

Why Choose an ARM Processor?

Package, price and peripheral support are, of course, extremely important factors when choosing which processor to use for any design. However the performance, power consumption and overall development cost of the entire system will also have a large impact on the success of the project.

Choosing an ARM processor provides designers with access to a huge range of third party development tools, operating systems and software. Furthermore you will experience the power of a scalable architecture to ensure your investment in software development is protected should you wish to move to higher performance ARM processors in the future.

The ARM processor portfolio provides designers with a range of solutions for applications across the full performance spectrum, from the extremely low cost Cortex™-M0 and Cortex-M0+ processor to the high-performance, >10k DMIPS Cortex-A53 and Cortex-A57 MPCore processors as well as the Mali family of Graphics Processing Units (GPU)

This document provides more information about ARM, the processors and the development tools available, which can be used to support your design.



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Web:

www.arm.com/products/processors/index.php

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ARM Processor Guide

ARM is the industry's leading provider of embedded RISC microprocessors. ARM processors are licensed by the majority of the world's leading semiconductor manufacturers, who together have shipped in excess of 35 billion processors since the company was formed in 1990. ARM offers a wide range of processor IP based on a common architecture delivering high performance together with low power consumption and system cost. This energy-efficient performance is enhanced by ARM Physical IP, development tools and the largest ecosystem in the industry. The ARM Connected Community is comprised of over 950 companies including third party systems, design support, software and training providers which combined provide a complete solution for products based on the ARM Architecture.



ARM[®]

The Architecture for the Digital World[®]

The ARM Architecture

The ARM architecture, which provides the basis for the company's technology leadership, is the most widely used embedded RISC solution in the world. All ARM processors share this architecture, ensuring that developers gain the maximum return on software development as they migrate to higher performance processors. Latest reports show that ARM's market share of the embedded RISC microprocessor market is more than 75 percent, with ARM Partners shipping more than 8 billion ARM processor-based devices per year. It has excelled because it is an open architecture that provides unparalleled levels of compatibility and design reusability, combined with superior performance, compact code density and low cost per DMIPS.

Thumb®

An integral part of the ARM architecture is the industry-proven Thumb® instruction set that features a subset of the most commonly used 32-bit ARM instructions that have been compressed into a 16-bit form, thereby using less power, offering a smaller footprint, and reducing overall system cost. These 16-bit instructions are decoded directly like their 32-bit equivalents without performance loss.

The Thumb-2 technology is a super set of the 16-bit Thumb instructions. It contains a number of 32-bit instructions as well as 16-bit instructions. Thumb-2 technology allows 32-bit instructions and 16-bit instructions to be mixed together under one processor state. This generally eliminates the need to ever switch the processor to ARM code in the majority of applications, minimising code size. Thumb-2 technology provides enhanced levels of performance, energy efficiency, and code density for a wide range of embedded applications.

