

Tuned

Up

30th ANNUAL

MICROPROCESSOR DIRECTORY

**NEW PROCESSOR
OFFERINGS CONTINUE
TO DELIVER OPTIMIZED
CONFIGURATIONS THAT
PROVIDE "TUNED" PRO-
CESSING ENGINES FOR
SPECIFIC APPLICATIONS.**

By Robert Cravotta, Technical Editor

WELCOME to the 30th consecutive annual *EDN* Microprocessor/Microcontroller Directory. This year's directory marks the beginning of an effort to make it a viable and dynamic online resource. An online database of the directory is not a new idea, and, in fact, an online version did exist a number of years ago, but the database was vulnerable to changes in Web-server engine tools. An online presentation allows *EDN* to continue delivering the directory to you despite the number of entries growing each year and exceeding the number of pages available for print. In years past, *EDN's* print version has included only a portion of the device table; this year, you will find the table exclusively at *EDN's* Web site. The print version contains an alphabetical company and product summary to give you a high-level overview of this year's companies and their products.

You can view the online versions of the table in two ways. The PDF versions are suitable for printing and are similar to the content-dense tables of previous years. This year's directory table includes more devices than in previous years—partly because new devices are available and partly because we loosened the device-grouping restrictions to offer finer granularity between comparable device families. Although each PDF version is static, the tables improve on last year's offerings by sorting along multiple columns, rather than alphabetically by company, to help you best find the devices you are looking for.

The second way to view the directory-table data is to access it directly online from *EDN's* Web site. The current online presentation engine allows you to sort the table along a single column of your choosing. The current table viewer is a crude, proof-of-concept engine that will act as the springboard for an improved version with expanded viewing capabilities and eventual support for dynamically updating the database as processor vendors release new devices and cores.

A compromise for delivering any online viewing capabilities this year is that the data in each column of the online table

is the same as the data that the static PDF tables list. Therefore, you'll be unable to usefully sort some of the columns in the table because they contain multiple types of information. We hope to resolve this compromise in the future with a database viewer that can handle parameterized data more suitable for sorting but present it in a dense format appropriate for viewing.

This directory includes only software-programmable microcontrollers and microprocessors—including processor cores and programmable-logic devices with embedded-processor cores. The directory does not include digital-signal processors; *EDN* lists DSPs in an annual DSP directory, which it publishes six months out of phase with this one.

We welcome your feedback about the directory, because it can help us to make the directory and the presentation capabilities more useful to you. Please let us know what types of information you'd like the directory to include, such as development tools or third-party support cross-indexing for each device. Send your comments and feedback to mpdirectory@edn.com. And, if this directory helps you choose a processor, please let the vendor know how you found their part.

ALTERA—WWW.ALTERA.COM

Altera's Nios embedded processor is a soft-core CPU optimized for programmable logic and SOPC (system-on-programmable-chip) integration. It is a configurable, general-purpose RISC processor targeting Altera FPGAs. Altera provides IP (intellectual-property) cores for Nios systems, such as an SDRAM controller, a DMA engine, a UART, a timer, an SPI, parallel I/O, and interfaces for on- and off-chip memory that you can combine with your user logic to target a range of applications. A 16-bit Nios CPU running from on-chip memory can act as a sequencer or controller. A 32-bit Nios CPU with external flash program storage and large external main memory can act as a 32-bit embedded processor system.

Altera's Excalibur embedded-processor offerings integrate a complete ARM922T processor subsystem with Altera's programmable-logic architecture. The Excalibur devices allow stand-alone processor operation before configuring the FPGA. Altera's SOPC Builder system-integration tool facilitates the rapid development of embedded systems incorporating FPGAs. SOPC Builder, which comes with Altera's Quartus II design software, provides a graphical user interface for selecting the processor and pe-

ripherals, as well as user-defined peripherals. It automatically connects the components via an intelligent switch fabric and generates a custom software-development kit for system development.

ANALOG DEVICES—WWW.ANALOG.COM

Analog Devices' ADuC8XX MicroConverters family of data-acquisition systems offer signal processing and flash memory. They integrate an 8052 processor core with fast, multichannel, 12-bit SAR (successive-approximation-register) ADCs or low-bandwidth, sigma-delta, 24-bit ADCs; dual 12-bit DACs; 16-bit PWMs; and 8- to 62-kbyte flash memory. Recent offerings upgrade to a single-cycle 8052 core at 16.7 MHz and retain hardware and software compatibility with earlier versions.

Developers can choose the entry-level QuickStart Development or the enhanced QuickStart Plus system. The QuickStart Development kit incorporates an assembler, an in-circuit serial-port downloader, a serial-port debugger, and analog performance-analysis tools. The more feature-rich QuickStart Plus includes all of the tools in the basic kit, plus an entry-level C compiler, C-source debugging capabilities, and a single-pin emulation pod.

ARC INTERNATIONAL—WWW.ARC.COM

ARC's family of configurable and extendable microprocessor cores—the ARCtangent A4, A5, and earlier A3 series of 32-bit optimized cores—targets the critical performance and integration requirements of early technology adopters and developers who are re-engineering their products for cost-sensitive markets. ARC's portfolio of peripheral IP spans simplistic I/O functions and USB and WLAN complexity.

