Trend of Windows CE Applications and Needs for Semiconductor Products

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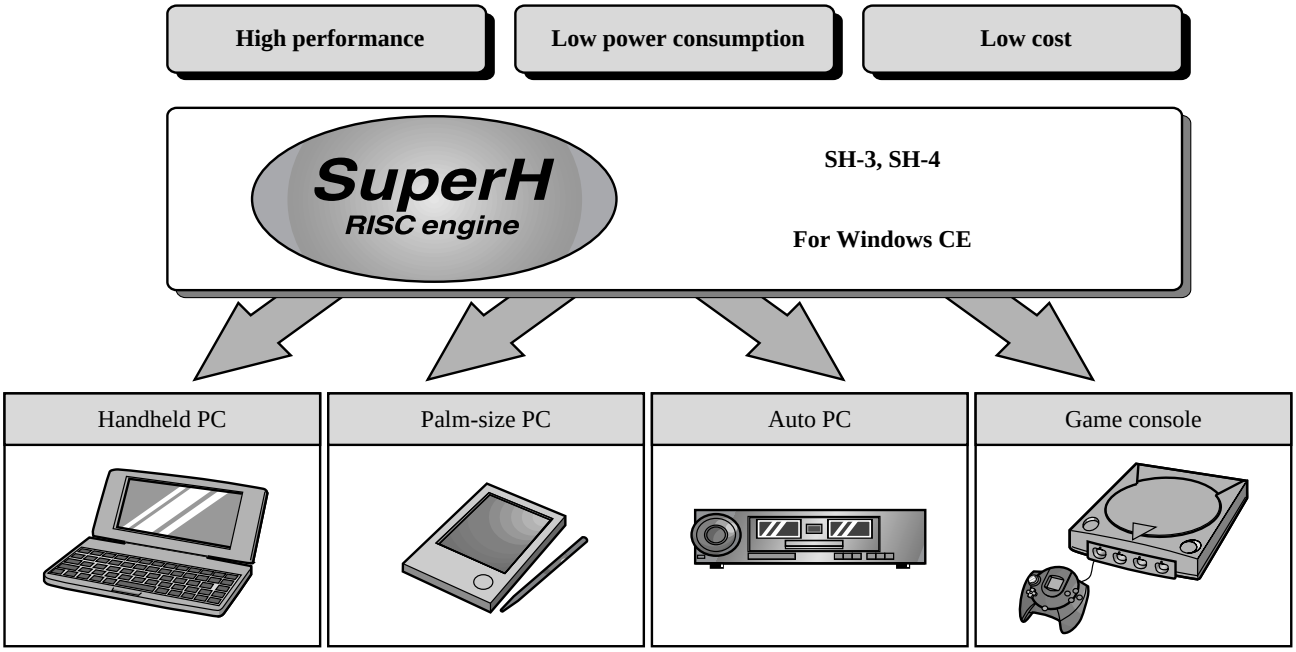
*OVERVIEW: The most representative products using the Windows CE*1 operating system (OS) are Handheld PCs, which are a type of mobile information device. Recently plans are underway to extend the use of Windows CE to even smaller mobile information devices such as Palm-size PCs, automotive terminals, and home game consoles. Hitachi, Ltd.'s SupperH RISC (reduced instruction set computer) engine is a central processing unit (CPU) suitable for those Windows CE applications that feature high performance, low power consumption, and low cost. Also, the companion LSI chip HD64461 has been developed that incorporates the peripheral functions required in mobile information devices. In combination with the SuperH, it forms a chip set that facilitates the rapid development of compact mobile information device products.*

INTRODUCTION

THE range of products using Windows CE is being extended from mobile information devices such as Handheld PCs and Palm-size PCs with the development of new products such as automotive information devices and home game consoles. As shown in Fig. 1, Hitachi's SuperH RISC engine is able to meet the requirements of these types of products including high performance, low power consumption, and low cost. In this paper we will discuss the trend of products using Windows CE, the features of the SuperH RISC engine that is ideal for these products, and system solutions utilizing the chip set.

*1: Windows is a registered trademark of Microsoft Corp. of the US in the US and other countries.



RISC: reduced instruction set computer

Fig. 1—Products Running the Windows CE OS Using the SuperH RISC Engine Family.
Windows CE products include mobile information devices such as Handheld PCs and Palm-size PCs, with the lineup now expanding to automotive information devices such as Auto PCs and entertainment devices as typified by game consoles. The SuperH RISC engine family satisfies the common requirements of these products with high performance, low power consumption, and low cost.

