SYSTEM ON A CHIP

Rights Reality

Powering Ideas

INTRODUCTION

Our handheld devices today have the same computing capability as that of a computer from a few years ago. Miniaturization has helped not only to reduce the size of equipment, but also in reducing cost and power consumption. This has largely been made possible by the integration of the many components necessary for computation onto a single chip, creating a system-on-a-chip, or an SoC.

SoCs are monolithic chips capable of holding all the hardware and software components necessary for a complete functional system. SoCs pack a large amount of processing power (main

IP on a CHIP?

With integration at this scale, the chip comprises of a combination of intellectual property (IP) from a number of parties, with components such as memory, processors, input/output systems belonging to different companies. These units are also known as semiconductor IP cores.

The patent/application publishing trend over the last few years in the SoC domain is depicted in the diagram below. Some of the major players in the SoC domain, including SoC related IP are Intel, ARM, Broadcom, Qualcomm, Apple and Samsung. ARM is one of the leaders in processor arena. ARM

SoC Patent/Application Publishing Trend in the US

processor, graphics processor) and memory (RAM, ROM) into a single chip. Multi-core processors are becoming more and more common. Further, they include peripheral interfaces, I/O logic control, and electronic circuitry. Depending on the application that the chip is intended for, it has additional components such as an audio processor, accelerometer, video encoder and decoder or a cellular modem. From common devices such as digital cameras, smartphones and tablets to devices with specific applications such as those in medical technology and nanotechnology, SoCs find wide application.
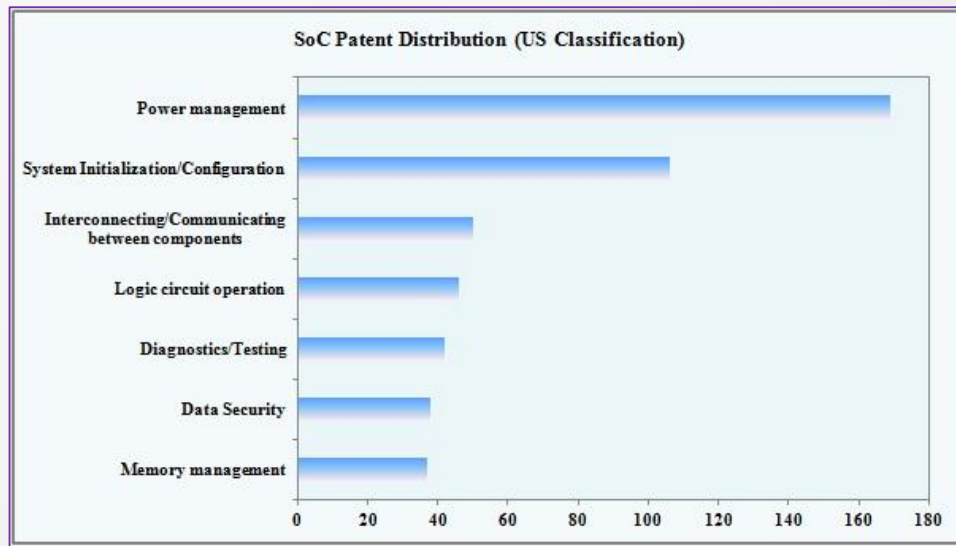
licenses its processor designs and many of the leading players in the market such as Samsung and Apple use ARM's processing cores for some of their products. Another way companies license ARM technology is by licensing the instruction set in their own processor designs. Similarly, one of the leaders in the graphical processors space is Imagination Technologies, counting Intel, Apple and Samsung among its licensees. Qualcomm is one of the major names in mobile chip-making, with a number of smartphone manufacturers licensing its technology.

SoC DESIGN ASPECTS

Miniaturization is not the only challenge in the production of SoCs. From the production of the chip to making it functional, there are a number of challenges as detailed below. Further, the number of patents filed in different sub-areas related to SoCs is depicted by the chart below.

IP Block integration: The use of third-party

heat generation. Add to this power fluctuations and functionality problems, and it is clear that innovation in the reduction of power consumption is a major challenge for SoC devices today.

Software: Efficient software is crucial for SoCs to achieve their maximum performance. A lot of embedded software is contained within the components of SoCs. For proper functioning of the system, the software components need to work seamlessly together. This requires proper integration

SoC Patent Distribution (US Classification)

IP blocks is becoming essential for SoC design to ensure turnout speed and performance. A resulting challenge is the complex integration of components while keeping the system error-free. Further, hardware-software integration also needs to be performed for such systems. There is a great need for innovation and, as a result, IP opportunities in the automation or efficient execution of the process of SoC design, integration, and verification.

