Software on Silicon

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THE SoC (system on a chip) or system LSI is now among the key technologies which support the rapidly advancing information-oriented society. The introduction of cellular phones and game machines, for instance, has had a variety of effects on our society and culture as well as on related technical fields. System LSI chip-design technology combines semiconductor technology and computer software technology. Technology for developing embedded software has long been regarded as a rather low-level effort carried out in a sunless back room. However, high-level information technology is playing an increasingly important role in the development of software to run on system LSI chips.

Software technology has mainly been developed on and for mainframes and other general-purpose computers such as PCs and workstations. Its utility on such general-purpose computers was the dominant factor in determining the value of a given technology in terms of both research and education. The introduction of system LSI chips, however, has provided a totally new area of application for software technology. The era of the system LSI chip requires that we dispel the traditional beliefs in general applicability and the separation of hardware and software, and to remove the restrictions placed by requirements for compatibility in terms of operating systems. We must create new concepts and ways of thinking to replace them.

An LSI chip for a cellular phone requires a group of software products in order to realize its intended functions, which mainly consist of communications and Internet access. A program for solving partial differential equations is not, however, necessary. Since a software product on a system LSI chip has the same service life as the LSI chip itself, it is not expected to run on a chip that will be designed 20 years from now. The traditional concept has been to install a wide variety of software products on general-purpose hardware in order to perform a variety of tasks. This approach will be replaced by the idea that software is a means of realizing complex processes within the system and that the design of LSI chips must conform with the software they will run.

When a system LSI chip is designed in this way, the data width does not need any longer to conform to 32- or 64-bit architectures used in general-purpose microprocessors. When designing the word widths and structures of memory areas, all we need to consider are the requirements of the particular system. New ideas such as changing the supply voltage under software control or tuning an instruction set to suit the software will be important in giving software designers a greater degree of freedom. The use of reconfigurable logic will enable systems in which the software optimizes the circuit during operation. Program compilation can be regarded as being at the same level of work with logic synthesis or placement/routing in terms of the magnitude of the effect that it has on the amounts of memory and power consumption by LSI chips.

Current technologies for assembling tens of millions of transistors on single chips have opened up a new field for software. The development of new software technologies that can be keys to system LSI chip design technology, which will be the core of future information technology, is urgently required. Recognizing that the boundary conditions have now changed, we must use the useful technologies from current systems to build new systems. It is fair to say that software is entering another age of technological revolution. Leading software designers, who have their own processor architectures and ability to design system LSI chip-oriented software, will be winners in the coming era of system LSI's.