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# Cirrus Cranks the Volume with Maverick

*Integrated Processor Exploits ARM 920T to Serve Up Multiple Music Streams*

*By Steve Leibson {7/24/00-03}*

A year ago, Cirrus Logic introduced the Maverick EP7209, based on the ARM 720T core, for MP3 players. That chip has most recently appeared in Diamond Multimedia's Rio 600, a third-generation digital-audio player. Now Cirrus has recruited ARM's 200MHz 920T processor core to construct an integrated processor, called the Maverick EP9312, that can act as a server capable of distributing multiple media streams. The envisioned target for this new Maverick is the as yet untested market for home music servers or digital jukeboxes. These home-audio products accept, encode, compress, and store input from a variety of analog and digital sources (CDs, audio DVDs, audio tape, LPs, the Internet, radio, etc.) and distribute the stored music to multiple rooms or receivers simultaneously. Other key EP9312 components include a numeric coprocessor to augment the 920T's native computational power, a variety of security features to safeguard copyrighted digital content, an eight-channel DMA controller with a CRC generator, and a number of additional peripherals that ease the design of media server systems. Cirrus unveiled the chip at last month's **Embedded Processor Forum**. It will be built using a 0.25-micron process with four-layer metal and will run at a core voltage of 2.5V, with 3.3V I/O. Chip power dissipation will be less than 1.5W—too high for a handheld player but fine for a server.

As Figure 1 shows, the EP9312 has a fairly conventional layout for an integrated processor. The 920T processor core, the MaverickCrunch numeric coprocessor, and the I and D caches communicate through an MMU over a 100MHz internal processor bus to the chip's memory interfaces and high-speed peripherals. The MMU allows the chip to run computer-oriented operating systems such as Windows CE and Linux in addition to commercial RTOS products. A bus

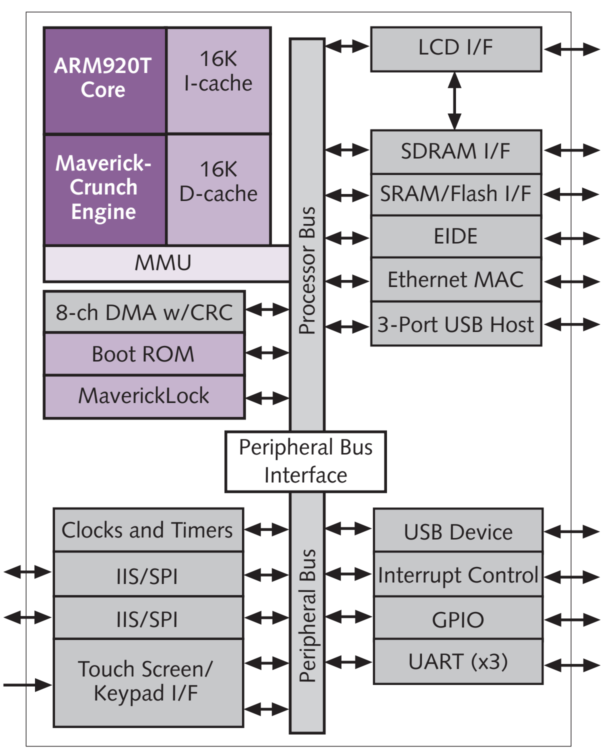


**Figure 1.** The Maverick 9312 combines an ARM 920T processor core with a fixed/floating-point numeric processor, security features to protect copyrighted digital files, and a comprehensive peripheral set, all geared at making it easy to develop digital media servers.

bridge links the high-speed internal processor bus to a peripheral bus that connects to slower peripherals: a real-time clock, timers, 16550 UARTS, and other serial interfaces.

Many of the EP9312's features relate specifically to serving up multiple media streams. The MaverickCrunch Engine, a fixed/floating-point coprocessor, can execute IEEE-754 single- and double-precision computations as well as 32- and 64-bit integer calculations. As Figure 2 shows, a 16 x 64 register file acts as a no-wait buffer between the ARM 920T core and the numeric coprocessor. In practice, the ARM 920T core handles loops and address calculations, while the MaverickCrunch Engine handles the media-stream computations. When built in a 0.25-micron process, the coprocessor adds less than 2mm$^2$ to the chip while providing a significant boost to the number of simultaneous media streams the processor can encode. For example, for a high-precision FIR-filter implementation, Cirrus estimates that the MaverickCrunch Engine will give better than a 6x performance boost to the 920T processor. Cirrus says the EP9312 will be able to encode 10 MP3 streams simultaneously.


**Jeff Klaas, Cirrus Logic's director of engineering, provides details of the Maverick EP9312 integrated processor at the Embedded Processor Forum.**

Another critical set of features that are directly related to the processor's use as an audio server are the security measures on the chip that protect copyrighted digital content. At the lowest level, the chip contains 256 laser-programmable fuses that allow personalization through IDs, passwords, security codes, and manufacturing codes. Content providers, such as the members of the Secure Digital Music Initiative (SDMI), are demanding hardware personalization for media players, and laser fuses certainly provide that. Furthermore, the on-chip boot ROM contains firmware and passwords that are not visible to the processor unless the chip is in a locked state, set by a programmable bit. The EP9312's debug and manufacturing-test modes are disabled when the chip is in its locked mode, so pirates will not be able to use these alternate-access routes to pry out security secrets. The chip also incorporates encryption hardware, so that firmware can be encrypted for even more security. It's possible to fill and lock on-chip cache and MMU entries without accessing external memory; sensitive keys and algorithms can thus be put in place without generating any observable external bus traffic.