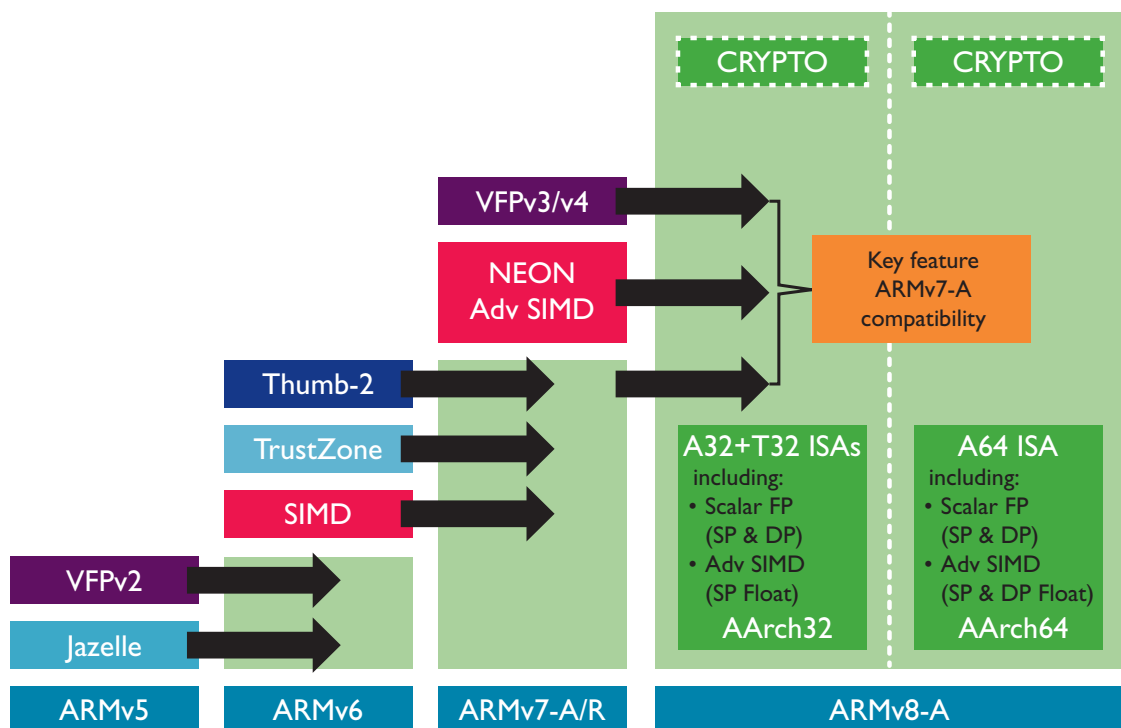
NEON™

The latest versions of the ARM architecture also includes the NEON technology extensions designed to address the demands of next generation high-performance, media intense, low power mobile handheld devices. NEON technology is a 64/128-bit hybrid SIMD architecture, developed by ARM to accelerate the performance of multimedia and signal processing applications including video encode/decode, 3D graphics, speech processing, compressed audio decoding, image processing, telephony and sound synthesis.

Jazelle®

ARM also offers a range of hardware architecture solutions to solve the performance requirements of managed execution environments such as Java and Microsoft Compact Framework. ARM Jazelle DBX (Direct Bytecode eXecution) technology delivers unparalleled Java performance, giving platform developers the freedom to run Java applications alongside established OS, middleware and application code on a single processor, and deliver very high performance Java in mobile handsets and other consumer devices without impacting memory consumption. ARM Jazelle RCT (Runtime Compilation Target) technology supports efficient ahead-of-time (AOT) and just-in-time (JIT) compilation with Java and other execution environments enabling a significant reduction of code bloat associated with AOT and JIT compilation, making AOT technology viable on mass-market devices.

Together with a wide range of ARM technology designed to address issues such as security and low power, plus its expertise in development tools, interconnect fabric and physical IP, the ARM architecture enables ARM to provide system designers and developers with a complete solution for next-generation, advanced digital devices.



ARM7™ Processor Family

The ARM7 processor family is a range of 32-bit RISC processors optimized for cost and power sensitive applications. The ARM7 processor family feature a 3 stage pipeline execution unit to provide exceptional area efficiency with very low power consumption, ideally suited for application specific SoC designs. The ARM7 processor family is made up of the ARM7TDMI™ and ARM7TDMI-S™ processors.

Typical applications include:

- Mobile phones (baseband processor)
- MP3 players
- Digital still cameras
- Automotive control
(Although still available for licensing, the ARM7TDMI processor has been succeeded for most applications by the Cortex-M3 processor)

ARM9(E)™ Processor Family

The ARM9 and ARM9E processor families comprise a medium to high performance range of 32-bit RISC processors. The ARM9E processor family also features ARM DSP instruction set architecture extensions. The ARM9E processor family also has an optional synthesizable floating point coprocessor, the VFP9-S, which supports single and double precision floating point. The ARM9(E) family processors can run at up to twice the frequency of ARM7 family processors. The ARM9(E) processor family consists of the ARM922T™, ARM926EJ-S™, ARM946E-S™, ARM966E-S™ and ARM968E-S™ processors.

Typical applications include:

- Platform OS-based devices
- Networking
- Point-of-sale terminals
- Audio decoding, speech recognition and synthesis.