ARC's MetaWare brand of embedded-software products serves the divergent needs for both chip- and board-level integration. These software products include a C/C++ compiler and debugger; a software-prototyping tool; a software-profiling tool; and the Precise/MQX RTOS, a high-performance, royalty-free RTOS targeting embedded-networking, communications, and multimedia applications. The RTOS is tightly integrated with ARC's compact, high-performance embedded networking protocols to support an unlimited number of hardware interfaces, security options, and routing and connectivity standards.

AMD—WWW.AMD.COM

The AMD Alchemy Au1000, Au1500, and Au1100 processors; development-board

kits; and reference-design kits target personal-connectivity devices, such as PDAs, Web tablets, and portable and wired Internet-access devices and gateways. The integration of peripherals with AMD's high-performance, MIPS-compatible core provides lower system costs, smaller form factors, and lower system-power requirements at multiple performance points. The ÉlanSC5220 is an x86 controller targeting the data-communications, telecommunications, and information-appliance markets; it combines a 32-bit, low-voltage Am5x86 CPU with integrated peripherals suiting real-time and PC/AT-compatible embedded applications.

The AMD64 extends the industry-standard x86 instruction-set architecture across 32- and 64-bit platforms. AMD64 replaces terms such as Hammer (now, "AMD64 technology") and x86-64 ISA (now, "AMD64 ISA"). The AMD Opteron processor targets servers and workstations, and the AMD Athlon 64 processor targets desktop and mobile PCs. The AMD Athlon XP processor is compatible with AMD's Socket A infrastructure and features the QuantiSpeed architecture and support for AMD's 3DNow! Professional instructions for enhanced multimedia. AMD packages the low-voltage mobile AMD Athlon XP-M processors in a smaller μ PGA package to support "thin and light" designs. The AMD Athlon MP processor x86 processor targets multi-processing servers and workstations in environments that require high performance, compatibility, and reliability.

ATMEL—WWW.ATMEL.COM

Atmel provides standard products, ASICs, and application-specific options for the embedded-product market using seven microcontroller or microprocessor architectures. These architectures include the 4-bit Mark-4, which is optimized for low-power automotive applications, such as tire-pressure measurement; the 8-bit AVR and 8051; the 16-bit ARM Thumb; the 32-bit ARM and MIPS; and the 32-bit Sparc, which targets radiation-tolerant aerospace designs.

The AVR is the latest offering of flash microcontrollers. Atmel's low-power AVR microcontrollers have a RISC core running single-cycle instructions and a

well-defined I/O structure that limits the need for external components. AVR devices include internal oscillators, timers, a UART, an SPI, pullup resistors, pulse-width modulation, an LCD driver, an ADC, an analog comparator, watchdog timers, and on-chip in-system programmable flash memory and EEPROM. AVR instructions support smaller programs, whether the code is written in C or assembly language.

BROADCOM CORP—WWW.BROADCOM.COM

Broadcom's high-performance, low-power processors target next-generation network applications. These network processors support packet classification, queuing, forwarding, and exception processing for wired and wireless networks. They enable you to perform complex networking applications, such as deep content switching, routing, and load balancing at wire-speed line rates of OC-3 to OC-48 (2.5 Gbps). Broadcom's network processors also target network-storage applications that perform complex protocol conversions, virtualization, and proxy computations.

CIRRUS LOGIC—WWW.CIRRUS.COM

Cirrus Logic offers a family of high-performance embedded processors with multiple price-performance-integration points for consumer-entertainment and general-purpose uses. Cirrus' ARM family of processors offers highly integrated SOC devices covering a range of price-integration-performance points for optimal design options. Cirrus embedded processors support Linux and WinCE. net and benefit from the ARM third-party network.

CYBERNETIC MICRO SYSTEMS—WWW.CONTROLCHIPS.COM

Cybernetic Micro Systems produces a line of ASICs to interface to a variety of peripherals that would be difficult to control from a general-purpose computer. These chips provide a high-level programmable interface to the low-level functions of the peripheral. The P-51 is a 100-pin, 8-bit microcontroller that 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 it has the intelligence and capability of an 8051 (timers, counters, I/O ports, interrupts, and a special square-root function) for the peripheral application.

The P-51 is chainable, so you can replicate it for multitask processing on a single host, and it can deal with real-time peripheral hardware and interrupts when general operating systems for PC104 embedded applications cannot. It is in-circuit-programmable at reset, so you can easily download and upgrade 8051 code. And, it includes built-in debugging features (breakpoints and single-step) to allow in-circuit code development without an in-circuit-emulator.

CYGNAL INTEGRATED PRODUCTS—WWW.CYGNAL.COM

Cygnal Integrated Products designs, manufactures, and markets IC products that integrate analog with high-speed digital and flash memory in a single device. The mixed-signal integration and in-system programmability support higher component integration and greater design flexibility. Cygnal processors target communications systems, industrial equipment, and consumer applications.

CYPRESS MICROSYSTEMS—WWW.CYPRESSMICRO.COM

PSOC devices are field-programmable, mixed-signal arrays targeting embedded-control functions in consumer, industrial, office-automation, telecom, and automotive applications. PSOC devices integrate programmable peripheral blocks of analog and digital logic, an 8-bit microcontroller core, 8 to 16 kbytes of flash memory, 256 bytes of SRAM, and a MAC (multiply-accumulator). All PSOC devices are dynamically reconfigurable, enabling designers to use the same analog or digital peripheral blocks in different circuits each clock cycle.

