

ARM Cortex Processor

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Introduction to ARM Processor

Reduced instruction set computing (RISC) has a special place on the map of hardware development, and the family of ARM processors is based on the RISC architecture.

- **Cortex A:** built for advanced operating systems and exhibits the highest possible performance.
- **Cortex R:** caters perfectly to the needs of real-time applications and provides its users with the fastest response times.
- **Cortex M:** mainly built for microcontrollers and used for embedded applications.

Cortex A - High performance

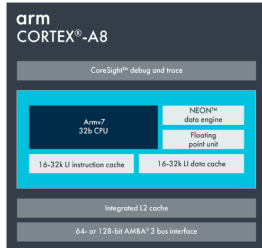
Cortex R - Fast response

Cortex M - Low power

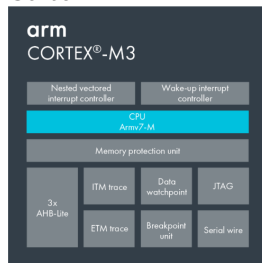


Basic Blocks

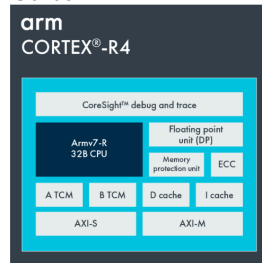
Cortex A



Cortex M



Cortex R



ARM Cortex A series

- The ARM Cortex-A series of applications processors provide a range of solutions for devices undertaking complex compute tasks.
- ARM Cortex-A is the highest performance series
- Reduced Instruction Set Computing (RISC)
- Supports 32 and 64-bit instruction sets
- ARMv7-A (A5, A7, A8, A9, A12, A15 and A17) and ARMv8-A architectures.
- Supports previous ARM systems
- The Cortex-A category of processors is dedicated to Linux and Android devices.
- Smartwatches, mobile phones, tablets, networking equipment etc.



ARM Cortex A5

- Cortex-A5 core is the smallest and lowest power member of the Cortex A series.
- It is compatible with the larger members of the series (A9 and A15).
- it enables higher performance and lower silicon cost.
- Applications - Telechips TCC892x, Qualcomm Snapdragon S4 Play, Atmel SAMA5D3...



ARM Cortex A7

- The Cortex-A7 is similar in power consumption and area to the Cortex-A5.
- Its performance is increased by 20% compared with A5.
- It enables higher performance and lower silicon cost.
- It is compatible with Cortex-A15 and Cortex-A17.
- Better choice for cost-sensitive smartphone and tablet.
- Applications - Broadcom VideoCore BCM2836, BCM23550, Qualcomm Snapdragon 200, NXP semiconductors communications processors.

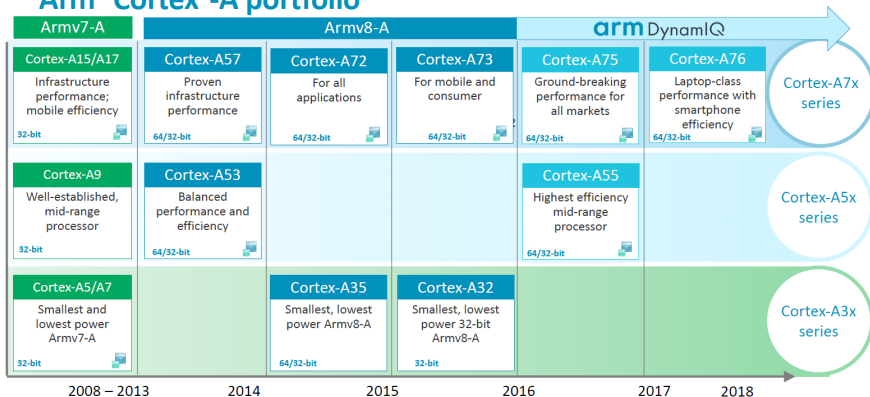


ARM big.LITTLE

- ARM big.LITTLE is a heterogeneous computing architecture developed by ARM.
- Coupling battery-saving and slower processor cores (LITTLE) with relatively more powerful and power-hungry ones (big).
- Only one core will be active at once, but have access to same memory.
- This architectures are used to create a multi-processor system-on-chip (MPSoC)
- In October 2011, big.LITTLE was announced along with the Cortex-A7, which was designed to be architecturally compatible with the Cortex-A15.



