SUPERH RISC Engine and Memories for Multimedia

Fumio Arakawa
Yuusuke Akao
Kiyoshi Inoue

OVERVIEW: Recently, the market for mobile multimedia products has been growing. Low power is important for making these products more portable, allowing extended use with small, lightweight batteries. Flash memories are well-suited as a storage medium for these products because of their nonvolatility and compactness, and their market is rapidly growing. The lineup of the SuperH RISC engine series (SH-1, SH-2, SH2-DSP, SH-3, SH3-DSP, and SH-4) offers low-power products in a wide range of performance levels. The series covers all of the needs of mobile multimedia products because it integrates peripheral circuits, memories, and other devices, to reduce overall system cost. We released the x64-type 256-Mbit SDRAM for the main memory in 1999. Its multichip packaging gives it high capacity and high speed in a small mounting area. Infineon Technologies and Hitachi jointly released the 16-Mbyte flash card, called the MultiMediaCard, which so far is the smallest and lightest currently available. Combined with Hitachi’s original AND type cell, this flash memory offers a high capacity and low cost.

INTRODUCTION
THE consumer market for mobile multimedia products such as handheld personal computers (H/PCs), digital still cameras, digital video cameras, MPEG2 cameras, and MP3 players has been growing recently. Mobile phones, originally used just for making calls, have become digital and multi-functional and are evolving into a multimedia communication tool capable of handling data and images as well as voice.

Fig. 1—Recent Products of SuperH RISC Engine and Memories.
(a) SH7751 achieves 1,000 MIPS/W for high performance mobile products.
(b) SH7751 chip (1,000 MIPS/W, on-chip PCI controller)
(c) world’s smallest and lightest 16-Mbyte MultiMediaCard, (joint development with Infineon Technologies)
(d) 256-Mbit SDRAM (four 64-Mbit chips in MCM)
(e) Inside of 256-Mbit SDRAM

MIPS: mega instructions per second
PCI: peripheral component interconnect
SDRAM: synchronous dynamic random access memory
MCM: multi-chip module
RECENT TRENDS OF MOBILE MULTIMEDIA CONSUMER PRODUCTS

Fig. 2 shows recent trends of mobile multimedia consumer products. Various types of products have appeared in the market. The H/PC, for example, has become popular in the first half of the 1990s. Initially, it was used for keeping track of schedules or addresses. Recently, however, its network function makes it possible to handle electronic mail and access the Internet. The digital still camera must be able to encode and decode still images in a JPEG (Joint Photographic Expert Group) format in a short time. Recently, motion picture processing capability is also required. The MPEG camera encodes and decodes digital moving picture data by an MPEG1 or MPEG4 standard in a real time. The MP3 player decodes MPEG1 audio layer 3. The smart phone is a mobile phone that can be connected to the Internet and can send and receive electronic mail.

Fig. 3 shows the processor performance and the storage media capacity required for several multimedia applications. Software is ideal for processing various multimedia operations flexibly. It is already available for processing audio data in an MP3 format or the modem. The quality of MPEG4 images covers a wide range, so some MPEG4 standards can be processed by the software. However, the MPEG2 images are very hard for the software to process. Therefore, it is still important to enhance the multimedia performance. It is also important to fasten and increase the size of main memories for processing large volumes of data at high speeds.

Flash card and PC card type hard disks are the conventional storage media for mobile multimedia products. The storage media market of the audio and visuals are expected to make rapid progress, which requires a large capacity. Further enhancement of the media capacity is necessary to record video.

LINEUP AND APPLICATIONS OF SuperH RISC ENGINE

Lineup

The SuperH RISC engine series consists of a microcontroller unit (MCU) lineup and a microprocessing unit (MPU) lineup. The MCU products are SH-1, SH-2, and SH2-DSP, and the MPU products are SH-3, SH3-DSP, and SH-4 (Fig. 4). The basic instruction sets of all the products are the same, and migration from the low end to the high end is possible with keeping the software competence.

The main feature of the MCU products is that they incorporate high-capacity read-only memories (ROMs) mainly for program storage, multifunction multichannel timers, serial communication interfaces, analog-to-digital (AD) and digital-to-analog (DA) converters, and so forth. The ROM lineup consists of erasable programmable ROMs (EPROMs) and flash memories as well as the low-cost mask ROMs, and effectively shortens the development period of multimedia applications, for which “Time to Market” is the key issue.
The MPU products incorporate memory management units (MMUs), which support Windows CE*1, the de facto standard operating system. High-capacity caches are also incorporated to process large programs and data efficiently. Basic peripherals such as direct memory access controllers (DMACs) and timers are also incorporated to reduce the number of parts and the cost of the system. The high-speed products, 133-MHz SH-3 series and 200-MHz SH-4 series, line up to process the multimedia middleware quickly.