ARM11™ Processor Family

The ARM11 processor family is a range of synthesizable processors based on the ARMv6 architecture. All products have support for Thumb, DSP, Java and multimedia architecture extensions. They are very high performance with low power consumption and suit many types of high-end performance applications. The ARM11 processors are available with or without integrated floating point coprocessor. The ARM11 family comprises the ARM1136J(F)-S™ processor, the ARM1156T2(F)-S™ processor, the ARM1176JZ(F)-S™ processor, and the ARM11 MPCore™ multicore processor.

Typical applications include:

- Advanced platform OS-based devices
- Smartphones
- Networking
- Next generation wireless, PDAs and videophones
- Set-top box
- High-end laser printers

ARM Processor Selector

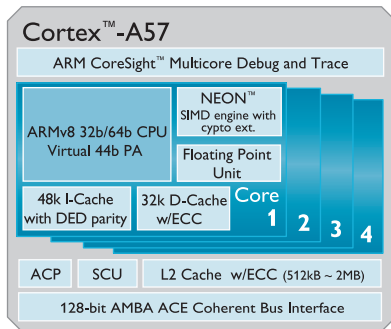
ARM Processor	Architecture	Performance DMIPS/MHz	ARM instructions	Thumb-2 instructions	Jazelle-DBX JAVA bytecode execution	Jazelle-RCT Dynamic compiler support	TrustZone security	E: DSP extensions	Media SIMD extensions	NEON SIMD extensions	Floating point	Caches	Memory Management Unit (MMU)	Memory Protection Unit (MPU)	Hardware Cache coherency	Target OS	Trace support
ARM7TDMI/ARM7TDMI-S	ARMv4-T	0.95	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	Real Time	✓
ARM946E-S	ARMv5-E	1.23	✓	✗	✗	✗	✗	✓	✗	✗	Optional	✓	✗	✓	✗	Real Time	✓
ARM926EJ-S	ARMv5-EJ	1.06	✓	✗	✓	✗	✗	✓	✗	✗	Optional	✓	✓	✗	✗	Platform	✓
ARM1136J-S	ARMv6	1.18	✓	✗	✓	✗	✗	✓	✓	✗	Optional	✓	✓	✗	✗	Platform	✓
ARM1156T2-S	ARMv6-T2	1.45	✓	✓	✗	✗	✗	✓	✓	✗	Optional	✓	✗	✓	✗	Real Time	✓
ARM1176JZ-S	ARMv6-Z	1.26	✓	✗	✓	✗	✓	✓	✓	✗	Optional	✓	✓	✗	✗	Platform	✓
ARM11 MPCore	ARMv6	1.25	✓	✗	✓	✗	✗	✓	✓	✗	Optional	✓	✓	✗	✓	Platform/SMP	✓
Cortex-M0+	ARMv6-M	0.90	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	Real Time	✗
Cortex-M0	ARMv6-M	0.90	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	Real Time	✗
Cortex-M1	ARMv6-M	0.79	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	Real Time	✗
Cortex-M3	ARMv7-M	1.25	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	Optional	✗	Real Time	Instruction only
Cortex-M4	ARMv7-ME	1.25	✓	✓	✗	✗	✗	✓	✓	✗	Optional	✓	✗	Optional	✗	Real Time	✓
Cortex-A5 MPCore	ARMv7+MP	1.58	✓	✓	✓	✓	✓	✓	✓	Optional	Optional	✓	✓	✗	✓+ACP	Platform/SMP	✓
Cortex-R4	ARMv7	1.66	✓	✓	✗	✗	✗	✓	✓	✗	Optional	✓	✗	Optional	✗	Real Time	✓
Cortex-R5	ARMv7	1.66	✓	✓	✗	✗	✗	✓	✓	✗	Optional	✓	✗	Optional	✗	Real Time	✓
Cortex-R7	ARMv7	2.53	✓	✓	✗	✗	✗	✓	✓	✗	Optional	✓	✗	Optional	✗	Real Time	✓
Cortex-A7	ARMv7+MP	1.90	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓+ACP	Platform/SMP	PTM
Cortex-A8	ARMv7	2.07	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	Platform	✓
Cortex-A9 MPCore	ARMv7+MP	2.50	✓	✓	✓	✓	✓	✓	✓	Optional	Optional	✓	✓	✗	✓+ACP	Platform/SMP	PTM
Cortex-A15 MPCore	ARMv7+MP	2.50	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓+ACP	Platform/SMP	PTM
Cortex-A53	ARMv8	2.3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓+ACP	Platform/SMP	PTM
Cortex-A57	ARMv8	>4.0	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓+ACP	Platform/SMP	PTM