Arm[®] Cortex[™] -A portfolio



Applications of ARM A Series

- Cortex A8 - Apple A4, Samsung Galaxy Sline,tab(Exynos 3110), Gooseberry(Allwinner A1x)
- Cortex A9 - Cyclone VSoC FPGA, Apple ipad(A5X), Xilinx zynq-7000, TI OMP4 etc.
- Cortex A15 - Samsung Chrome Book laptop,Samsung Galaxy Note(Exynos 52xx,58xx), CM-T54 board, IGEPV5 board(TI OMP5 SoC).
- Cortex A17 - ASUS Tinker board, Broadcon EM3288 (Rockchip RK3288)
- Cortex 5X - Xilinx zynqMP, IOT board(Qualcomm Snapdragon 410).
- Cortex 7X - 5g Chipset(MediaTek Dimensity 1000), Galaxy S10 (Samsung Exynos 9820)



ARM Cortex R series

- The Arm Cortex-R series provides a range of processors optimized for high performance, hard real-time applications.
- These are based on the ARMv7- R architecture .
- It has three complementary processors: the Cortex-R4, Cortex-R5 and Cortex-R7 processors.
- Applications - hard disk controllers (or solid state drive controllers), networking equipment, printers , Blu-ray players, media players, airbags, braking systems and engine management.



Features

- Tightly coupled memory
- Increased exception handling in hardware
- Hardware division instructions
- Memory protection unit (MPU)
- Deterministic interrupt handling as well as fast non-maskable interrupts
- ECC on L1 cache and buses
- Dual-core lockstep for CPU fault tolerance

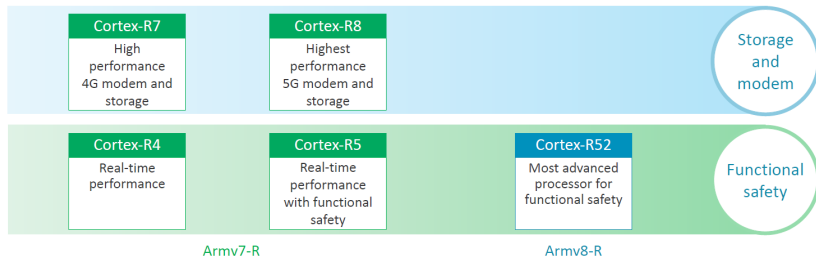


Cortex R Series

- The Cortex-R4 processor delivers high-performance, real-time responsiveness, reliability, and dependability with high error-resistance.
- The Cortex-R5 processor is same as Cortex-R4 with enhanced error management, extended functional safety, and SoC integration features.
- In R7 for the first time there is an integrated Generic Interrupt Controller (GIC), Snoop Control Unit (SCU) and timers to further reduce latency and enable symmetric multiprocessing in a dual core configuration.
- The Cortex-R8 processor delivers twice the performance of the Cortex-R7 processor.
- The Cortex-R52 is the first ARMv8-R processor, support hypervisor, simplifying software integration with robust separation to protect safety-critical code.



ARM Cortex-R Portfolio



Applications of Cortex R

- R4 is good for ASIC, ASSP, and MCU embedded applications.
- Networking and data storage applications are well served by the Cortex-R5
- Medical devices
- Programmable logic controller (PLC)
- Electronic control units (ECU) for a wide variety of applications
- Robotics
- Electronic braking system
- Motion control



ARM Cortex M series

- The Arm Cortex-M series contains the smallest/lowest power processors build by Arm, optimized for discrete processing and microcontrollers.
- The ARM Cortex-M is a group of 32-bit RISC ARM processor cores licensed by ARM.
- low-cost and energy-efficient microcontrollers
- Cortex-M cores are used as microcontroller chips, acts as power management controllers, I/O controllers, system controllers, touch screen controllers, smart battery controllers, and sensors controllers.



