

# Chip technology today

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System integrators often make Single Board Computer (SBC) choices based upon what type of chips the SBC uses. The intense competition among chip manufacturers has advanced IC speeds to new heights, increased bandwidth, and improved power management. However, for developers this level of competition has also made selecting chips tougher and tougher because so many manufacturers are producing ICs with the desired performance, bandwidth, and power features.

However, some applications require a different balance of these features than others. Certain applications rely on low power constraints; others can live with higher power usage but need maximum bandwidth. Depending on the application, the chip plays one of the most crucial roles in a successful product.

This *SBCs and Chips* segment of the product guide focuses on six vendors in the chip market and briefly outlines what they offer. Although this list is by no means all-inclusive, it will certainly provide a starting point for choosing the right chips.

## Cores

Processor cores are the building blocks of highly functional embedded applications. With processor core use spreading across all market segments, from next-generation handhelds to automotive systems, these building blocks have become integral to today's technology. This cores section of our product feature focuses on two companies, ARM and MIPS Technologies.

We include at the end of each company's listing a table that lists the following specifications for each product:

- Generic foundry process (mm)
- Performance (MIPS/MHz)
- Power consumption (mW/MHz)
- Area (mm<sup>2</sup>)
- Frequency, worst case (MHz)

## ARM

ARM offers 16/32-bit embedded RISC microprocessor solutions. They have an array of solutions for any task. Highlighted here are the ARM7 Thumb family, ARM9 family, and SecurCore family of products. The specifications can be found in Table 1.

### ARM7 Thumb family

This family of products comprises low-power, 32-bit RISC cores optimized for cost- and power-sensitive applications. The ARM7 Thumb family suits applications involving basic wireless handsets, pagers, ink/bubble-jet printers, digital still cameras, and PDAs.

The family also supports Java-enabled applications such as home automation, entertainment systems, gaming, and information delivery.

### ARM9 family

This family of low power, 32-bit RISC cores best serves platform OS-based applications, next-generation hand-held products, digital consumer products, imaging applications, and automotive applications.

### SecurCore family

The SecurCore family includes a range of low-power 32-bit RISC cores that meet smart card and secure IC development needs with unique 32-bit solutions. This family offers a set of benefits to developers who need a core that facilitates secure applications.

## MIPS Technologies

MIPS Technologies designs industry-standard, high-performance, low power, 32-bit and 64-bit RISC microprocessor architectures and cores for embedded systems. MIPS Technologies has an array of cores and architectures. Some of these products are the MIPS32 4K family, MIPS32 M4K, and the MIPS64 20Kc. Specifications for these products can be found in Table 2.

ARM family of cores					
Family	Generic Foundry Process (mm)	Performance (MIPS/MHz)	Power Consumption (mW/MHz)	Area (mm <sup>2</sup> )	Frequency, worst case (MHz)
ARM7 Thumb	0.13 or 0.18	0.9 or 1.0	0.06 to 0.65	0.26 to 3.0	75 to 133
ARM9	0.18 or 0.18	N/A	0.25 or 0.8	3.2 to 11.8	185 to 250
SecurCore	0.18 or 0.25	N/A	0.3 to 0.84	0.6 to 100	66 or 100

N/A = Not available at time of publication

Table 1

## MIPS32 4K family

This family of cores addresses System-On-Chip (SOC) applications that require high performance, ease of use, and cost efficiency. These cores suit digital consumer product, network system, and information management needs.

## MIPS32 M4K

This product provides a competitive solution for multi-CPU SOC designs, a popular design for next-generation networking and broadband uses. MIPS32 M4K processor cores help make possible such applications as home gateways, high-end multi-service routers, and storage area networks.

## MIPS64 20Kc

This drop-in processor core delivers integer, floating point, and 3D graphics performance for designers of advanced SOC applications. The MIPS64 20Kc successfully meets digital entertainment and other advanced SOC applications.

## Processors

With speeds well over the one-gigahertz range, processors have come a long way since their 8-bit days.

A vital component for most SBCs on the market today, processors have benefited greatly from manufacturing technology advances.

The following section briefly covers some of the processors affected by forward leaps in technology, describing them from the standpoint of four major vendors:

- IBM
- Intel
- Motorola
- Sun Microsystems

Again, this is by no means an all-encompassing list of processor vendors in the market but merely a starting point for a look at current technology.