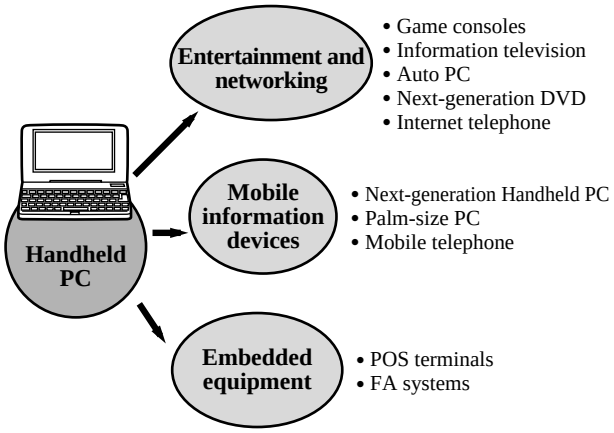
PROGRESSION OF PRODUCTS USING WINDOWS CE

Windows CE 1.0, which had been announced by Microsoft of the U.S., emerged in the autumn of 1996 in Handheld PCs — which are mobile information devices. These Handheld PCs running Windows CE 1.0 have almost the same performance of operability as PCs running Windows — with which they excel in data interchange and coprocessing. The display screen is black and white.

In the autumn of 1997 Microsoft announced Windows 2.0 and a number of companies announced Handheld PCs running this OS at the same time. The display screen of Handheld PCs running Windows CE 2.0 is a 640- by 240-pixel color display with 256-colors. Thus color display capabilities must be added to the semiconductors used to make the Handheld PC; and to enable battery operation the central processing unit (CPU) especially is required to provide high performance with low power consumption. It is also essential that peripheral facilities and communications facilities be integrated on chip including those for connection to the Internet and for high-speed data interchange with PCs by infrared.

In January, 1998, Microsoft announced new types of equipment running Windows CE 2.0. These were mobile information devices in the form of a Palm-size PC and an Auto PC for installation in automobiles. The Palm-size PC has a vertical display with 240 by 320 pixels, pen input operation, and voice recording and playback capability. The Auto PC features use of voice recognition technology enabling it to perform many different operations without being touched by the user's hands.

The Windows CE OS market trend is shown in Fig 2. Windows CE was first used in Handheld PCs, but expectations were that its use would progress to a variety of mobile information devices including Palm-size PCs and embedded devices, Auto PCs, game consoles, and entertainment networks. In Auto PCs and game console applications, voice and image processing by software will become increasingly important, and thus CPU performance improvements will be required.



DVD: digital versatile disc
POS: point-of-sale

Fig. 2—Windows CE Market Trend.
Products using Windows CE started with Handheld PCs, but have now expanded to include a wide range of products including those in the mobile information device fields and various embedded fields, and also in the entertainment and networking fields.

FEATURES OF THE SUPERH RISC ENGINE FAMILY

The SuperH RISC engine family has been designed as a microcomputer for applications including small mobile information devices and embedded devices with consideration given to a progression path that maintains a balance among performance, power consumption, and price. Utilization of a RISC architecture makes the CPU small, with the remainder of the chip used for on-chip cache memory and peripheral circuits.

Systems can be built inexpensively with a small number of external components because an on-chip interface can be directly connected to dynamic random access memory and a wide variety of other memory types. Also contributing to keeping the price low is the short fixed instruction length of 16 bits, which keeps down the memory capacity needed to store instruction codes.

Fig. 3 shows the SuperH road map for Windows CE. The SuperH RISC engine family product lineup consists of the SH-1, SH-2, SH-3, and SH-4. SH-3 and SH-4 products shown in Fig. 3 are suitable for devices running Windows CE.

The SH-3 series microcomputers — SH7708, SH7707, and SH7709 — were developed for mobile information devices including Handheld PCs and PDA (personal digital assistants) requiring high performance, small size, and low power consumption. However the progress toward higher performance in Handheld PCs and other mobile information devices has been remarkable, leading to increased demands on the CPU for even higher speed and higher performance. Thus we are proceeding with the development of higher performance versions of the SH-3: the SH7709A and SH7729.