ARM Cortex™ Processor Family

The ARM Cortex family of processors provides ARM Partners with solutions optimized around specific market applications across the performance spectrum. The three series within the ARM Cortex family all implement the Thumb-2 instruction set to address the increasing demands of various markets. The three categories are:

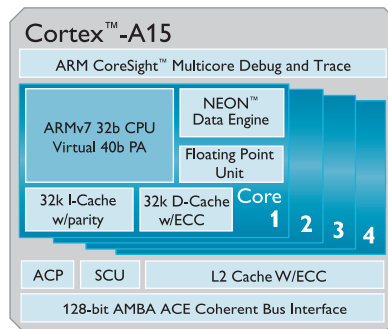
- ARM Cortex-A Series: applications processors for complex OS and user applications;
- ARM Cortex-R Series: embedded processors for real-time systems;
- ARM Cortex-M Series: deeply embedded processors optimized for microcontroller and low-cost applications.

Cortex-A57 Processor



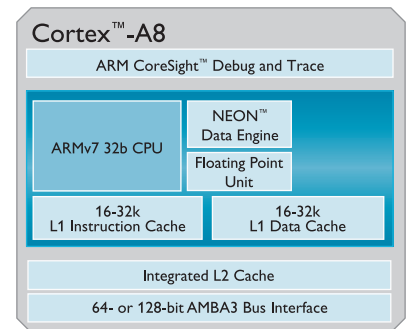
The ARM Cortex-A57 processor is ARM's highest performance processor based on the ARMv8 architecture featuring AArch64 execution. The Cortex-A57 processor is designed to further extend the capabilities of future mobile and enterprise computing applications.

Cortex-A15 Processor



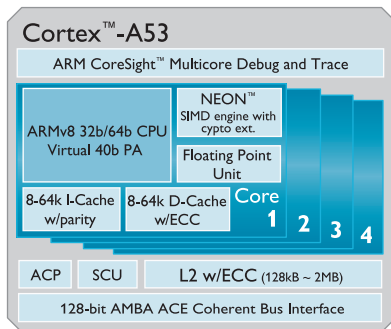
The Cortex-A15 processor is the highest performance ARM processor to date, and is targeted at next-generation smartphones, tablets, large-screen mobile computing and high-end digital home entertainment devices through to wireless basestations and enterprise infrastructure products.

Cortex-A8 Processor



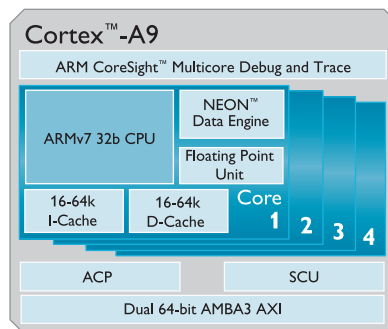
With the ability to scale in speed from 600MHz to greater than 1GHz, the Cortex-A8 processor can meet the requirements for power optimized mobile devices needing operation in less than 300mW and performance optimized consumer applications requiring 2000 Dhrystone MIPS.

Cortex-A53 Processor



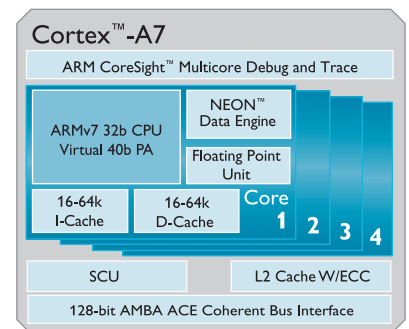
The ARM Cortex-A53 processor is the lowest power 64-bit processor available and has been designed to provide the optimum blend of high levels of performance with high levels energy-efficiency. The Cortex-A53 will enable advanced applications to be brought into the mainstream using power-efficient performance based on ARM 64-bit technology.