The PSOC family includes preprogrammed, specialized versions of peripheral blocks for lighting, energy, mo-

tor-control, communications, automotive, and battery applications. Each family member includes a reference design and application notes. The original PSOC device, the CY8C25/26xxx, includes 12 analog blocks, eight digital blocks, 16 kbytes of flash memory, and 256 bytes of SRAM integrated with an 8-bit microcontroller core. The enhanced analog PSOC device, the CY8C27xxx, adds a full-featured MAC and a precision real-time clock.

DALLAS SEMICONDUCTOR (MAXIM INTEGRATED PRODUCTS)—WWW.MAXIM-IC.COM

Dallas Semiconductor offers four families of 8051-instruction-set-compatible, high-performance microcontrollers. The High-Speed 8051 drop-in products combine a selection of internal and I/O options with proprietary core designs to provide the highest performance 8051 derivatives available. Devices include one-clock/machine-cycle parts that can achieve operating speeds approaching 33 MIPS. The memory configurations for these devices are ROMless, EPROM, and in-system-programmable flash memory. The Secure microcontrollers target applications demanding protective measures against IP theft. These devices employ advanced encryption techniques supporting ATM machines, 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, 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.

FUJITSU MICROELECTRONICS AMERICA—WWW.FMA.FUJITSU.COM

Fujitsu and Fujitsu Microelectronics America design, manufacture, and market comprehensive 8-, 16-, and 32-bit microcontroller product lines for both gen-

eral-purpose and application-specific products. The F2MC (Fujitsu Flexible Microcontrollers) product line includes the 8-bit architecture F2MC-8L series and the 16-bit architecture F2MC-16L/16LX/16F series.

The FR (Fujitsu RISC) is the latest generation of Fujitsu microcontrollers and integrates as much as 768 kbytes of internal flash; ROM; as much as 160 kbytes of internal RAM; an external bus interface; ADC, DAC, multiple CAN, LIN, USB, UART, SIO, and I²C interfaces; timers/counters; a stepper motor; and LCD controllers targeting automotive, communications, computer-peripheral, industrial, consumer, and security applications.

Fujitsu provides development tools, such as emulators for debugging of real-time processing in application development, and a software-development environment that includes a macroassembler, C/C++ compiler, linker, simulator debugger, and real-time operating system that supports large-scale software development.

INFINEON TECHNOLOGIES—WWW.INFINEON.COM

Infineon Technologies offers a range of processors that target applications in the wireless- and wireline-communications, automotive, industrial, computer, security, and chip-card markets. The processors are available as both stand-alone devices and embedded processor cores. The devices in the C500 microcontroller family are fully compatible in architecture and software with the standard 8051 microcontroller family, differing in the number and complexity of their peripheral units, which Infineon has adapted to specific application areas. The C166 family of microcontrollers offers varying levels of performance (maximum 40-MHz clock speeds), peripheral support, and programmability for industrial control, automotive electronics and PC-peripheral control, and consumer-electronics devices.

In addition to C166-family CPUs, the C166S synthesizable core is available for SOC design as a core in the DesignWare Star IP program of Synopsys. The TriCore unified microcomputer/DSP architecture operates as a single multitasking

engine with fast context switching. The TriCore-based TC-1MP microprocessor is available as a hard-core and fully synthesizable macro in the Synopsys DesignWare Star IP program. Applications for the core include servo control; audio-domain DSP, such as speech processing; data communications; modems; automotive systems; and portable applications, such as wireless phones and Internet appliances.

INTEGRATED DEVICE TECHNOLOGY—WWW.IDT.COM

IDT (Integrated Device Technology) bases its Interprise family of integrated communications processors on the MIPS instruction-set architecture. The product line includes a range of devices targeting communications-market applications, such as enterprise, SOHO (small-office/home-office) and residential gateways, desktop/workgroup switches, VPN/firewalls, and wireless access points. IDT integrates communications-specific and generic peripherals with industry-standard external interfaces, such as Ethernet, TDM, USB, and PCI interfaces, with a high-performance CPU core to provide processors optimized for system flexibility and lower overall system cost. Some IDT devices include a hardware-enabled security engine that accelerates IPsec and supports DES, 3DES, and AES encryption standards.

The IDT processor offerings include the RC32365, RC32355, and RC32351 processors in the Interprise Access family and the RC32438, RC32336, RC32334, RC32333, and RC32332 devices within the Interprise PCI family. In addition to the Interprise processors, IDT offers software tools and partners with other industry leaders to support the development of embedded-system applications.

INTEL—WWW.INTEL.COM

The Intel IXP4XX product line targets applications such as high-end residential gateways; small to midsized enterprise routers, switches, and security devices; wireless access points; industrial-control systems; and networked printers. The four processors in the IXP4XX product line are the IXP425, IXP422, IXP421, and

the IXP420. Intel bases the IXC1100 control-plane processor on the same hardware and software architecture as the IXP4XX processors. It targets control-plane-type functions within wired- and wireless-telecom equipment and other networked embedded devices.

The Intel Architecture family of processors targets traditional embedded-system applications, such as point-of-sale, kiosk, ATM, print imaging, NAS (network attached storage), and high-end SAN (storage area network), as well as industrial-control, factory-automation, medical-imaging, and communications applications that support wireless and wireline infrastructure. Intel Architecture processors include the Intel Celeron, ultralow-voltage Celeron, Pentium 4, Pentium M, Xeon, and low-voltage Xeon processors. This range of processors features high performance with speeds reaching 1.6 GHz, reduced power consumption, hyperthreading, dual processing, and high I/O bandwidth.