Application to Multimedia Products

The digital still camera is one application of the SH2-DSP. The SH2-DSP runs the JPEG software at high speed with its DSP (digital signal processor) function. The number of parts and on-chip peripherals required is low, which realizes small and inexpensive camera.

Since car navigation systems first appeared in the market, SH-1 and SH-2 have been used extensively because of their direct memory interfaces and high-capacity on-chip ROMs, and because their fast multiply-add operation can draw graphics at high speed. Recently, the higher-performance SH-3 and SH-4 are being used for car information systems due to software compatibility and portability.

The major application of the SH-3 is H/PCs which use Windows CE. The SH-4 features enhanced three-dimensional (3D) graphics performance, and is used for Dreamcast,*2 the latest home video game console from Sega Enterprises, Ltd. The SH-4 is used for Hitachi’s high-end H/PC making use of the reduced power dissipation for mobile applications.

The advantages of the H/PC are its data compatibility with PCs, compactness, and long battery life. It will soon perform and function similar to the PC, but with greater portability and convenience. Hitachi will develop the SH3-DSP, SH-4, and SH-5, which will have better performance to meet market requirements of H/PCs.

MEMORY PRODUCT LINEUP FOR MULTIMEDIA AND ITS APPLICATIONS

Flash Memories

Flash memories are nonvolatile, electrically-rewritable memories. The random-access NOR-type flash memory is used for program storage for mobile phones or PCs. The high-capacity serial-access AND- or NAND-type flash memory is used for data storage for digital cameras or H/PCs.

Hitachi developed a high-capacity, small cell-size, AND-type flash memory. The cost is kept low by using MGM (mostly good memory) technology. Hitachi released the 64-Mbit version in 1996 and the 256-Mbit

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*1: Windows CE is a registered trademark of Microsoft Corp. in the US and other countries.
*2: Dreamcast is a registered trademark of Sega Enterprises, Ltd.
version in 1998, both of which were the first of their kind. The 256-Mbit version keeps two-bit value in a cell.

Hitachi has also developed two flash cards, which are flash memory storage devices, called the ATA (advanced technology attachment) card and CompactFlash cards. The key technologies of these cards are the control technology of the H8 or SH series microcontroller and the high-density mounting technology.

This year, Infineon Technologies and Hitachi came out with the 16-Mbyte MultiMediaCard, the world’s smallest and lightest memory card suitable for mobile multimedia applications. The compactness, high capacity, and high performance of the flash memories are made possible by the incorporation of the SuperH microcontroller core on the flash memory chip. Hitachi plans to release a 32- and 64-Mbyte version of the MultiMediaCard in addition to the current 16-Mbyte version.

DRAM (Dynamic Random Access Memory)

It is necessary to enhance the capacity and speed of the main memory for real-time applications such as motion picture processing. However, the mounting area of the memory must also be small enough for mobile use. This year, Hitachi has released a \( \times \)64 type 256-Mbit SDRAM (synchronous DRAM) in a multichip package. The 256-Mbit SDRAM has a wide bandwidth and high capacity, but its package size is the same as that of the 64-Mbit SDRAM.

Low power consumption is also important for mobile use. Hitachi’s 64-Mbit SDRAM is fast, but consumes little power. It operates at 133 MHz and CAS (column address strobe) latency of two cycles, and consumes only 200 mW, which is about 40% less than the product it replaces. This was accomplished by reducing the supply voltage to 2.5 V.

CONCLUSIONS

This article described recent mobile multimedia consumer products on the market and the lineup of Hitachi’s high-performance RISC processor series, the SuperH RISC engine series, and Hitachi’s memory devices.

The market of the mobile multimedia consumer products is expected to continue growing rapidly, and these products will become more portable and more functional. As Hitachi’s SuperH RISC engine and memories are key components supporting them, Hitachi will continue to develop better-performing, more-functional, higher-capacity, and lower-power products to satisfy the customer’s needs.

REFERENCES

ABOUT THE AUTHORS

Fumio Arakawa
Joined Hitachi, Ltd. in 1986, and now works at the System LSI Research Department, Solution LSI Research Center, Central Research Laboratory. He is currently engaged in the research and development of microprocessors. Mr. Arakawa can be reached by e-mail at arakawa@crl.hitachi.co.jp.

Yasushi Akao
Joined Hitachi, Ltd. in 1979, and now works at the 1st SH Engineering Dept, Advanced Microcomputer Business Operation, System LSI Business Division, Semiconductor & Integrated Circuits Group. He is currently engaged in the development of 32-bit microprocessors. Mr. Akao can be reached by e-mail at akaoy@cm.musashi.hitachi.co.jp.

Kiyoshi Inoue
Joined Hitachi, Ltd. in 1977, and now works at the Product Marketing Department, System Memory Business Division, Semiconductor & Integrated Circuits Group. He is currently engaged in the marketing of SRAM and flash memory products. Mr. Inoue can be reached by e-mail at k-inoue@denshi.head.hitachi.co.jp.