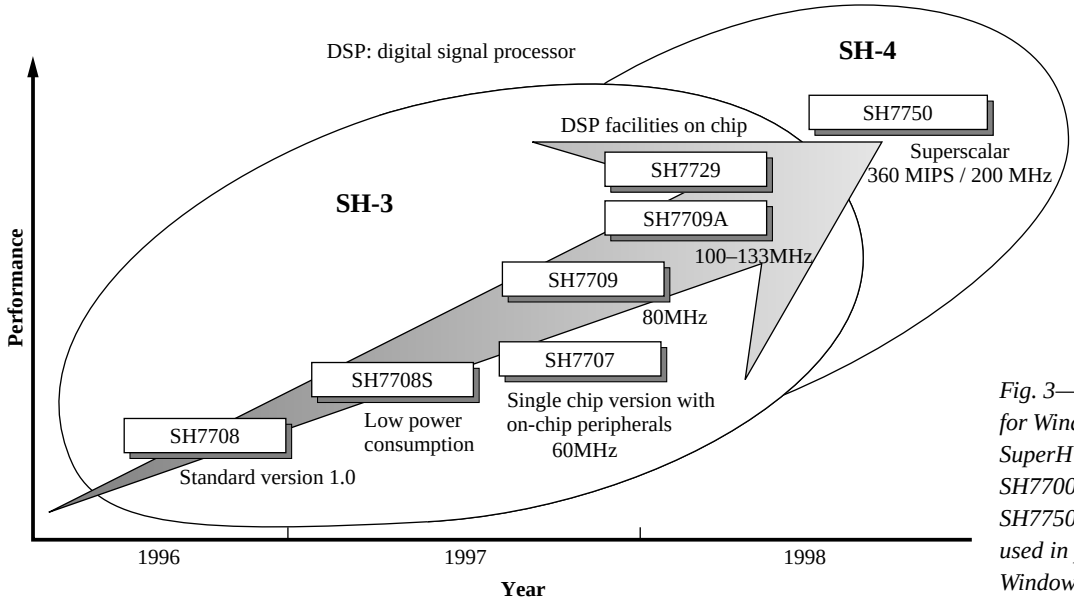
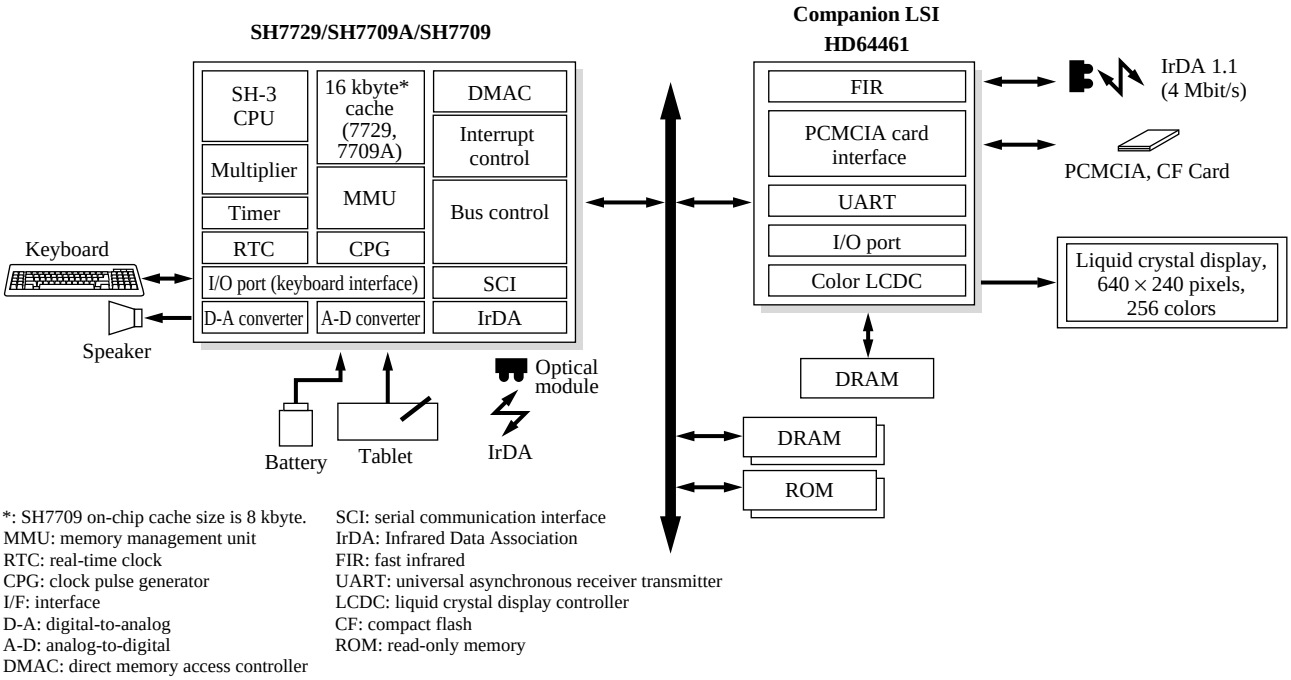


Fig. 3—Road Map of SuperH for Windows CE.
SuperH RISC engine family SH7700 series, SH-3, and SH7750 series, SH-4, can be used in products running Windows CE.

