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Research Article

DEVELOPING TRENDS OF SYSTEM ON A CHIP AND EMBEDDED SYSTEM

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ABSTRACT
The Soc (system on a chip) is a new form of embedded system, which integrates microprocessor, analog IP cores, digital IP core and memory (or off-chip memory controller interface) on a single chip. It is usually customized (CSIC) or a standard product for particular purposes (ASSP). It successfully integrate the hardware integrated circuits and embedded software, which can implement the computer system functions, on a silicon chip, and it belongs to the emerging cross-disciplinary for computer and microelectronics Soc represents a new generation of technology development of embedded processor, its design technology provides an opportunity for computer professionals to be involved in IC design area. And SOC design is still hot now in application design and other areas like microelectronics technology.

Keywords*: SOC, Embedded, Applications, Technology*

INTRODUCTION
Soc is known as system on chip, which means it is a product, and it is an integrated circuit with specific targets, which contains a completed system and the entire embedded software (Huang *et al.*, 2008). Soc is also translated as "System on Chip integration ", which means it is a technique used to accomplish the whole process from determining the system functions to the software and hardware division, and finally completing the design. With the development of microelectronics technology, IC not only improves its technology in production, but also improves its design capacity. Due to the emerging of new EDA tools, IC design capacity approximately experiences a step-like increase every 10 years, which effectively narrows the gap with its technology.

The first generation of EDA, established the version of Gallery for repeated structure in IC, using copy function of the system to improve the efficiency; the second-generation EDA system which mainly talked about gate array and standard cell placement and routing appeared at 80s of last century, and comprehensive system (synthesis) appeared at 90s improved the design level from the schematic to behavior described (Murphy *et al.*, 2005), in further shorten the design cycle and improve the design efficiency. Particularly the standard cell library, including the IP core development, full use the accumulation of design experience, from the basic unit of the circuit, to the function modules, subsystems, systems, achieve the design reuse, thus raise the starting point of design (Edwards *et al.*, 1998).

The technology development of IC industry has experienced integrated circuit, functional integration, technology integration, until today, becomes the knowledge-based computer hardw3re and software integration. With the development of semiconductor technology, IC designers can integrate more and more complex functions into a single silicon chip. And Soc just appeared under the background when integrated circuit (IC) changed into integrated system (IS). From the narrow perspective, it is some kind of chip integration of the information system, that is, integrates the system on a chip. The emergence of SOC improves the integrated circuit into the integrated system, which means the electronic machine's functions can be integrated into a single chip.

Key Technologies of SOC
SOC as a system-level integrated circuits, can accomplish functions like signal acquisition, conversion, storage, processing and I / O on a single silicon chip, and integrate digital circuits, analog circuits, signal acquisition and conversion circuitry, memory, MPU, MCU, DSP, etc. on a single chip to implement a system function. This is a very complex technology, which mainly involves the following aspects:

VDSM IC Design Technology

In the ultra-deep sub-micron IC design, it inevitably involves device structure, key technology, integration technology, materials and other issues. With the level of IC integration increasing, processing technology makes the wire thinner so that it increases the current density, with high electron density, the current transmission will cause atomic displacement which affect the quality of transport, mass transport caused by free field and charged carrier is known as electro-migration, which is one of the reasons of IC failure; the increasing of job design frequency and smaller spacing between wires will bring about crosstalk and system noise which lead to the non-linear process effect in the working process of analog circuit.

The nonlinear effect undermines the integrity of signal. Thus bring new challenges for circuit design and simulation. Constitute the second and third level of circuit constituted the device models should also be taken into consideration, and the interaction between lines and devices will become noticeable.

Low-Voltage Low Power Technology

IC mainstream technology has entered VDSM era, with the decrease of feature size, we can integrate more devices in the same area, and more devices with increased working frequencies make the power consumption increasing per unit area, which will directly affect the power supply of embedded system. The increase of power consumption will affect the stability of system when power supply is low. Smaller width also reduces the voltage. Thus the circuit design should consider the request of the threshold voltage to take appropriate measures to reduce power consumption.

Low Noise Design and Isolation Technology

In IC design, improve the integration level is a trend to follow, however increasing integration means internal width and spaces between wires becomes narrower, which makes it prone to crosstalk and noise, and the noise impacts will become serious with working frequency increasing. In order to ensure the reliability and stability of the SOC, noise reduction and isolation techniques become very important in IC design.

Design Technology of Embedded IP Core (Intellectual Property Core)

SOC is composed of many embedded IP cores, system design methods and technologies based on IP core is critical, so it is urgent for us to do more research and exploitation. IP Core not only refers to digital IP core, but also includes analog IP cores. Analog IP core usually contains capacitors and inductors.

At the same time IP core is also divided into Soft Core, Hard Core and Firm Core. Traditional electronic design engineers face a variety of customized integrated circuits, while electronic system design engineers using SOC technology face a huge IP library, with all the design work based on IP module. SOC technology enables design engineers of electronic system the application to become the ones for electronic device. Thus, SOC is a design technology based on IP core, while IP core is the basis for SOC applications.

Testing Strategies and Testable Techniques for DFT

In order to detect design errors, testable design is necessary, only with that we can ensure the correctness of design and functions. SOC test has methods like structural testing and testable design. DFT (Design for Test) includes built-in self-test, scan test and specific tests. I/O pins and signals in IP core design are generally as the internal variables and signals, which greatly increases the difficulty. A complete SOC chip testing including IP core testing internal and cross, as well as test for user-defined logic circuit. In VLSI era, DFT is an important part for circuit and chip design, which by inserting a variety of logic hardware used to improve the testability of chips (including controllability and observe ability) in original design, so that the chips become easy to test, saving a lot of costs in chip testing. Therefore, SOC technology includes theoretical research of multi-disciplinary in electronic and computer field, is the fastest growing technology in electronics and IT areas currently.