Specifications that may prove pertinent to making a decision accompany each product summary

## IBM

A popular processor brand, the PowerPC is an excellent starting point for many embedded applications. A wide array of PowerPCs is available. This guide focuses on the PowerPC 440GX, PowerPC 750FX, and the PowerNP NPe405 processors. Table 3 has pertinent specifications for each of these IBM processors.

### PowerPC 440GX embedded processor

The PowerPC 440GX offers a very versatile and high-bandwidth solution for networking and storage applications. The 440GX integrates current peripherals such as PCI-X and DDR SDRAM and offers four Ethernet interfaces as well as other advantages.

### PowerPC 750FX RISC microprocessor

The PowerPC 750FX RISC microprocessor is an implementation of the PowerPC family onto RISC microprocessors. This processor is well suited for a variety of applications such as networking, communications, storage, imaging, computing, and consumer electronics.

### PowerNP NPe405 embedded processor

The PowerNP NPe405 family of processors focuses on networking applications. Providing ease of integration with the added benefit of utilizing the scalable PowerPC architecture, this processor makes a very good choice for upgrading next-generation systems.

### MIPS family of products

Family/Product	Generic Foundry Process (nm)	Performance (MIPS/MHz)	Power Consumption (mW/MHz)	Area (mm <sup>2</sup> )	Frequency, worst case (MHz)
MIPS32 4K family	0.13 or 0.18	310 or 390	0.4 to 2.8	0.4 to 2.5	160 to 255
MIPS32 M4K	0.13	405	0.1 to 0.28	0.3 to 1.0	200 to 240
MIPS64 20Kc	0.13 or 0.18	720 to 1370	1.37 or 4.14 (W)	8 to 35	360 or 533

Table 2

### IBM family of products

Model	Frequency	L2 Cache	Bus Interface	Architecture	Package
PowerPC 440GX	Up to 800 MHz	256 Kbytes on-chip SRAM	PCI-X, 32/64-bit, 133 MHz, support for PCI V2.3	32-bit	552-CBGA (25x35)
PowerPC 750FX	Up to 800 MHz	512 Kbytes	32/64-bit data, 32-bit address	32-bit	292-CBGA (21 x 21)
PowerNP NPe405	Up to 266 MHz	None	32-bit, PCI 2.2 compatible (NPe405H only)	32-bit	324-PBGA (23x23) (L), 580-PBGA (35x35) (H)

Table 3

**Intel**

Intel meets application needs with a wide variety of processors Intel's family of processors includes the Celeron, Pentium III, Pentium 4, and Xeon. Table 4 lists the pertinent specifications for each of these processors.

*Celeron processor*

An affordable and reliable solution, the diverse Celeron adapts readily to a variety of applications. This processor has demonstrated its market longevity and is always an acceptable choice for development needs.

*Pentium III processor*

A solid performing processor, the Pentium III best suits mid-range and value servers. Capable of managing a broad variety of server applications, the Pentium III is always in consideration for next-generation designs and applications.

*Pentium 4 processor*

Manufactured with 90nm technology, the Pentium 4 processor supports Hyper-Threading Technology enhancements and features Intel's NetBurst micro-architecture. With the versatility to handle a wide variety of applications, the Pentium 4 processor is positioned to solve both current and future application challenges.

*Xeon processor*

The high-performance Xeon MP processor supports Intel's NetBurst micro-architecture and Hyper-Threading Technology. Optimized for multiprocessor applications, the Xeon microprocessor can be scaled up within the NetBurst micro-architecture, to a total of four Xeon processors.

**Motorola**

Motorola has long been involved in the semiconductor industry. Providing innovative ideas and products to the market over the years, Motorola has been able to bring to the processor realm the PowerQUICC family of processors. The PowerQUICC family builds on the PowerPC core and targets communications applications. Discussed here is Motorola's PowerQUICC family. Table 5 summarizes the specifications of each processor in this family.

*MPC885 PowerQUICC processor*

Powered to deliver on-chip security, dual Fast Ethernet, USB, and bus speeds scaling to 80 MHz, the MPC885 family is a great bargain for the price. Geared towards applications such as VPN routers, enterprise routers, home networking equipment, ADSL gateway boxes, and factory automation, the MPC885 is a very diverse and affordable processor family.