MEDIAQ—WWW.MEDIAQ.COM

MediaQ offers three product families. The MQ1000 platform-controller family targets handheld systems and smart phones, delivering high-end graphics, camera, and connectivity capabilities. The MQ2000 family targets the emerging multimedia-phone market without redesigning the handset-system architecture. Products in the MQ2000 family are cost-sensitive for high-resolution color-graphics and camera applications.

The Katana family includes three processors. The MQ9000 uses the ARM922T core and incorporates embedded memory, an integrated CCIR-656-compliant camera interface, and connectivity options such as 4-bit secure-digital I/O. Dedicated hardware-acceleration engines include 64-bit, 2-D graphics, MPEG-4 postprocessing, and Java. Adding to these features, the MQ9100 supports JPEG compression in hardware for cameras that stream VGA images for real-time, high-quality images. The MQ9150 enhances image capture by providing JPEG compression in hardware for capturing megapixel images. The MQ9100 and MQ9150 also simultane-

ously support two LCDs—a requirement for flip-style handsets.

MICROCHIP TECHNOLOGY—WWW.MICROCHIP.COM

Microchip's PIC microcontrollers combine high performance, low cost, and small packages to offer price-to-performance-ratio flexibility. The PICmicro architecture uses a RISC core and supports an easy migration path from eight to 84 pins among all families with little or no code change required. Advanced features include sophisticated timing peripherals; embedded ADCs; extended instruction/data memory; interprocessor-communications peripherals (I²C/SPI/USB/CAN ports and USARTs); in-circuit serial-programming technology; and memory technology, including field-reprogrammable (flash) memory, OTP (one-time programmable) memory, and ROM.

The dsPIC family of digital-signal controllers features a digital-signal-processor engine, 30-MIPS nonpipelined performance, C-compiler-friendly design, and a familiar microcontroller architecture and design environment. Microchip is currently sampling 20 dsPIC30FXXXX 16-bit flash microcontrollers that target motor-control, power-conversion, sensor, and general-purpose applications. Microchip's microcontroller-development systems include the MPLAB ICE universal in-circuit emulators; Pro Mate II full-featured device programmer; PIC-start low-cost development system; MPLAB integrated development environment; MPLAB C compiler; MPLAB ICD in-circuit debugger; PICDEM.net Internet/Ethernet demonstration board; and PICKit 1 flash starter kit.

MIPS TECHNOLOGIES—WWW.MIPS.COM

MIPS Technologies licenses processor architectures and synthesizable cores targeting digital-consumer, networking, and security applications. Its 32-bit, synthesizable offerings include cores from the 4K, M4K, 4KE, and 4KS families that offer a range of features and capabilities, code compression, low power, and high performance. The Pro Series cores enable expert SOC designers to write their own

CorExtend instruction extensions and add functions to a core to create differentiated products. Using standard tools and software, designers can implement critical operations with CorExtend instructions to increase performance and reduce power consumption. The 5K family of synthesizable processor cores enables SOC designers to optimize frequency and performance for their applications and maintain the flexibility of choosing any foundry process to suit their application needs.

MOTOROLA SEMICONDUCTOR—WWW.MOTOROLA.COM/SEMICONDUCTORS

Motorola's TSPG (Transportation and Standard Products Group) is an organization within Motorola's Semiconductor Products Sector that provides microcontrollers and microprocessors for the automotive, industrial, and consumer markets. Motorola's TSPG delivers a range of 8-, 16-, and 32-bit microcontrollers and microprocessors targeting areas such as consumer applications, including remote-keyless-entry devices, pedometers, MP3 players, and white goods; industrial-control equipment, such as robotics, diagnostic instrumentation, and factory-floor-automation tools; and automotive applications, including antilock-braking systems, air-bags, and power-train applications.

Many of Motorola's microcontrollers include on-chip flash memory, intelligent timers, security peripherals, networking functions, low power/low voltage, and the ability to withstand wide temperature ranges. Specifically, Motorola integrates flash memory on its microcontrollers that allows OEMs to program their code late in the manufacturing cycle and to make upgrades remotely in the field. Motorola supports development for its microcontrollers and microprocessors with a variety of hardware- and software-development tools, as well as reference designs, comprehensive documentation, online assistance, and online training.

NATIONAL SEMICONDUCTOR—WWW.NATIONAL.COM

National's CP3000 connectivity processors combine a high-performance

RISC core with on-chip SRAM and flash memory, hardware communications peripherals, and an expandable external bus to target embedded communications applications. CP3000 processors include single-chip devices with a Bluetooth lower-link controller, USB, CAN, Access.bus, Microwire/Plus, SPI, UART, and Advanced Audio Interfaces.

National's 8-bit COP8flash microcontrollers include as much as 32 kbytes of onboard flash, usable as data or program storage and specified for 100,000 delete/write cycles. The devices offer virtual-EEPROM functions, in-system programming, and integrated analog and mixed-signal functions to simplify control of Internet-controlled applications.