Cortex-A9 Processors



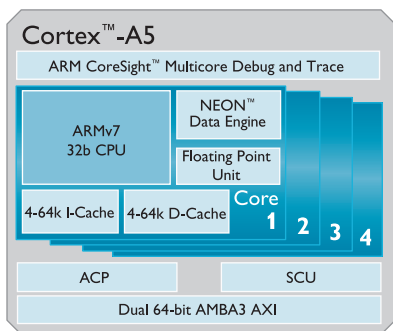
The Cortex-A9 processors deliver flexibility, performance, power efficiency and functionality for leading edge products across a broad range of applications. The Cortex-A9 microarchitecture is delivered within either a scalable multicore processor, the Cortex-A9 MPCore multicore processor, or as a more traditional single core processor.

Cortex-A7 Processor



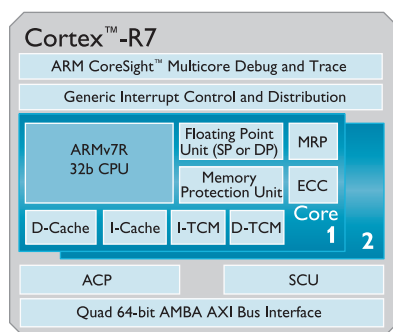
The ARM Cortex™-A7 MPCore™ processor is the most efficient application processor ARM has ever developed and dramatically extends ARM's low-power leadership in future entry level smart phones, tablets and other advanced mobile devices.

Cortex-A5



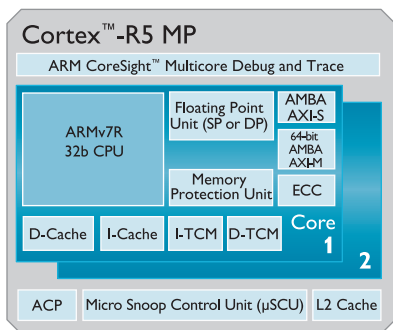
The ARM Cortex™-A5 processor is the most energy efficient, lowest cost processor capable of delivering the internet to the widest possible range of devices: from ultra low cost handsets, feature phones and smart mobile devices, to pervasive embedded, consumer and industrial devices.

Cortex-R7



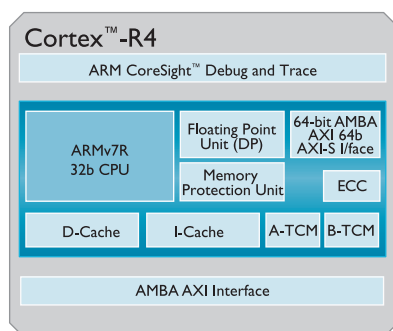
The ARM Cortex-R7 processor brings new levels of extreme performance to the Cortex-R family of processors. The Cortex-R7 processor offers more than a 50% performance uplift through increased pipeline efficiency with enhanced branch prediction, advanced superscalar and out-of-order execution.

Cortex-R5



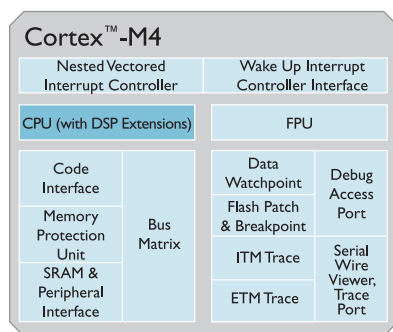
The ARM Cortex-R5 processor is based on ARMv7 architecture and targets high volume, deeply embedded, real-time critical applications such as HSPA and LTE mobile baseband processing, hard disk drives, solid state storage and dependable automotive and industrial systems. Cortex-R4 Processor

Cortex-R4



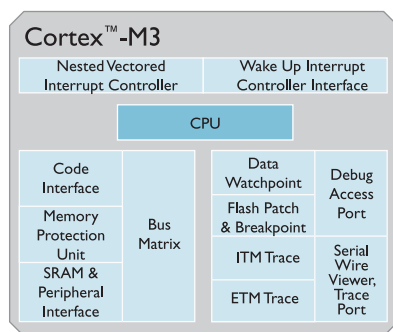
The Cortex-R4 processor supports substantial configurability during synthesis to optimize the processor for different applications and is capable of running at clock speeds of up to 500MHz on typical 65nm processes. The Cortex-R4F processor provides an additional, synthesis-optional Floating-Point Unit (FPU) optimized for single precision processing.