Cortex M3, M4 and M0

- 1.25 DMIPS/MHz with a 3-stage pipeline, multiple 32-bit busses, clock speeds up to 200 MHz.
- Both share the same architecture and instruction set Thumb2.
- M4 consists of DSP and FPU blocks.
- For DSP and FPU applications M4 is better. M3 consumes 3 times more power than M4.
- Cortex-M0+ has micro trace buffer (MTB). This peripherals allows you to dedicate some of the on-chip RAM to store program branches while in debug.

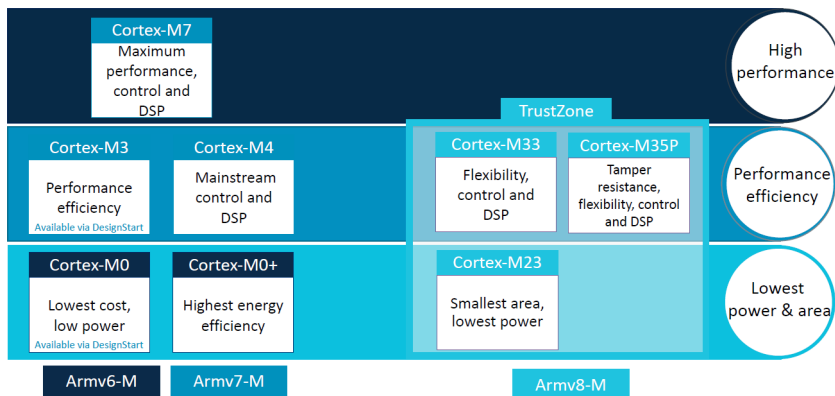


Cortex M23 , M33 and M55

- ARM has launched the first of a series of Cortex-M series microcontrollers based on the V8M architecture that incorporate the Trustzone security mechanism.
- The Cortex-M23 is similar to Cortex M0 additionally having TrustZone security features, with a 2-stage instruction pipeline and ARMv8 architecture.
- The Cortex-M33 is based on ARMv8-M architecture and is Cortex-M4 and Cortex-M23, with TrustZone security feature.
- The Cortex-M55 core was announced in February 2020 and is based on the ARMv8.1-M architecture . It also has a 4-stage instruction pipeline.



ARM Cortex-M portfolio



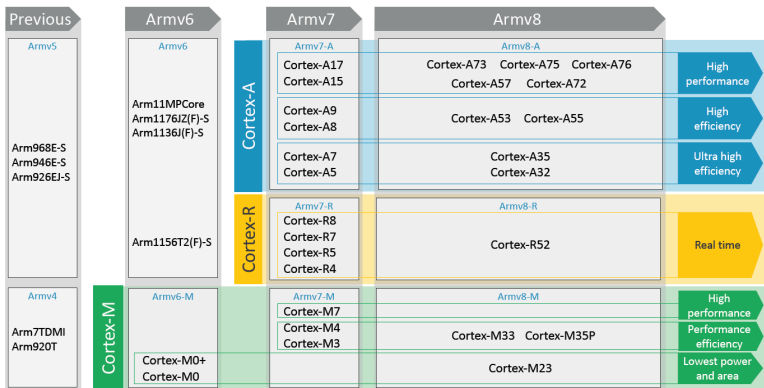
Applications of ARM M Series

- Cortex M3 - Arduino Due board(ATSAM3X8E), Broadcom wifi chip(BCM4319XKUBG),Xilinx softcore(Spartan 3, Artix7)
- Cortex M4 - TI Stellaris launchpad (LM4F120), Analog devices (CM400)
- Cortex M7 - Microchip(Atmel SAM E7,S7,R7), NXP(Kinetics KV5x)
- Cortex M23 - Gigadevice (CD32E230), Microsoft(SAM L10,L11)
- Cortex M33 - Digilog(DA1469x), NXP CPC5500



Cortex Processors

Performance and scalability for a diverse range of applications



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