The Geode GX1 integrated processor series works with the CS5530A I/O companion to provide the core functions of an information appliance—including the CPU, graphics, SDRAM, PCI controllers, and I/O functions. The Geode IAOAC (Information Appliance on a Chip) series includes five devices for specific information appliances, including smart displays, thin clients, and digital set-top boxes. IAOAC devices contain GX1/5530A functions plus SuperI/O, internal 66-MHz PCI, and VIPs (Versatile Input Ports) and VOPs (Versatile Output Ports). National bases the Geode GX2 integrated processor series, which delivers higher performance and lower power than its predecessors, on the GeodeLink™ architecture. You use this series with the CS5535, and it targets high-end thin clients, set-top boxes, and mobile devices requiring streaming media.

▶ **NEC ELECTRONICS**—WWW.NECEL.COM

NEC Electronics America manufactures and markets a variety of highly integrated, low-power embedded microprocessors and microcontrollers targeting applications from consumer electronics to high-end computing, communications, automotive, wireless, and networking. The 8-bit K0 and K0S families of microcontrollers provide low power consumption and integrated peripherals, including LCD drivers and controllers, at competitive prices. The microcontrollers target consumer appliances and industrial-control applications.

The V850 family of microcontrollers delivers 32-bit processing performance, low-voltage operation, DSP functions, and on-chip peripherals targeting consumer-electronics and other embedded applications. The 64-bit VR Series MIPS microprocessors provide high-performance scalability targeting embedded systems from Internet and digital-consumer electronics devices to servers and switches. To help developers bring products to market, NEC offers development systems, including hardware platforms and software packages.

▶ **NEOMAGIC**—WWW.NEOMAGIC.COM

NeoMagic's MiMagic family is a line of application-system processors that integrate an ARM processor core with I/O functions and multimedia hardware targeting multimedia-rich handheld applications. The MiMagic 3 is an ARM-7TDMI-based device that targets low-power multimedia applications for cost-sensitive handheld devices. The MiMagic 5 is an ARM922T-based device that targets mobile camera phones and imaging-intensive wireless PDAs that require camera input, video decoding, video streaming, and digital-audio playback. The MiMagic 6 is an ARM926ESJ-based device that relies on parallel processing to provide more multimedia computing performance.

▶ **NETSILICON (DIGI INTERNATIONAL)**—WWW.NETSILICON.COM

NetSilicon offers network-attached processors and device-connectivity software. It integrates the high-performance Net+ARM 32-bit microprocessor with its Net+WorksR advanced networking software and provides development tools, a real-time operating system, and connectivity software to support development of intelligent, networked devices.

▶ **OKI SEMICONDUCTOR**—WWW.OKISEMI.COM/US

Ok Semiconductor's Advantage general-purpose microcontrollers support 16- and 32-bit applications and offer 32-bit performance at 16-bit prices using an

ARM7TDMI core. Available in four series—from the inexpensive ML671000 with built-in USB controller to the high-performance, 60-MHz cache-based ML675K series—Oki's Advantage microcontrollers offer a broad mix of I/Os to balance cost, performance, and features. The peripheral sets for these processors include timers, watchdog, PWM, UARTs, other serial ports, and ADC channels. Other advanced features include built-in flash ROM for space-constrained systems, a PLL clock multiplier, as much as 32 kbytes of high-speed SRAM, and 8-kbyte cache to increase performance. Oki Semiconductor's microcontrollers include selectable clock gears and standby modes to support low-power applications. The 674K and 675K series are drop-in-compatible, so flash-ROM-size and performance upgrades do not require a CPU-board redesign.

▶ **PHILIPS SEMICONDUCTORS**—WWW.SEMICONDUCTORS.PHILIPS.COM

Philips Semiconductors offers 8-, 16-, and 32-bit devices to satisfy the needs of low- to high-end applications. The eight-pin P89LPC90x, P89LPC92x, P89LPC93x, and OTP P87LPC76x devices use an 80C51 microcontroller architecture and target applications that require power management and a small footprint, such as handheld devices, white goods, and HVAC. The P89LPC92x and P8xLPC76x devices are pin-compatible. The 14-pin P89LPC91x devices target sensor monitoring, system configuration/management, and LIN (local-interconnect-networking) applications. The LPC210x devices use an ARM7 core and feature a large on-chip data buffer to target point-of-sales, serial-protocol-converter, and security-systems applications.

▶ **PMC-SIERRA**—WWW.PMC-SIERRA.COM

PMC-Sierra's RM5200 family processors are true 64-bit MIPS-based microprocessors with clock speeds of 200 to 400 MHz and typical power consumption of less than 1W. These processors target cost-sensitive applications, such as set-top boxes, printers, and other advanced consumer products. Third-party development partners provide develop-

ment platforms; board-support packages; and debug, test, and verification suites for all of PMC-Sierra's MIPS-based processors.

The RM7000 family processors are true 64-bit MIPS-based microprocessors that feature a tightly coupled 256 kbytes of L2 cache and access as much as 64 Mbytes of L3 cache for networking and high-end networked printers. Clock speeds for these processors range from 300 to 600 MHz, with SysAD capability reaching 200 MHz. Typical power consumption is less than 3.5W at 400 MHz. The RM7900 class processors expand the family by offering maximum speeds of 900 MHz with ECC protection and on-chip EJTAG.

