BENEFITS OF RISC MICROPROCESSOR ARCHITECTURE

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Annotation. This basic information about CISC and RISC microprocessor architectures is presented in the paper. The main advantages of the RISC architecture over the CISC design are described in the article.

Keywords. Microprocessor, instruction set, CISC, RISC, CPI, RAM, register, instruction pipeline, rule "80/20", transistor, ARM

An integral part of any computer technology is a microprocessor. A microprocessor is an electronic unit or integrated circuit that executes machine instructions. The microprocessor consists of three main units: the ALU, multiple registers and the control unit. To transfer data between these units a microprocessor uses an internal data bus. The main characteristics of microprocessors are clock speed, bus speed, word size, instruction set, and number of cores.

One of the important parameters of a processor is its architecture. Today, the processor market is dominated by two architectures CISC and RISC. Each architecture has its advantages and disadvantages. In this article, I would like to mention the advantages of RISC architecture versus CISC design.

First, we should answer the question: "What is RISC and CISC?" To answer this question we need to figure out what the instruction set of a microprocessor is. An instruction set is a limited set of activities, such as addition, subtraction, counting and comparisons. CISC means a complex instruction set computer, while RISC is a reduced instruction set computer.

CISC. A complex instruction set computer is a computer in which single instructions can execute several low-level operations such as a memory load, an arithmetic operation, and a memory storage or are capable of multi-step operations or addressing modes within single instructions. Examples of CISC architecture include complex mainframe computers to simplistic microcontrollers where memory loading and storage operations are not separated from arithmetic instructions.

A reduced instruction set computer is a computer with a small, highly optimized set of instructions, rather than more specialized set, often found in other types of architecture, such as in a complex instruction set computer (CISC). The main distinguishing feature of RISC architecture is that the instruction set is optimized with a large number of registers and a frequently used instruction pipeline, allowing a low number of clock cycles per instruction (CPI).

RISC architecture has many advantages over CISC design. Data processing is performed only on the contents of the internal registers of the microprocessor without RAM access. A typical example of RISC technology is the principle of pipelined data processing: when each operation is divided into the same type simple steps that are performed in parallel. The instruction set of a RISC processor is reduced to 70-100 instructions instead of several hundred for CISC microprocessors. Instructions have a simple, well-defined format. The rarely used instructions are excluded from the instruction set, as well as commands that do not fit into the accepted format. Microprocessors that are based on RISC architecture have lower cost of hardware parts than microprocessors based on CISC technology [1].

What is also worth mentioning is "80/20" rule: the execution of 20% of the commands, included in the command system, takes 80% of a program execution time. Therefore, regarding microprocessor performance, it is only a fifth part of all commands that plays the main role, while other commands are rare enough [2].

As current experience shows, the RISC architecture has better performance than CISC design. Also, RISC architecture has greatly reduced the power consumption of the processor by reducing the number of transistors. Currently, many processor architectures are RISC-like, such as ARM, DEC Alpha, SPARC, AVR, MIPS, POWER, and PowerPC. The most widely used of them is ARM. This architecture is used in the microcontrollers of such IT giants as Apple, Samsung and Qualcomm. The most widely used x86 processors in desktop computers were formerly CISC processors, but new processors, starting with the Intel Pentium Pro (1995), are CISC processors with a RISC core. They transform the CISC instructions of x86 processors into a simpler set of internal RISC instructions just before execution [3].

To sum up: RISC architecture is one of the most widespread in the world now, with more than 40% of the world market. Thus, the evolution of RISC processors has made a giant leap forward and the reserve of their development potential is still very, very large.

References:

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