Microprocessors & Microcontrollers

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5: ARM Processor

ARM Processor

- An ARM processor is one of a family of CPUs based on the RISC (reduced instruction set computer) architecture developed by Advanced RISC Machines (ARM).
- ARM makes 32-bit and 64-bit RISC multi-core processors. RISC processors are designed to perform a smaller number of types of computer instructions so that they can operate at a higher speed, performing more millions of instructions per second (MIPS). By stripping out unneeded instructions and optimizing pathways, RISC processors provide outstanding performance at a fraction of the power demand of CISC (complex instruction set computing) devices.

- ARM processors are extensively used in consumer electronic devices such as smartphones, tablets, multimedia players and other mobile devices, such as wearables. Because of their reduced instruction set, they require fewer transistors, which enables a smaller die size for the integrated circuitry (IC).
- The ARM processor's smaller size, reduced complexity and lower power consumption makes them suitable for increasingly miniaturized devices.

ARM processor features include:

- Load/store architecture.
- An orthogonal instruction set.
- Mostly single-cycle execution.
- Enhanced power-saving design.
- 64 and 32-bit execution states for scalable high performance.
- Hardware virtualization support.

- The simplified design of ARM processors enables more efficient multi-core processing and easier coding for developers. While they don't have the same raw compute throughput as the products of x86 market leader Intel, ARM processors sometimes exceed the performance of Intel processors for applications that exist on both architectures.
- The head-to-head competition between the vendors is increasing as ARM is finding its way into full size notebooks. Microsoft, for example, offers ARM-based versions of Surface computers. The cleaner code base of Windows RT versus x86 versions may be also partially responsible. Windows RT is more streamlined because it doesn’t have to support a number of legacy hardware.
- ARM is also moving into the server market, a move that represents a large change in direction and a hedging of bets on performance-per-watt over raw compute power. AMD offers 8-core versions of ARM processors for its Opteron series of processors. ARM servers represent an important shift in server-based computing. A traditional x86-class server with 12, 16, 24 or more cores increases performance by scaling up the speed and sophistication of each processor, using brute force speed and power to handle demanding computing workloads.
- In comparison, an ARM server uses perhaps hundreds of smaller, less sophisticated, low-power processors that share processing tasks among that large number instead of just a few higher-capacity processors. This approach is sometimes referred to as “scaling out,” in contrast with the “scaling up” of x86-based servers.

ARM registers

ARM processors provide general-purpose and special-purpose registers. Some additional registers are available in privileged execution modes.

In all ARM processors, the following registers are available and accessible in any processor mode:

- 13 general-purpose registers R0-R12.
- One *Stack Pointer* (SP).
- One *Link Register* (LR).
- One *Program Counter* (PC).
- One *Application Program Status Register* (APSR).

- ARM processors, with the exception of ARMv6-M and ARMv7-M based processors, have a total of 37 registers, with 3 additional registers if the Security Extensions are implemented, and in ARMv7-A only, 3 more if the Virtualization Extensions are implemented.
- The registers are arranged in partially overlapping banks. There is a different register bank for each processor mode. The banked registers give rapid context switching for dealing with processor exceptions and privileged operations.

Is Arm better than Intel x86?

- Not necessarily. Both types of processor architecture have their own strengths and weaknesses. The excellent power consumption and heat dissipation makes Arm a great fit for small, portable devices such as smartphones and tablets.
- Meanwhile, Intel's x86 CISC (complex instruction set computer) architecture has been traditionally better suited for performance-focused tasks as it can carry out more complex instructions per clock. This made them a natural fit for laptops and desktop PCs, which generally see heavier workloads than the likes of smartphones and tablets.
- Laptop manufacturers have previously snubbed Arm-based chips as they require huge amounts of RAM and suffer compatibility issues with the Windows operating systems, but that's all looks to be gradually changing. Now RAM is a lot more affordable, and Microsoft is working with Qualcomm to address those compatibility issues.
- We're now at a stage where manufacturers are selling laptops equipped with Arm-based chips, including Samsung's Galaxy Book S, Lenovo's Yoga C630 13 and Microsoft's Surface Pro 9 5G. These laptops flaunt above-average battery life, new ultra-portable designs and support for LTE connectivity, and while the CPU performances weren't quite as good as Intel x86 counterparts, they were still easily powerful enough for basic tasks such as web browsing, video streaming and word processing.

H.W

Write a report about the following title:

Massively Parallel processing on ARM Processor