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The Application of SOC Technology

SOC technology is an advanced integration technology of firmware system. The core idea of using SOC technology to design application system is to integrate the whole system on a single chip, in addition to the external circuit or mechanical parts that cannot integrated.

Application characteristics of SOC are as followed:

System Function Integration

For SOC, application system design is also based on functions and parameters, but it is essentially different from traditional methods. SOC is not a distributed system integration technology based on function circuit, but kind of system firm ware and circuit integrated technology based on IP function. First, the realization of function no longer due to the integration of function circuit, but the integration at the realization of the whole system firm ware, which means using IP technology to combine the whole system with circuits. Second, the final results of circuit design are related to the IP modules and firmware features, yet they have little relationship with the way the circuit separating into blocks and connection technology on PCB. Therefore, features of EMC in design results have been greatly improved.

Firmware Integration

In traditional distributed integrated design technology, the firm ware properties of system are often difficult to be optimal because of the technology. Generally, we must consider two design goals for functional integrated circuits in order to meet different using aspects as many as possible, one is the function controlling objectives that can meet requirements of different application areas; the other is application functions and technical indicators that can satisfy larger range. Therefore, the function IC (integrated circuit which is custom) must attach numbers of circuits on I/O and controlling to make average users obtain exploitation performance as much as possible. However, the application electronic system of custom circuit design cannot achieve the best easily, especially with the firmware features scattered.

From the core technology of SOC we can see, the basic design ideas of using SOC technology, designed application system is to achieve system-wide firmware integration. Users only need to select and improve various parts of module and embedded structure according to their needs, thus fully optimized firmware features can then be achieved without taking time to be familiar with the development technology of custom circuit. The advantage of firmware-based system is that it is much more idealized and can more easily meet the design requirements.

The Best Model of Embedded Systems

SOC technology plays an important role for the promotion of the development of embedded system, because the SOC can achieve embedded structure very easy. From the perspective of the entire embedded system, SOC select the appropriate kernel according to the system needs, and together consider the model algorithm, the chip structure and designs for different levels of circuits and devices, thus complete the entire system. Single chips constitutes a system, reducing the workload and additional effect of the second integration, and can more ful1y realize the whole system's firmware features, make the system much closer to ideal design. The embedded structure can greatly shorten the design cycle, and has obvious advantages in improving cost-effective. It is one of the best models of the development technology of embedded systems.

The Development of SOC Technology

SOC technology has come to use from the 90's last century, and works successfully in various industries and productions. However, it is still not maturity enough. As its application developed, there are lots of researches about related technology, mainly show as followed.

Design Language for System Level SOC

System design method nowadays is taking hardware design language for hardware system, which uses languages facing the progress or objection to design' It is different from software design with the method, the language and the operators, which is distinctly bad for the harmony between the two kinds, meanwhile makes it difficult for the function transformation and optimization' Current method increases the design difficulties, and cost more time and money.

In order to make the hardware and software more corresponded in the design process' we need a design language which can contain every aspects. At present, C language and C++ facing the object works much better on the program and design. But SOC system contains hardware design with many overlapped modules, including IP core and testing norms, which cannot achieved by C language. Thus some researchers now are working to apply subsets that can be expanded for hardware.

COT (Customer Owned Tool) Method

COT design is a method that the users can have process tools. In that method users can distribute circuits inside the core, providing the factories with describing files about integration circuits, and take charge of packet, testing and managing the yield. COT combines the physic and logic design together, and the specialty is we can correctly forecast problems such as the capacitance inductive effects the impact of single crosstalk and impedance matching problems, which are consisted by physic distribution and circuit shape in logic design, thus solve them as earlier as possible. Compared with ASIC, COT design can greatly reduce the costs, its development ask high demands for the exploitation of EDA tool, and is related to the degree of automation of EDA designing tools However it cannot achieve the conversion from ASSIC to COT completely at present.

The Automatic Division of Hardware and Software Eat Wares

The automatic division of hardware and software features is an important part in SOC design, which is done by the designers based on the experience at the early time. Late 20th century Ambrosio and Hu proposed that by abstract estimating the probability of scheduled system structure (Edwards *et al.,* 1998), we can implement the division of hardware and software. And the improved iterative algorithm of Chattha and Venuri, divides the task graph at single co-processor (Utkin, 1978) and general-purpose processor else proposed that using simulated annealing algorithm and the Tabu search algorithm can implement the division. And Gupta and De Micheli proposed iterative algorithm for the characteristics (Sesharirl *et al.,* 2002) of embedded real-time systems. Since the 90s of last century there have been a lot of algorithms, such as iteration of the processor, iteration from software to hardware, simulated annealing algorithm with variable grain, partition algorithm of structural features, functional division algorithms between isomorphism distributed (Slotine *et al.,* 1991).

CONCLUSION

Soc represents the new generation of technology development of embedded processor, integrates software and hardware in one, and pursuit best inclusive of production system in system integration which requires multi-disciplinary collaboration and integration. Thus, Soc technology development has higher demands on professional and technical staffs, not only requires IC design knowledge, but also strong background knowledge about computer architecture of Soc chip design Soc highlights the proportion of software development, and we need to provide it u good development platform and embedded operating systems.

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