The highly integrated RM9000 family of 1-GHz dual- and single-CPU-processor devices includes enhancements for networking and very-high-end networked printers, such as tightly coupled L1/L2 caches with deterministic access times, a seven-stage pipeline that allows a 1-GHz pipeline frequency, and sophisticated branch prediction. The RM-9000x2GL dual-1-GHz multiprocessor expands the family by offering additional multiple I/O targeting a wider range of networking and security applications. The RM9000 processors offer multiple I/O and memory controllers including three ports of 10/100/1000 Ethernet MAC (media-access controller), GPIs (generic packet interfaces), PCI or HyperTransport, SysAD, and DDR SDRAM.

QUICKLOGIC—WWW.QUICKLOGIC.COM

QuickLogic's ESP (Embedded Standard Product) architecture combines fixed-function blocks with a programmable fabric that enables high-performance, low-power devices that are difficult to reverse-engineer. QuickLogic bases the ESP platform on its secure ViaLink interconnect technology—the foundation of the Eclipse FPGA, QuickPCI, and QuickMIPS ESP product lines. The QuickMIPS family integrates a CPU core, a memory controller, Ethernet, PCI, and other general-purpose peripherals with a programmable fabric that avoids latencies for off-chip access to a FPGA. The

processor core's 100%-compatible MIPS32 instruction-set architecture allows you to select from a range of off-the-shelf MIPS32 embedded software and development tools. QuickLogic provides board-support packages for a number of popular embedded operating systems, including Linux, VxWorks, Windows CE.net, Nucleus, and ThreadX.

RABBIT SEMICONDUCTOR—WWW.RABBITSEMICONDUCTOR.COM

Rabbit Semiconductor is a global provider of high-performance, 8-bit microprocessors and development tools for embedded control, communications, and Ethernet connectivity and a sister division of single-board-computer and software manufacturer Z-World. Rabbit Semiconductor introduced the Rabbit-Core line of microprocessor core modules in 2001. The company offers developers low-cost development kits and comprehensive technical support for both hardware and software issues.

RENESAS TECHNOLOGY—WWW.RENESAS.COM

Renesas Technology is a joint venture of Hitachi and Mitsubishi Electric that offers 8- to 32-bit microcontrollers, microprocessors, SOC devices, smart-card ICs, mixed-signal products, flash memories, and SRAMs. Renesas and the many third-party suppliers offer an array of hardware and software tools.

The 32-bit SuperH family targets mobile applications, telematics/car-navigation systems, and consumer electronics; the 32-bit M32R family and the SH-2 series (lower end series within SuperH) target home appliances and PC peripherals. The 8- and 16-bit H8/300L, 740, H8/300H, H8/Tiny, H8S, M16C/10, M16C/20, M16C/60, M16C/80, H8SX, M32C/100, and M32C/80 devices are upward-compatible and target a range of embedded systems for consumer, automotive, industrial, medical-instrumentation, motor-control, and PC-peripheral applications. Many of these devices have a built-in flash memory and are available in small-memory, low-pin-count packages.

SHARP MICROELECTRONICS—WWW.SHARPSMA.COM

Sharp Microelectronics of the Americas offers 16- and 32-bit BlueStreak microcontroller products, which use ARM7 and ARM9 cores. The LH75400 series of devices integrates an ARM7TDMI-S core, 32 kbytes of on-chip SRAM, CAN 2.0B, serial interfaces, an ADC, and an LCD controller that can control STN, CSTN, TFT, HR-TFT, AD-TFT, and gray scale LCD with as many as 4096 colors or 16 shades of gray. These devices operate at 70 MHz maximum at 3.3V from -40 to +85°C in 144-pin LQFPs.

The LH79520 integrates a 32-bit ARM720T core, which includes an 8-kbyte cache, write buffer, and memory-management unit, with a DMA controller, vectored interrupt controller, color-LCD controller, 32 kbytes of SRAM, infrared support, on-chip PLL, and JTAG debugging support. It operates at 77.4 MHz maximum at 1.8/3.3V from -40 to +85°C in a 176-pin LQFP. The ARM922T-based LH7A400 targets Internet- and multimedia-centric applications. It integrates several memory-media interfaces and similar functional blocks to those of the LH79520 and operates at 200 MHz maximum at 1.8/3.3V from -40 to +85°C in a 256-ball PBGA or CABGA package. The LH7A404 includes all the features of the LH7A400, adding a 10-channel, 10-bit ADC; a touchscreen controller; USB 2.0 full-speed host; secure digital interface; and PS/2 Interface. It operates at 200 MHz maximum at 1.8/3.3V from -40 to +85°C in a 324-ball CABGA package.

SILICON STORAGE TECHNOLOGY—WWW.SST.COM

SST (Silicon Storage Technology) designs and manufactures various densities of high-function 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 SuperFlash CMOS, 8-bit microcontroller products implement the 8051 instruction set, have the same architecture as, and are pin-for-pin-compatible with standard

8xC5x microcontroller devices. These microcontrollers include SST's in-application-programming, soft-partition architecture (uniform small sector), and SoftLock security features. The FlashFlex51 microcontrollers target the high-reliability, high-flexibility, low-voltage, and low-power requirements of today's computer peripherals, communication equipment, digital consumer appliances, and portable appliances.

STMICROELECTRONICS—WWW.STM.COM

No single microprocessor family can meet all application needs, so STMicroelectronics offers a broad portfolio of devices and families. The microcontroller portfolio includes the low-power ST5 family, the ST6 and ST7 8-bit families, the 8- and 16-bit ST9, the 16-bit ST10 family with a four-stage pipeline, and the STPC family of x86-based single-chip PCs. STMicroelectronics also offers 32-bit RISC cores for custom designs, such as the ST20 and ST40. The company joined with Hitachi to develop the 64-bit ST50, an optimized 16-bit microcontroller with digital-signal-processing instructions, x86 cores, ARM cores, and a variety of DSP cores for different applications. All of the standard microcontrollers and cores feature robust development tools and expert application support.

