Tracing the Emergence of Domestic MCUs through the Lens of MCU Development History

MCU is an abbreviation for Microcontroller Unit, commonly known as a microcontroller or single-chip microcomputer in Chinese.

HONG KONG, CHINA, September 13, 2023 /EINPresswire.com/ -- MCU is an abbreviation for Microcontroller Unit, commonly known as a microcontroller or single-chip microcomputer in Chinese. Although the history of microcontrollers is not long, their development has been extremely rapid. As a very important category in integrated circuits, they are widely used in various fields. This article aims to sort out the global history of MCU product development and understand the rise of domestic MCUs from a temporal perspective.

I. History of MCU Development
The emergence and development of MCUs generally coincide with the emergence and development of microprocessors. From a temporal perspective, the development of MCUs can be roughly divided into three stages: exploration stage, formation stage, and comprehensive development stage.

The Exploration Phase of Microcontrollers (1971-1976)

In January 1971, Ted Hoff of Intel, in collaboration with Japanese Business Communications, compressed the original plan's dozens of chips into three integrated circuit chips while developing a desktop computer. Two of the chips were used for program and data storage, and another chip integrated the arithmetic unit, controller and some registers. This was the 4-bit microprocessor Intel 4004, marking the advent of the first generation of microprocessors and the beginning of the era of microprocessors and microcomputers.

In April 1972, Hoff and his team developed the first 8-bit microprocessor, the Intel 8008. As the 8008 used a P-channel MOS microprocessor, it was still considered a first-generation microprocessor.

In August 1973, Hoff and his team developed the 8-bit microprocessor Intel 8080, replacing the P-channel with an N-channel MOS circuit, marking the birth of the second generation of microprocessors. The 8080 chip had a main frequency of 2MHz, was ten times faster than the 8008, could access 64KB of memory, used 6000 transistors based on 6μm technology, and had a processing speed of 0.64MIPS.

In 1975, Texas Instruments first introduced the 4-bit microcontroller TMS-1000, marking the official birth of microcontrollers. The TMS1000 is recognized as the world's first commercial microcontroller. Subsequently, various semiconductor design companies rushed to introduce their own 4-bit microcontrollers, such as the COP4XX series from National Semiconductor, the PD75XX series from Nippon Electric, and the TMP47XXX series from Toshiba.

The Formation Stage of Microcontrollers (1976-1990s)

This was a period dominated by Intel microcontrollers.

In September 1976, Intel developed the MCS-48 series of 8-bit microcontrollers, the prototype of modern microcontrollers, commonly referred to as the first generation of microcontrollers. It adopted a single-chip structure, integrating an 8-bit CPU, 8-bit parallel I/O interface, 8-bit timer/counter, and small-capacity RAM and ROM on one chip. Its addressing range was less than 4KB. Due to limitations in integration, it did not have a serial I/O interface, had small RAM and ROM capacities, and a simple interrupt system, but it could meet the needs of general industrial control and intelligent instruments. From then on, microcontrollers began to develop rapidly, with expanding application areas, and became an important branch of microcomputers.

In the late 1970s, many semiconductor companies saw the huge market prospects of microcontrollers and continually joined the field's research and development. In 1978, Motorola introduced the M6800 series of microcontrollers, Zilog introduced the Z80 series, and in 1979, Nippon Electric introduced the µPD78XX series.

With the increasing demands in the field of industrial control, 16-bit microcontrollers began to appear, but due to their unsatisfactory cost-performance ratio, they did not gain widespread application. In 1983, Intel introduced the high-performance 16-bit MCS-96 series, which used the latest manufacturing process, with a chip integration of up to 120,000 transistors per chip.

Worth mentioning is the typical product of this stage, the high-performance 8-bit MCS-51 series microcontroller launched by Intel in 1980 based on the MCS-48 series. The MCS-51 series was a microcontroller designed entirely for embedded applications, with significantly improved performance compared to the MCS-48 series. It added a serial I/O interface and a 16-bit timer/counter. The storage capacity of the built-in ROM and RAM was increased accordingly, with an addressing range of up to 64KB, a built-in ROM capacity of 4-8KB, and multi-level interrupt processing capabilities.

In the mid-1980s, Intel focused its efforts on CPU research and development and gradually gave up on the production of microcontrollers. Therefore, it transferred the 80C51 core technology to other IC manufacturers, such as Philips, Nippon Electric, Atmel, ADI, Winbond, and others, through patents or technology exchanges. These companies expanded on the basis of maintaining compatibility with the 80C51 microcontroller. Thus, the 80C51 became a large family supported by many manufacturers, developing hundreds of varieties. The derivative products compatible with it are collectively referred to as the 80C51 series, which are mainstream products in microcontroller applications, with stronger functions and market competitiveness, and are still widely used today.

The Comprehensive Development Phase of Microcontrollers (1990s to the present)

This period is the current era when microcontrollers are blooming. Microcontrollers are developing towards higher levels in all aspects such as integration, functionality, speed, reliability, and application fields. In addition to the 8051 MCU core, there are also MIPS, self-researched cores, and the impactful Arm Cortex-M core and RISC-V core.

In 1997, Atmel developed the AVR, a high-speed 8-bit microcontroller with an enhanced built-in Flash and RISC instruction set. The AVR microcontroller has an innovative system architecture, higher integration, and is paired with Atmel's own Flash process. It performs better in performance and power consumption compared to previous von Neumann architecture products. This type of microcontroller has a simple circuit, low failure rate, high reliability, and low cost.