Cortex-M4



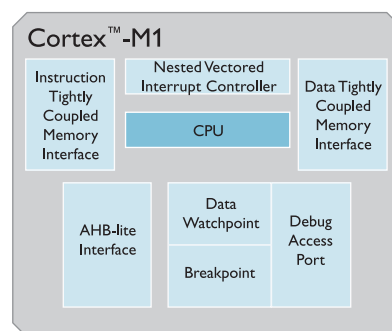
The ARM Cortex-M4 processor is the latest embedded processor by ARM specifically developed to address digital signal control markets that demand an efficient, easy-to-use blend of control and signal processing capabilities.

Cortex-M3 Processor



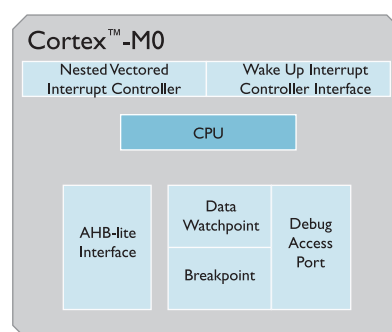
The Cortex-M3 processor provides a high-performance, low-cost platform for a broad range of applications and can be configured to meet the exact requirements with a Nested Vectored Interrupts Controller (NVIC), configurable debug and trace options and optional MPU. In addition, the Wake Up Interrupt Controller (WIC) enables the system to be placed into an ultra low power retention mode.

Cortex-M1 Processor



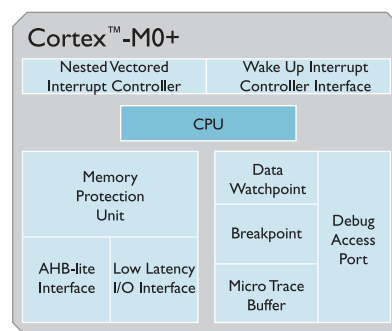
The Cortex-M1 processor is designed specifically for implementation as a soft core in FPGAs and targets all major FPGA devices. The Cortex-M1 processor implements the Thumb instruction set which enables both the processor and software footprint to meet the area budget of the smallest FPGA devices.

Cortex-M0 Processor



The ARM Cortex-M0 processor is the smallest, lowest power ARM processor available, in an area of under 12K gates. The exceptional low power, small gate count and code footprint of the processor enables MCU developers to achieve 32-bit performance at an 8-bit price point.

Cortex-M0+ Processor



The ARM Cortex-M0+ processor is the most energy efficient ARM processor available. It builds on the very successful Cortex-M0 processor, retaining full instruction set and tool compatibility, while further reducing energy consumption and increasing performance.

ARM Mali™ Graphics Processor Family

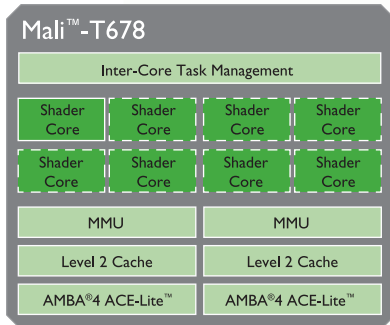
The ARM Mali family of Graphics Processing Units (GPU's) provides ARM partners with the solutions to support the demand for superior graphical displays on electronic devices.

Two product roadmaps have been developed to provide solutions across the performance spectrum.