SUN MICROSYSTEMS—WWW.SUN.COM

Sun Microsystems' "high-end" UltraSparc-processor designs incorporate RAS (remote-access-server) features to ensure data integrity and support for large-way, vertically scalable, SMP environments with more than 100 processors in a server. The UltraSparc "midrange" processors target one- to four-way systems and incorporate the RAS features. These processors may include memory and I/O controllers, large on-chip caches, and a less complex bus to reduce the overall system costs. Sun's forthcoming processor family targets Blade Computing in a uniprocessor-blade-computation form factor. These UltraSparc processors fit within the smallest power envelope for Sparc/Solaris platforms.

SUPERH—WWW.SUPERH.COM

The SuperH product range includes the 32-bit SH-4 and the 64-bit SH-5 CPU core families, which are available as hard- or soft-core deliverables. They target multimedia applications that require a single CPU core executing general-purpose code or a mix of general-purpose code and DSP algorithms in consumer, automotive, telecom, and handheld-appliance applications. The SH-4 RISC CPU core measures 0.85 mm² in 0.13-micron CMOS and delivers 1.5-DMIPS/MHz, single-cycle MAC (multiply-accumulate) performance and a vector FPU delivering 7 Mflops/MHz. The upward-compatible SH-5 CPU core adds SIMD (single-instruction multiple-data) capabilities and measures 3 mm² in 0.13-micron. Future generations will include the SH-6 superscalar 64-bit CPU core and the multithreading SH-7.

In addition to CPU cores, SuperH offers the SuperHyway bus on-chip interconnect and a set of open-source development tools. It bases these tools on the Gnu-compiler technology and Linux operating system for programmers developing code in C, C++, Java, and assembler that the MicroDev development boards support. A partner program with more than 65 members delivers a variety of IP, tools, kernels, application software, and design services.

TENSILICA—WWW.TENSILICA.COM

Tensilica's Xtensa processor enables developers to mold processor cores to fit their applications by selecting and configuring predefined elements of the architecture and by inventing completely new instructions and hardware-execution units that can deliver significant performance improvements. The 32-bit Xtensa processor architecture features a five-stage pipeline, user-defined registers, and execution datapaths reaching 1024 bits; a compact 16- and 24-bit instruction set; 80 RISC instructions; a 32-bit ALU; 32 or 64 general-purpose 32-bit registers employing a register-windowing scheme that accelerates function calls; and six special-purpose registers. The Xtensa ISA includes powerful branch instructions, such as combined

compare-and-branch and zero-overhead loops, as well as bit manipulations, including funnel shifts and field-extraction operations. Floating-point and vector DSP units are optional.

The Xtensa Processor Generator automatically generates a complete optimized software environment for each processor configuration, including the compiler, linker, assembler profiler, operating-system support, synthesis scripts, instruction-set simulator, and bus-functional models. Designers can explore multiple hardware-software trade-offs, because each instance of the Xtensa processor takes about one hour to create. Designers can explore multiple architectures by basing area, speed, power, and code-density design trade-offs on real-time feedback built into the Xtensa processor generator and available through the Xtensa Explorer design environment.

TEXAS INSTRUMENTS—WWW.TI.COM

The Texas Instruments MSP430 family of ultralow-power, 16-bit RISC mixed-signal processors enables system designers to simultaneously interface to analog signals, sensors, and digital components and maintains low power for battery-powered measurement applications. The architecture features power consumption at 0.1 μ A for RAM retention, 0.8 μ A during real-time clock mode, and 250 μ A/MIPS while active. The family offers on-chip high-performance analog peripherals, such as comparator-gated timers and high-performance data converters, targeting precise measurement applications. The in-system-programmable flash memory permits flexible code changes, field upgrades, and data logging. Prices for a complete integrated development environment start at \$49, and prices for devices start at just 49 cents. Key applications include utility metering, portable instrumentation, and intelligent sensing.

Texas Instruments' MicroSystem Controller products use an enhanced 8051 CPU that incorporates a 32-bit accumulator, a high-resolution delta-sigma ADC, a high-resolution DAC, an eight-channel multiplexer, burnout detection, a selectable buffered input, an offset

DAC, a programmable-gain amplifier, a precision temperature sensor, a precision voltage reference, flash program memory, flash data memory, and data SRAM. Devices within the product families are pin-compatible, simplifying device migration.

 **TOSHIBA AMERICA ELECTRONIC COMPONENTS**—[HTTP://CHIPS.TOSHIBA.COM](http://chips.toshiba.com)

Toshiba offers highly integrated 8-, 16-, and 32-bit CISC microcontrollers and a full family of 32- and 64-bit MIPS-based RISC microprocessors. Reference designs are hardware and software platforms that provide a ready-to-use bill of materials. Platforms are available for home-appliance, industrial-control, mobile and wireless, and digital consumer applications. Toshiba offers access to expert technology professionals for design questions and application support.

