❖*This article has been translated from the original release in Japanese for your convenience*❖

5th February 2002

Low-power Application Processor Technology for Next-generation Cellular Phones

- Enabling of MPEG-4 Software Encoding at 70MHz and 140mW -

The Central Research Laboratory of Hitachi, Ltd. (General Manager Dr. Eiji TAKEDA) has developed low power application processor technology for next-generation cellular phones enabling high-speed low-power multimedia processing. When the technology was applied to MPEG-4 encoding software, necessary for video-attached e-mail and TV-phones, it was found that processing could be executed at a low-power level of 70MHz and 140mW; a level comparable to dedicated hardware. This technology is not limited to MPEG4, but can also be applied for music playback and Java™ processing, etc., and thus can achieve the variety of multimedia functions required of next generation cellular phones at a reasonable cost and low power.

The explosive increase in cellular phones over the last few years can be attributed to the increasing functionality of cellular phones, for example providing WWW (World Wide Web) browsing and music playback functions. With improvements in data transfer performance accompanying the shift to 3rd Generation Cellular Phones,(*1) it can be expected that additional multimedia functions such as sending/receiving video will be available. In previous cellular phones, additional functionality was achieved chiefly through the surplus performance of the baseband processors. As the demand for various multimedia functions increases, however, there is a limit to the functionality extensions that can be achieved by surplus performance.

The Central Research Laboratory proposed an application processor(*2) technology based on a general purpose CPU/DSP, capable of flexibly expanding functions in response to the variety of multimedia processing required for cellular phones. The main features of the technology are as follows:

1) A low-power SH3-DSP(*3) core with built-in full DSP functions was developed. This processor core reduces operating power by decreasing the activation rate in the clock and memory. As a result, at 133MHz operation, a power requirement of 170mW was achieved, providing high performance and low power consumption suitable for cellular phone usage.

2) A memory architecture suitable for multimedia processing was developed using a large capacity on-chip SRAM (128 kByte) capable of read or write in one machine cycle. By storing the necessary data, e.g. for image processing, on a large-capacity on-chip SRAM, the number of times of external RAM/ROM access is decreased, enabling high-speed low power real-time processing.

3) To increase the standby time of the cellular phone, a special standby mode that enables partial power cut-off, was developed. By cutting off the electricity supply

to most of the circuits which are not operating in the standby mode, a very low standby current of less then 10μA was achieved for the entire LSI.

When this technology, using the above full DSP functionality and large capacity SRAM, was applied to MPEG-4(*4) encoding software, it was confirmed that a MPEG-4 dedicated hardware level of performance (70MHz, 140mW) could be achieved for encoding processing using QCIF(*5) at 15 fps (frames per second) in an actual LSI. This technology is not limited only to MPEG-4, but can be applied to music playback or Java™(*6) processing, etc. and will help to achieve the variety of multimedia functions required of the next generation cellular phones at low cost and low power.

The above technology was presented at the International Solid State Circuits Conference (*ISSCC 2002*) held in San Francisco, U.S.A. from 4th February 2002.

Explanation of Terms Used:

1) Third generation cellular phone: An advanced cellular phone in accordance with the IMT-2000 standard set out by the International Telecommunications Union (ITU). It can achieve a higher data transfer rate of 144Kbps – 2Mbps compared to conventional cellular phones.

2) Application processor: In cellular phones, the processor that executes the basic functions of transmission and voice communication, is called a baseband processor. On the other hand, a processor that executes other functions such as WWW browser and multimedia processing, is called an application processor.

3) SH3-DSP: One of the CPU cores in the SuperH™ RISC engine family. It has a built-in DSP function for voice and image processing acceleration, and is suitable for multimedia products with low power consumption.

   SuperH is a trademark of Hitachi, Ltd.

4) MPEG-4: One standard for compressing video. Currently, MPEG-1, MPEG-2, and MPEG-4 are being used commercially. Among these, MPEG-4 in particular, achieves a higher compressibility and is suitable for moving picture compression at a lower bit rate such as from several tens to several hundreds Kbps (bits per second). Thus, it has been used for moving picture distribution on cellular phones.

5) QCIF (Quarter Common Intermediate Format): A video signal format of 176 pixel in width ×144 pixels in length.

6) Java™: A programming language and operating environment developed by Sun Microsystems, Inc. of the United States of America. As the execution of program is not dependent upon the platform, it has been increasingly used in the development and distribution of applications in recent years.

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