The two roadmaps are:

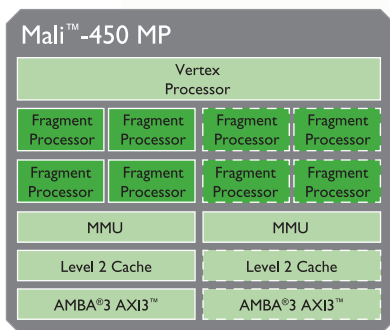
- Graphics – market leading balance of graphics performance, power and cost - Mali-300, Mali-400MP and Mali-450MP
- Graphics plus GPU Compute – premium graphics solutions for high end electronic devices - Mali-T624, Mali-T628 and Mali-T678

Mali-T678



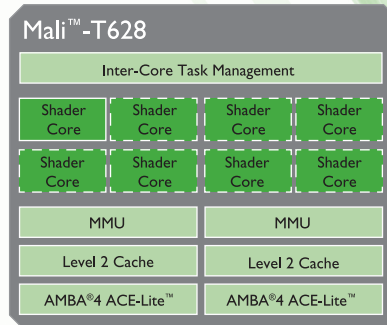
The ARM Mali-T678 GPU is the latest addition based on the Midgard architecture and builds on proven technology leadership. Mali-T678 is the GPU of choice for use in the next generation of market-leading devices, optimized to bring breathtaking graphical displays to consumer applications such as 3D graphics, visual computing, augmented reality, procedural texture generation and voice recognition.

Mali-450 MP



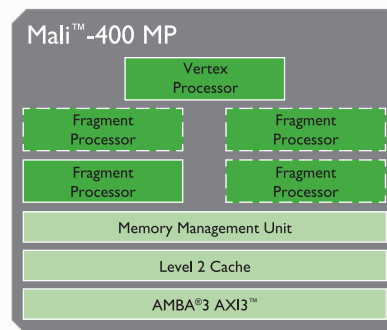
The Mali-450 MP addresses the increased fill rate requirements of UHD 4K with extended scalability of pixel processing and improved vertex processing throughput. It expands the range of performance points addressed by the Mali-400 MP by supporting scalability up to 8 cores whilst also increasing the per core processing.

Mali-T628



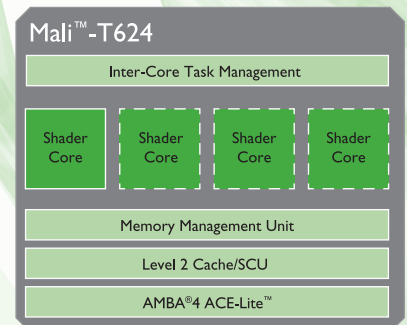
The ARM Mali-T628 GPU offers scalability from one to eight cores – providing up to twice the graphics and GPU Compute performance compared to the Mali-T624 GPU. The Mali-T628 shares key API support with the other products in the Mali-T600 Series – including OpenGL™ ES 1.1, 2.0 and 3.0, DirectX™ 9, DirectX 11, OpenCL 1.1 Full Profile and Google Renderscript.

Mali-400 MP



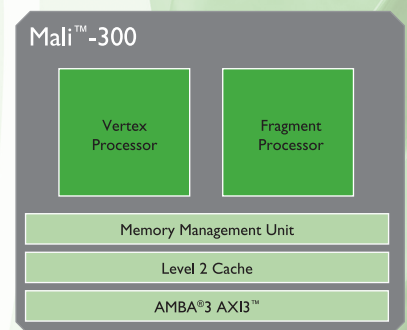
The world's first OpenGL ES 2.0 conformant multi-core GPU provides 2D and 3D acceleration with performance scalable up to 1080p resolutions, while maintaining ARM leadership on power and bandwidth efficiency. Provides a range of graphics APIs including OpenVG™.

Mali-T624



Designed for visual computing and using innovative tri-pipe architecture, the ARM Mali-T624 GPU delivers significant graphics improvements over current Mali graphics processors whilst adding GPU Compute functionality. The second generation Mali-T600 Graphics Processor Unit (GPU) extends API support to include Khronos™ OpenCL™ Full profile as well as embedded and Microsoft™ DirectX®.