The SH7709A and SH7729 are being implemented for high performance with the high operating frequency of 133 MHz and achieve the low power consumption of 200 mW typical. On-chip peripheral facilities are compatible with the SH7709 and the upgraded cache memory capacity is a large 16 kbyte. Moreover the power supplies for the internal circuits and input output (I/O) have been separated. The power supply for the internal circuits has been reduced to a low 1.8 V to achieve even lower power consumption. Support for DSP functions has been incorporated in the SH7729 to facilitate high-speed processing of image and audio data.

Superscalar processing has been implemented in the SH-4 — SH7750, which operates at 200 MHz and realizes 360 million instructions per second (MIPS). A superscalar architecture uses multiple arithmetic execution units to achieve increased processing performance; the SH-4 has two arithmetic execution units. Because it aims to fulfill the requirements of multimedia applications, a 128 bit graphics engine has been newly added to upgrade 3-dimensional image



*: SH7709 on-chip cache size is 8 kbyte.
MMU: memory management unit
RTC: real-time clock
CPG: clock pulse generator
I/F: interface
D-A: digital-to-analog
A-D: analog-to-digital
DMAC: direct memory access controller
SCI: serial communication interface
IrDA: Infrared Data Association
FIR: fast infrared
UART: universal asynchronous receiver transmitter
LCDC: liquid crystal display controller
CF: compact flash
ROM: read-only memory

Fig. 4—Example of System Configuration of a Handheld PC Running Windows CE.
A Handheld PC system can be built with an SH7729, SH7729A, or SH7709 and a companion chip.

display performance. CPU core operating voltage is 1.8 V.

WINDOWS CE SYSTEM SOLUTIONS

When developing devices using Windows CE, the devices can be made compact and the product development time shortened by having the chip set constitute the major portion of the device. Below we will discuss the chipset for Handheld PCs consisting of the SH7709 SH-3 CPU and the HD64461 companion LSI.

Fig. 4 shows an example of the configuration of a Handheld PC running Windows CE. Handheld PCs running Windows CE feature a color display screen. Thus it is absolutely necessary to use a color LCD controller. Because the PC is powered by batteries, the semiconductors — especially the CPU — must combine high performance with low power consumption. Moreover communications facilities must include 4-Mbit/s high-speed infrared wireless communications; also important is modem facility support for connection to the Internet to receive and send e-mail and read home pages. Further necessary is a PCMCIA (Personal Computer Memory Card International Association) controller to support connection of cards such as PC Cards and CF Cards*2.

The HD64461 is a companion LSI that supports all the peripheral functions required in a Handheld PC. On-chip peripherals include a color liquid crystal controller for simple connection to a color liquid crystal display screen, a PCMCIA controller that supports connection of PC Cards and CF Cards, and an IrDA1.1 high-speed infrared wireless controller. The SH7709 has a CPU interface for connection to this LSI, and the HD64461 can also be used in combination with microcomputers now being developed including the SH7709A and the SH7729.

Use of the companion LSI HD64461 in combination with the SH7709 or SH7709A or SH7729 facilitates rapid development of compact mobile information devices. The Handheld PCs discussed above can be expected to evolve into next generation models with even higher performance and higher functionality. At present, development for use in the next generation of Handheld PCs is being carried out on both a new companion chip that extends the functionality of the HD64461 and a high performance graphics LSI with on-chip DRAM. These LSIs will be used in combination with the SH-4 to create new products.

*2: CF Card (CompactFlash ™ Card): CompactFlash is a trademark of SanDisk Co. of the US and licensed to CFA (CompactFlash Association).

CONCLUSIONS

We have discussed the trend in the evolution of information devices running the Windows CE OS together with the features of the SuperH RISC engine and the companion LSI used in combination with SuperH. We expect Windows CE to be used in a wide range of device models, with the CPU being required to provide ever higher performance with lower power consumption. The companion chip providing the peripheral facilities will be required to have a richer complement of functions to facilitate simple development of devices for a wider variety of applications. For the future we expect to use finer-pattern process semiconductor technology and high-level CPU architecture to develop even higher performance and lower power consumption SuperH RISC engines together with upgraded companion LSIs.

REFERENCES

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