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1985

FPGA (Xilinx, Inc., U.S.A.)

~ Integrated Circuit ~

FPGA (Field-Programmable Gate Array) is characterized by its ability to program functions on the user side after shipment. It was first commercialized by Xilinx in 1985. Initially, the number of gates was small and the operation speed was slow, so the application was somewhat limited, such as for ASIC prototype verification, but in the 1990s, as flexibility and low cost began to be recognized, the gate scale expanded and the operation performance was also improved. In addition, in the 2000s, processor cores, high-speed interfaces, dedicated processors for multiplication and addition, etc. were built in, enabling a variety of functions such as DSP, microcontroller and processor. At present, the development of AISC is rather expensive, and FPGAs fabricated by cutting edge CMOS process tend to outperform ASIC both in terms of gate size and performance. Xilinx and Altera account for 80% of the current FPGA market.

The basic concept of the FPGA is to make it possible to change functions and wiring of logic gates, logical blocks, etc. after shipment. In this sense, PROM (Programmable Read-Only Memory) or PLD (Programmable Logic Device) which allows the user to change the wiring after shipment of the LSI can be said to be a pioneer of that.

XC2064 which was first commercialized by Xilinx in 1985 consisted of 64 CLBs (Configurable Logic Blocks) each with an 8×8 lattice structure, with 3-input LUT (Look-Up Table). However, the number of gates in this series was less than 1200-1800, and compared with ASIC, integration level and performance were inferior and the price was high. As a result, the application was limited, such as trial production verification of ASICs and research purposes.

However, in the 1990s, its flexibility and future potential began to be recognized, the number of player companies increased, and with the benefits of miniaturization, the degree of integration and operation performance also improved greatly. Xilinx announced XC 4000 series in 1990 with the gate count of 26,000. In addition to the memory block, PLL (Phase-Locked Loop) was also installed, and the correspondence to high-speed design advanced. Applications expanded to communications, networks, automobiles, industrial applications and others.

In the 2000s, the functions of FPGAs were further improved and advanced to system LSI. First, a processor core was installed. In 2000. Altera commercialized Excalibur, the FPGA with an embedded ARM processor. In addition, a high-speed external interface, dedicated blocks for multiplication and addition for image processing, etc. were mounted, and FPGA functions could now cover not only ASIC but also DSP, microcontroller, or processor. In addition, state-of-the-art CMOS process was used, and higher integration and higher performance advanced. Xilinx announced Vertex-6 in 2009 as a FPGA in 40nm/45nm process, which had 760,000 logic cells and 26Mbit RAM blocks. Stratix-5 which Altera plans to ship in 2011 is manufactured in 28nm process, and it has 3,680 multipliers, more than 1 million

logic cells, and has more than 50 Mbit RAM.

As the requirements of the LSI market changed in a short period of time and products tended more towards small-volume-many-kinds, ASICs based on high volume mass production and having a long development period were replaced by FPGAs that were flexible and short in development period. Given that the future computer environment will become more and more diverse and complicated with video, music, photo transmission, cloud computing, mobile access, and more, it is considered that the flexibility and low cost of FPGAs will further expand its applications in the future.

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