Power consumption: It is critical to reduce power consumption on the chip for a number of reasons. First, with a number of devices being battery driven, low power consumption is necessary for prolonged performance. Further, life-time and reliability of a device decreases as the power consumed increases. Moreover, heat sinks and cooling apparatus becoming necessary with more

of the components, from a higher level of abstraction to the lower-level modules.

Programmability: Cypress Semiconductor produces a family of products called Programmable System on a Chip. These chips contain an MCU core, programmable analog and digital blocks and programmable routing. This configurability helps the chips become dynamic and facilitates the addition of new features to the existing system.
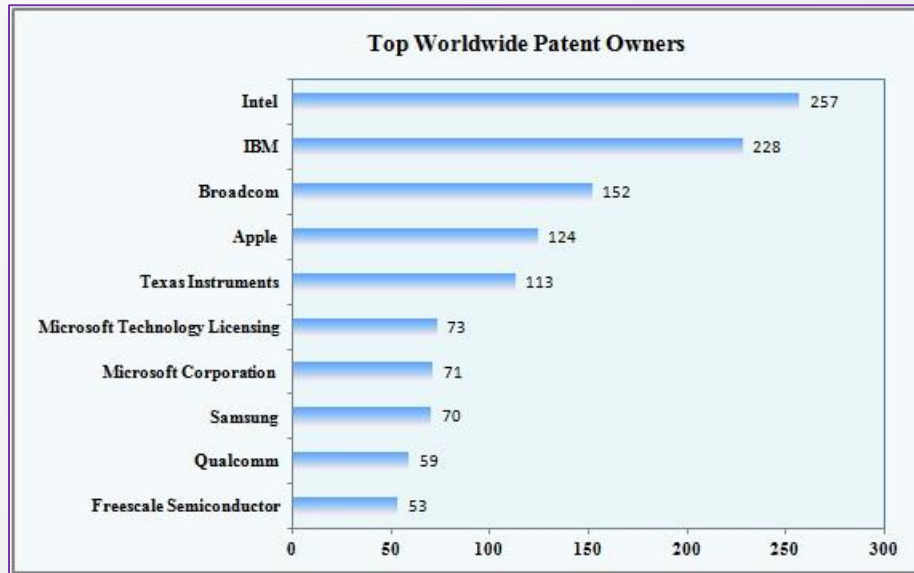
APPLICATION AREAS

Although SoCs have potential application in any area where intensive computing is required, such as the already mentioned mobile phones, some of the other most common or upcoming application areas are provided here as examples.

Wearable Devices: An excellent example is Intel's Curie, an SoC developed to provide computing capabilities to wearable devices. It includes an accelerometer and a gyroscope sensor. There are other wearable products utilizing SoCs which automatically take pictures and videos while a user is engaged in everyday activities.

manufactures and service-providers to stay competitive.

The future – Nanorobots: Sensors and transistors have already been successfully implemented together with integrated circuits at the nanoscale for medical applications. It is envisioned, and efforts are being made for the same, that

Top Worldwide Patent Owners

Company	Patents
Intel	257
IBM	228
Broadcom	152
Apple	124
Texas Instruments	113
Microsoft Technology Licensing	73
Microsoft Corporation	71
Samsung	70
Qualcomm	59
Freescale Semiconductor	53

Networked Home Appliances: With the advent of the Internet of Things (IoT), a large number of home appliances are connected to the internet. The requirement of always being part of a communication network makes compactness as well as security an issue. SoCs are being developed which will be embedded into an appliance, and provide the necessary connection functionality, together with ensuring information security.

Digital Set-top boxes: Set-top boxes have becoming increasingly versatile and common home entertainment devices integrating a number of functions. In addition to the primary function of decoding video and audio, set-top boxes provide the functionality of handling and manipulating media content with multiple digital streams, accessing the internet, while operating efficiently and on low power. SoCs are crucial in allowing set-top box

nanorobots will be developed which will act to diagnose and cure diseases at site.

CONCLUSION

The SoC market is by no means nascent. It is mature and is shared by a number of big players, as seen from the chart above depicting the top patent owners in this field. However, it is also far from saturated. There is a lot of competition in the development and monetization of intellectual property. Licensing is already extensively utilized in this field, and patent litigations are probable with so much overlap in the technology and so many players. While difficult to break through into, the technology promises big rewards, largely contingent on the possession of IP.

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