*MPC8280 PowerQUICC II processor*

Possessing the abilities and strong points of the MPC885 family, the MPC8280 processor builds on these strengths with feature enhancements, a wider range of performance than the MPC885, and package options with lower power requirements. This family of processors best serves wired and wireless infrastructure communications processing tasks.

*MPC8560 PowerQUICC III processor*

The third generation of the PowerQUICC family, the MPC8560 PowerQUICC III processors take communications processing a step forward. A performance monitor facility, memory management unit, and enhanced hardware and software debug support bring the MPC8560 to a level above previous PowerQUICC

Intel family of products					
Model	Frequency	L2 Cache	Memory	FSB	Package
Celeron	1.70 to 2.60 GHz	128 Kbytes	DDR	Up to 400 MHz	FC-PGA2
Pentium III	Up to 1.40 GHz	256 or 512 Kbytes	SDRAM and Rambus RDRAM	100 or 133 MHz	Multiple
Pentium 4	Up to 3.40E GHz	Up to 1 Mbyte	Dual-channel DDR	400, 533, or 800 MHz	478 pin PPGA
Xeon MP	Up to 2.8 GHz	256 or 512 Kbytes	Dual-channel DDR	400 MHz	603 pin PPGA

**Table 4**

Motorola family of products					
Model	Frequency	L1 Cache	Memory Controller	Bus Interface	Package
MPC885 PowerQUICC	66, 80, and 133 MHz	8 Kbytes data and 8 Kbytes instruction	EDO, EPROM, Flash, SDRAM, and SRAM	PCMCIA, PowerPC ISA	357-pin PBGA
MPC8280 PowerQUICC II	Up to 450 MHz	16 Kbytes data and 16 Kbytes instruction	EDO, EPROM, Flash, SDRAM, and SRAM	60x, Local, PCI 2.3	480-pin TBGA
MPC8560 PowerQUICC III	Up to 1 GHz	32 Kbytes data and 32 Kbytes instruction	Integrated DDR memory controller	PCI 2.2 and PCI-X 1.0 compatible	783-pin FC-PBGA

**Table 5**

processors. This family of processors solves any application challenge that the PowerQUICC family can address.

**Sun Microsystems**

Sun Microsystems has established a solid reputation in the processor market. Making the best use of its long-standing relationship with Texas Instruments, Sun Microsystems has delivered high quality processors and technologies. This article discusses Sun’s UltraSPARC family. Table 6 provides specifications for each UltraSPARC family member.

*UltraSPARC IIIi processor*

Focused on embedded 64-bit computing and low-end workstation needs, the UltraSPARC IIIi processor incorporates substantial computing power in a highly integrated package. The power-efficient IIIi processor is based on the same 64-bit SPARC V9 architecture in

Internet and enterprise servers today. This processor is suitable for datacom, Internet, telecom, and network environments.

*UltraSPARC III Cu processor*

Sun created its flagship processor, the UltraSPARC III Cu, for network computing. This processor meets RAS, scalability, and power efficiency requirements while maintaining binary compatibility. The UltraSPARC III Cu is a high-performance networking processor that can be used in a variety of high-end workstations, enterprise servers, and mission-critical applications.

*UltraSPARC IIIi processor*

The Sun UltraSPARC IIIi network processor targets volume servers and performance workstations. Incorporating core technologies of the UltraSPARC III Cu processor, the IIIi takes these and further optimizes them for customer applications.

Sun family of products					
Model	Frequency	L2 Cache	Memory Controller	Bus Interface	Architecture
UltraSPARC III Cu	900 MHz, 1050 MHz, and 1.2 GHz	1, 4, or 8 Mbytes	Integrated, coupled to system bus	Fireplane interconnect at 150 MHz	64-bit SPARC architecture
UltraSPARC IIIi	Up to 1.28 GHz	On-chip 1 Mbyte	Integrated MHz DDR-1 memory interface	JBus interface at up to 200 MHz	64-bit, 4-way SuperScalar SPARC V9
UltraSPARC III	550 or 650 MHz	On-chip 512 Kbytes	PC100/133 SDRAM interface	Integrated 32-bit, 33/66-MHz PCI 2.1 interface	SPARC V9 compliant 64-bit

**Table 6**