

Embedded Systems Essentials with Arm: Getting Started

Module 1

KV4 (1): Arm Architecture and Processors

The Arm architecture is a family of RISC-based processor architectures, well known for its power efficiency and used in many mobile devices. The architecture details a set of instructions that define how the hardware should work upon execution of certain instructions. These specifications are in place so that software that conforms with them can be executed on any Arm-based processor.

Arm architecture is suited for use in an array of IoT applications and includes features that meet the ever-evolving demands for new functionality, integrated security features, high performance and the needs of new and emerging markets. For example, the Armv7-M architecture used in the Arm Cortex-M4 processor is designed specifically for embedded systems, and so enables simple pipeline design, low cycle count execution, and minimal interrupt latency, all of which improve speed, battery life and simplicity of operation in an embedded systems environment.

Some companies license the Arm architecture and design their own CPU based on the licensed architecture, rather than using a CPU designed by Arm.

Arm architecture also forms the basis for every Arm processor.

Although Arm processors are widely considered an industry standard, Arm itself does not manufacture them. Instead, Arm designs the processor cores in its hardware libraries, licenses the designs to producers, and provides an ecosystem of development tools and manuals. Producers combine these processor designs with their own intellectual property or with other third-party intellectual property to create a complete product.

Arm's processor technology is designed and optimized with the needs and constraints of IoT devices in mind, and so are more energy efficient. Arm processors cover IoT applications from sensors to servers.

Arm Cortex-A Processors are application processors used for feature-heavy operating systems and third-party applications. For example, machine learning at the edge, autonomous context-based decision making, or securely connecting IoT devices to the cloud.

Arm Cortex-R Processors are embedded processors for real-time signal processing and control applications. They meet the need for high performance, very low latency, and low power in devices such as connected cars, high-end cameras, or disk drive controllers.

Arm Cortex-M Processors are microcontroller-oriented processors. They can be application-specific, or suitable for system-on-chip uses. They are optimized for low energy consumption and small executables, requiring less physical space and silicon for a lower cost.

This course focuses on M-series processors.

The Arm Cortex-M0 and Cortex-M0+ are designed for applications that require minimal cost, power, and area. These processors are optimized for simple sensing and controlling.

The Cortex-M3, Cortex-M4 and Cortex-M7 are designed for data-intensive operations with Harvard architecture, dedicated fast hardware multipliers, and math packages. The Cortex-M4 and Cortex-



M7 integrate Digital Signal Processing and accelerated floating point processing capability for fast and power-efficient algorithm processing of digital signal control applications.