 **TRANSMETA**—[WWW.TRANSMETA.COM](http://www.transmeta.com)

Transmeta develops and sells software-based microprocessors and develops additional hardware, software, and system technologies to run standard x86-compatible programs. Transmeta's processors target mobile computing systems, such as "thin and light" notebooks and tablet PCs, in which extended battery life in a small form factor is important to end-user productivity. The microprocessors target x86-based embedded systems, in which cool, fanless operation is critical to end-product reliability.

 **TRISCEND CORP**—[WWW.TRISCEND.COM](http://www.triscend.com)

Triscend offers CSOC (configurable system-on-chip) devices and customizable microcontrollers that allow design engineers to create and modify customized embedded-system applications—from prototyping through manufacturing.

This ready-to-customize SOC platform targets industrial-control, point-of-sale, security, and consumer-electronics applications. Triscend devices combine an industry-standard processor, programmable logic, memory, and an advanced bus architecture on a single chip. FastChip is Triscend's development environment for designing, implementing, and debugging embedded systems with Triscend CSOC and customizable microcontroller devices.

The Triscend A7 CSOC combines on one chip a 32-bit ARM7TDMI processor core with programmable logic, a memory subsystem, a high-performance dedicated internal bus, and other functions. Triscend bases the E5 customizable microcontroller on a performance-accelerated, 8-bit 8051 microcontroller. The E5 targets embedded-system applications that demand both short time to market and high levels of customization. The E5

is compatible with third-party 8051 firmware tools—from code development to in-system, real-time debugging.

UBICOM—WWW.UBICOM.COM

Ubicom supplies wireless-network processors that can implement most communications and control functions in software, allowing one processor to support multiple protocols. Developers can program and reprogram devices to support the latest specification of a standard or support a newly developed feature via a firmware upgrade. Platform innovations include multithreading, a memory-to-memory architecture, a deterministic instruction set, and fast context switching. The architecture significantly reduces memory requirements and eliminates caches to reduce die size and increase processor efficiency.

The IP3023 is the first member of the IP3000 family and features eight-way hardware multithreading and zero-cycle context switching. Eight-way multithreading allows the processor to operate as eight separate processors operating at varying speeds—from 0 to 250 MHz in 3.9-MHz increments. Ubicom's IP2000 family consists of three devices that include 64 kbytes of on-chip flash and 20 kbytes of RAM. The IP2022 is available in 120- or 160-MHz versions and features two serializer/deserializers. The lower cost IP2012 runs at 120 MHz and features one serializer/deserializer.

VIA TECHNOLOGIES—WWW.VIA.COM.TW **XEMICS**—WWW.XEMICS.COM OR WWW.VIATECH.COM

Via offers the C3, Eden ESP, and Antaur native x86 processors. The Nehemiah core is the foundation for Via's latest

processors. It features a hardware random-number generator for efficiency and cool operation. The Via C3 processor targets low-noise, low-profile, and small-form-factor PC systems. The Via Eden ESP processor is part of the fanless Via Eden Platform, which features ultralow power consumption and stability and that targets embedded and networking devices. The Via Antaur processor targets ultraportable notebook PCs with low power consumption and reduced cooling requirements. Available from 1 GHz, the Via Antaur processor consumes as little as 11W.

Xemics 8-bit microcontrollers target autonomous battery-operated wireless devices. The company bases them on two major proprietary RF-transceiver plat-

forms for ISM (industrial, scientific, and medical) RF and Bluetooth. The Radio Machine SOC for ISM-band transceiver interfacing includes a low-power RISC core with BitJockey, a serial interface for radio protocols, and a UART. Xemics of-

fers tools and application notes for radio development. The Sensing Machine SOC for sensor interfacing includes a low-power RISC core with the ZoomingADC, a high-resolution sigma-delta ADC with a programmable preamplifier and a se-

lection of other peripherals. The ZoomingADC can interface with most sensors, even sensors with millivolt signals, without external components.

 **XILINX**—WWW.XILINX.COM

Xilinx's Virtex-II Pro and Spartan-3 FPGA family of devices can integrate embedded hard- and soft-core processors, customizable IP, DSP functions, multigigabit serial transceivers, and FPGA logic in a single device for programmable systems. The Virtex-II Pro and Spartan-3 FPGA family of devices integrate 3000 to 125,000 logic cells with a processor core. The Virtex-II Pro includes as many as four embedded PowerPC processors that can operate at 400 MHz maximum and 24 Rocket I/O transceivers. It can host any of more than 200 available IP cores. The Spartan-3 FPGA can host the MicroBlaze core, which is a 32-bit soft processor that can operate at 150 MHz and 125 D-MIPS. Xilinx's Embedded Development Kit includes support for the Platform Studio IDE, IP generation and customization, Gnu compiler/debugger tool chains, and tool options from embedded-tool vendors, such as Wind River Systems. Xilinx also offers ISE (Integrated Software Environment) FPGA software and more than 200 IP cores to support development.

 **ZILOG**—WWW.ZILOG.COM

Zilog offers micrologic devices that combine microprocessors, microcontrollers, and digital-signal processors with memory and I/O functions on a single device. Micrologic devices also include microperipherals that operate in conjunction with these processor-based devices to provide system support or to control communications, graphics and images, mass storage, voice, and other user-input systems. Zilog designs, manufactures, and markets both ASSPs (application-specific standard products) and general-purpose micrologic products. ASSPs are application-specific but not proprietary to a single customer; general-purpose products are neither application- nor customer-specific.