For external memory, the EP9312 has separate SDRAM and SRAM/flash/ROM ports. The SDRAM port can interface to as many as four banks of 66- or 100MHz SDRAM. The SRAM/flash/ROM interface supports both 16- and 32-bit memory widths and has eight programmable chip-select pins. The chip also has an EIDE port for direct connection to one or two disk

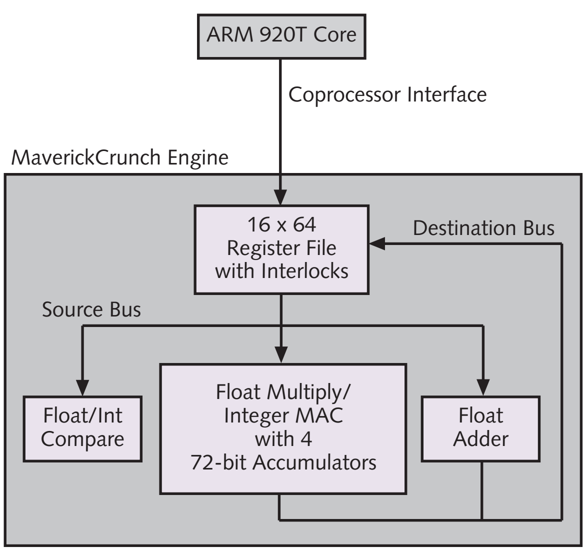


**Figure 2.** The MaverickCrunch Engine augments the EP9312's native processing power with an IEEE-754 floating-point multiplier and an integer MAC with a 32 x 32-bit multiplier and four 72-bit accumulators.

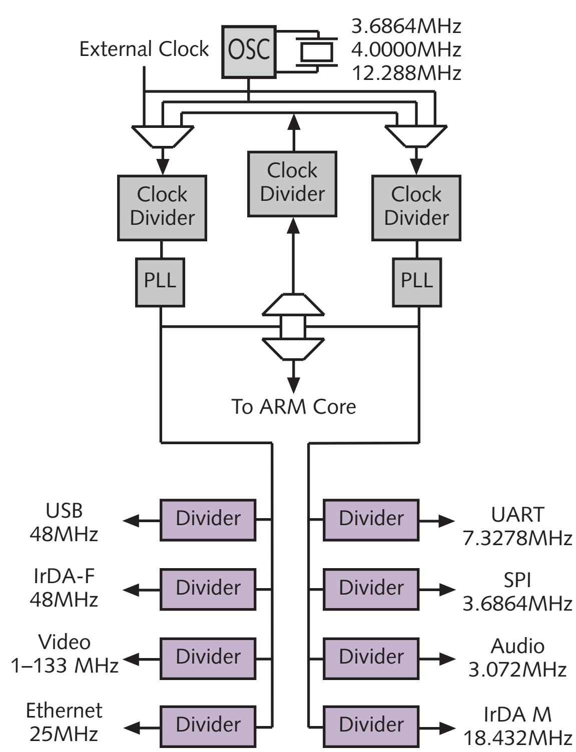


**Figure 3.** A sophisticated clock-generator module, consisting of three PLLs and eight dividers, generates the EP9312's processor clock and the eight other frequencies needed by the on-chip peripherals.

drives with UDMA-33 interfaces. The drives can be either hard disks or CD ROM drives.

User interface support comes in the form of an LCD interface and a touch-screen/keypad interface. The LCD interface accommodates displays with 4, 8, 16, or 18 bits/pixel. It resides on the chip's high-speed processor bus and also has a dedicated bus connecting it to the on-chip SDRAM controller, so that display refresh activity consumes none of the internal processor bus bandwidth. The LCD controller also employs PWM for controlling display brightness and a 6-bit DAC for contrast. The touch-screen interface handles 4-, 5-, or 8-wire resistive screens and incorporates an ADC for pressure sensitivity. The separate keypad interface incorporates hardware debouncing and accommodates as many as 64 buttons, arranged in an 8 x 8 array.

A wide range of standard peripherals provides access to the computer industry's favorite devices and networks. Three USB host ports link to a growing number of user-input, storage, and printing devices. (However, ARM-based software drivers for USB peripherals may be somewhat problematic, as most drivers are written in x86-compatible code for Windows.) An Ethernet MAC puts the EP9312 on the world's most common network and offers a way to easily connect to high-speed Internet links such as DSL and cable modems. Three 16550 UARTs provide traditional, slow serial access to older standard peripherals like mice, keyboards, and analog modems. Two $I^2S$/SPI ports allow systems designers to easily connect common interface chips, especially ADCs and DACs. The chip's remaining peripherals provide traditionally needed services, such as time of day, elapsed time, and general-purpose parallel I/O.

## Price & Availability

The Maverick 9312 will begin sampling in the fourth quarter, with volume shipments expected to begin early in 2001. The price is $38.50 each in 10,000-unit quantities. For more information, go to www.cirrus.com.

It takes a lot of different clocks to run all these standard peripherals. Some system design approaches might require multiple crystals to provide all the needed clocks, but the EP9312 has a fairly sophisticated clock generator, capable of generating all needed clock frequencies from one crystal, as Figure 3 shows. This approach certainly adds cost to the chip itself, in terms of extra transistors and design time, but it also reduces system costs by eliminating the cost, board space, and test requirements incurred with multiple crystals and oscillators.

Clearly, with the ability to send 10 different music streams into various rooms around the house simultaneously, the EP9312 has more than enough capability to provide all the audio encoding, storage, and transmission a home could want or need. What's not so clear is whether the existence of a chip, even with these capabilities, is sufficient to jump-start an entirely new concept in home audio. As the purveyors of home networking have already discovered, it's really not silicon that stands in the way of widespread use of networks in the home. It's copper. ◇