets wired- and wireless-networking applications. The processor also implements I/O in software and features single-cycle instruction execution; deterministic operation; on-chip flash and RAM; and flexible, general-purpose I/O.

Ubicom's IP3000 family devices drive high-data-rate standards and multifunction wireless devices. The first family member, the IP3023-250, targets high-performance network devices or 802.11 a/b/g-infrastructure equipment, such as routers, bridges, and access points. The devices feature single-cycle instruction execution and a fixed, deterministic, three-cycle interrupt response time.

The IP3023 processor targets SOHO (small-office/home-office) wireless-system applications and can operate as eight separate processors running at speeds as high as 250 MHz in 3.9-MHz increments by providing eight-way multithreading and zero-cycle context switching between the threads. For wireless-networking applications, the IP3023 can deliver, without data compression, line-speed NAT (network-address-translation) routing on 10/100 Mbps of real data throughput with 802.11 a/g radio chip sets using turbo mode.

► **VIA TECHNOLOGIES**

Via offers power-efficient processors for the x86 personal-electronics and embedded-device markets with a range of feature-rich Via digital-media chip sets. Via divides its processors into five product families that it bases on power consumption and performance criteria ranging from fanless operation to power-saving capabilities for battery-operated mobile devices: the Via C7 and Via C7-M (Mobile), fanless Via "Luke," Via Eden-N, fanless Via Eden ESP, Via C3-M (mobile), and Via C3 processors.

► **XEMICS**

Xemics offers 8- to 22-bit microcontrollers that interface sensors and radio transceivers and target autonomous battery-operated wireless devices. These devices operate at a constant one instruction per clock that is independent of the type of operation and addressing mode. The dedicated interface blocks; high-resolution, pre-amplified ADC; and transceiver serializer/deserializer all enable miniature wireless-sensing applications, reducing the bill-of-materials costs by eliminating external components.

The Radio Machine device for ISM (industrial, scientific, and medical)-band transceiver interfacing, includes a low-power RISC core with the BitJockey, a serial interface for radio protocols, and a UART. The Sensing Machine device for sensor interfacing includes a low-power RISC core with the ZoomingADC and a high-resolution sigma-delta ADC with a programmable preamplifier.

► **XILINX**

Xilinx offers processor and silicon platforms that enable designers to optimize performance and prices for their applications. The PowerPC 32-bit core is immersed (hard) in the Virtex family of FPGAs. New offerings include dual 32-bit embedded PowerPC processors running at 450 MHz on the Virtex-4 FX platform.

New features include an integrated APU (auxiliary-processor-unit) controller and dual integrated trimode Ethernet MACs (media-access controllers). The APU enables designers to extend the native PowerPC instruction set and improve software-algorithm execution with application-specific hardware accelerators implemented in the FPGA logic.

The 32-bit, configurable, general-purpose RISC MicroBlaze soft core processor is available with Spartan and Virtex-platform FPGAs. The latest version of the Xilinx MicroBlaze 32-bit configurable soft-processor core delivers a 25% increase in core performance over previous versions. In addition, MicroBlaze includes a tightly integrated FPU option, user-configurable hardware options, and optimized debugging logic. The 8-bit PicoBlaze microcontroller can target Spartan FPGAs and CoolRunner CPLDs.

► **ZILOG**

Zilog provides 8-bit micrologic semiconductors for embedded control and communication applications in markets such as consumer electronics, home appliances, security systems, POS (point-of-sale) terminals, PC peripherals, industrial, and automotive. Zilog has four families of microprocessors: The Z8 and Z80 are its legacy microprocessor architectures, and the Z8 Encore! and eZ80 Acclaim! are next-generation microprocessor architectures. In most of its micrologic devices, a microprocessor joins with ROM, OTP (one-time-programmable), or flash memory. The company also sells a stand-alone, general-purpose Z80 microprocessor that does not integrate memory.

Zilog continues to focus on the 8-bit-system market, adding application-specific features that target universal-remote-control, home-appliance, computer-peripheral, security, sensor, and industrial-automation applications. Zilog extended the Z8 Encore! XP family with an eight-pin device that includes the on-chip features and functions of its larger counterparts. It also this year launched the Z8 Encore! GP323 family of low-cost, low-power, general-purpose microcontrollers. Zilog continues to extend the Z8 Encore! and XP families to include additional flash-memory options. It also extended the Crimson microcontroller family to include additional ROM versions. **EDN**

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