At the same time, various manufacturers are actively developing their own architectures and cores. Renesas, established in 2003, uses its own Renesas core, in addition to Freescale's HC05/HC08 series, Motorola's MC68HC series, TI's MSP430 series, and others.

In 2002, MIPS launched the M4K core, a high-performance, integrated processor core designed specifically for MCUs and small-sized embedded controllers. Some of Microchip's 32-bit PIC series MCU products use the MIPS core.

In 2004, Arm launched a series of 32-bit Cortex-M cores. STMicroelectronics was the first to use them, and 32-bit microcontrollers quickly replaced the high-end position of 16-bit microcontrollers. The performance of 16-bit microcontrollers that entered the mainstream market also improved rapidly, with processing capabilities hundreds of times higher than in the 1980s. Representative products include Motorola's M68300 series and Hitachi's SH series.

In 2010, the open-source instruction set RISC-V originated from the University of California, Berkeley.

In 2019, GigaDevice Semiconductor and Nuclei Technology launched the world's first general-purpose microcontroller based on the open-source instruction set architecture RISC-V and the Bumblebee processor core-the GD32VF103.

In the 21st century, high-speed, large addressing range, strong computing power 8/16/32-bit general-purpose microcontrollers and special-purpose microcontrollers for specific fields have appeared. Currently, microcontroller systems are no longer developed and used in bare machine environments, and a large number of dedicated embedded operating systems are widely used on microcontrollers. High-end microcontrollers that serve as the core processors of handheld computers and mobile phones can even directly use dedicated Windows and Linux operating systems.

II. The Rise of Domestic MCUs

If we trace back to the birth of the 4-bit microprocessor Intel 4004 in January 1971, MCUs have a history of nearly 50 years. However, most domestic MCU products did not emerge until the beginning of the 21st century, a relatively short history. Domestic MCUs did not participate in the exploration and formation stages of MCU development, but in the comprehensive development stage of MCUs, domestic MCUs are an undeniable presence, especially in the current international environment.

Although the popular microcontroller series on the market are still dominated by European, American, and Japanese companies, such as STMicroelectronics' STM32 series, Microchip's PIC series, Atmel's (acquired by Microchip) AVR series, NXP's LPC series, and Texas Instruments' MSP430 series, we have noticed that some domestic MCU products, such as GigaDevice's GD32 series and Nuvoton Technology's APM32 series, are slowly appearing on the sales lists of various component distribution platforms. Domestic MCU products are rising rapidly.

Domestic MCUs are in the stage of "from existence to strength". Based on the history of MCU development mentioned above, the author believes that the high-speed development of modern MCUs in the true sense began when Arm introduced the Cortex-M core and adopted the division of labor form of IP authorization. Currently, Arm's Cortex-M core holds a dominant position in the market with a share of 52%. Taking the application of the Arm Cortex-M core as a standard, in some sense, we can glimpse the current richness and competitiveness of domestic MCU products.

Arm has launched 11 Cortex-M series MCU core IPs, each with different positioning, involving performance, power consumption, cost, volume, specific extensions, etc., to meet low, medium, and high-end needs. Among them, the M0, M0+, M1, M23 series are low-end MCU cores; M3, M4 are mid-range MCU cores; M33, M35P are mid-to-high-end MCU cores; M7, M55, M85 are high-end MCU cores.

In addition, domestic MCU manufacturers are also continually exerting efforts in high-end products. Reportedly, as of the third quarter of 2022, leading mainland enterprises such as GigaDevice and NationalChip are in the research and development stage of high-performance Cortex-M7 core series products. Moreover, during the 2021 Munich Electronics Show, Zeng Hao, the Vice President of Nuvoton Technology, revealed: "Nuvoton's high-end product, APM32F720 based on the Arm Cortex-M7 core, is about to be launched soon."

However, it's worth mentioning that Cortex-M55 is the first processor based on the Armv8.1-M architecture, using Helium technology, and supporting AI processing capabilities; Cortex-M85 is touted as the "most powerful Cortex-M processor to date," with scalar computing 30% higher than Cortex-M7, and also adopting Helium technology. As high-end cores, they were released respectively in February 2020 and April 2022. Even STMicroelectronics, the global leader in MCUs, has not mass-produced related products yet.

When will the era of domestic high-end MCUs arrive? Specifically, GigaDevice, as the leading company in the domestic MCU industry, can basically represent the strongest competitiveness of China's MCU manufacturers with the release timeline of its 32-bit MCU products.

Currently, GigaDevice's products have covered mid-to-high-end MCUs, but for high-performance, high-performance Arm Cortex-M7 core high-end MCUs, they are still in the research and development stage. According to the timeline of GigaDevice's MCU product releases above, a new MCU product based on the Arm Cortex-M core is launched about every three years. The author hopes that by 2025, GigaDevice can mass-produce MCU products based on the Arm Cortex-M7. It should be noted that STMicroelectronics released the world's first high-end MCU product based on the Arm Cortex-M7 as early as 2014.

If you'd like to learn more, please feel free to visit our website.

JAK Electronics
JAK Electronics
+852 9140 9162
email us here

This press release can be viewed online at: https://www.einpresswire.com/article/655390623

EIN Presswire's priority is source transparency. We do not allow opaque clients, and our editors try to be careful about weeding out false and misleading content. As a user, if you see something we have missed, please do bring it to our attention. Your help is welcome. EIN Presswire, Everyone's Internet News Presswire™, tries to define some of the boundaries that are reasonable in today's world. Please see our Editorial Guidelines for more information.
© 1995-2023 Newsmatics Inc. All Right Reserved.