Mali-300



The area-efficient Mali-300 GPU offers high performance embedded graphics, making OpenGL ES 2.0 grade immersive gaming and High Definition (HD) user interfaces a reality on future mainstream consumer devices up to full HD 1080p.



* Mali GPUs noted as based on a published Khronos Specification are conformant, or expected to pass the Khronos Conformance Testing Process. Current conformance status is available at <http://www.khronos.org/conformance>

Mali – Visual Computing by ARM

The ARM® Mali™ family of Graphics Processing Units (GPUs) scales to deliver industry-leading graphics on entry level smartphones and market leading superphones, right through to visually-stunning user experiences for the future of top-end, cutting-edge superphones, tablets and Smart TVs. This scalability is enabled by the range of Mali GPUs based on the Utgard architecture, now proven in mainstream devices, and those that are now shipping based on the Midgard architecture for the next generation of OEM products. ARM is in the unique position to provide an optimized compute platform that uses ARM Cortex™ CPU, Mali GPU and ARM CoreLink™ CCI-400 technologies. This heterogeneous approach means that range of applications can be processed more efficiently when shared between the CPU and the GPU, making full use of the capabilities of each system component to achieve the best possible balance of power versus performance.

The Mali-T600 series supports the major compute APIs to perform GPU Compute for more efficient execution of parallel-intensive tasks. All ARM Mali GPUs benefit from an integrated software stack that provides long term support of industry standard APIs and enables code-compatibility across the architectural product family.

The Mali Ecosystem is a comprehensive community of graphics industry players, helping developers to achieve shorter time-to-market and supporting application development for Mali through the ARM Mali Developer Center: an online portal providing support and resources.

Tools Support

Each product in the tools portfolio has been developed closely alongside the ARM hardware and software IP, ensuring that it maximizes the IP's performance and provides full support to leading edge ARM technologies.

The ARM Tools range includes Fast Models™ for development on virtual platforms, the Versatile Express family of development boards, the ARM Development Studio 5 (DS-5™) toolchain for ARM application processors and System-on-Chip devices and Keil MDK-ARM™ development kit for all ARM processor-based microcontrollers. DS-5 and MDK-ARM consist of compilers, debuggers, Integrated Development Environment (IDE), and performance analyzers.

Working with ARM Tools provides an extensive and cohesive product range that empowers architects and developers alike to confidently deliver optimal products into the marketplace faster than ever before.

Systems IP

The Systems IP group's position within ARM uniquely enables it to design integrated, high-performance AMBA protocol-based IP products to maximize system efficiency. The ARM Fabric IP group develops and delivers:

- CoreSight™ on-chip debug and trace technology
- The AMBA specification
- AMBA Designer
- A broad range of high-performance CoreLink system IP including:
 - High-performance Interconnect
 - Memory Controllers
 - DMA Controllers
 - Interrupt Controllers
 - Cache Controllers

Physical IP

ARM Physical IP solutions provide the building blocks to create highly optimized System-on-Chip (SoC) designs. The products are offered in three platform solutions:

- High-performance platforms
- High density (low area) platforms
- High speed PHYs

Within these platforms, ARM offers a wide range of high-performance and high-density, digital and analog products, for the manufacture of advanced SoC.

Services

There is an ARM Service to help you through every phase of your design project. Our experienced Support team of specialized application engineers can provide the best answers to your most challenging design issues, and if needed can draw on the entire ARM engineering resource pool to get solutions to you as quickly as possible.

We currently offer three premium services: Training, On-site support (Active Assist) and Support and Maintenance.

Through these services you gain access to ARM's technical support engineers who will help and educate your engineers to get the best out of ARM's wide variety of technology and tools, enabling you to get better products to market faster.

Third party support

The ARM Connected Community is the industry's largest network of leading silicon, systems, design support, software and training providers enabling system designers to access a huge range of ARM technology-optimized IP to provide a complete solution, from design to manufacture and end use, for products based on the ARM architecture.



Licensing ARM Technology

ARM offers several flexible licensing models for its processor, systems and multimedia IP, designed to meet the differing needs of existing and future Partners.

The essential characteristics of each of the three most popular models are outlined below:

Perpetual (Implementation) License

- The perpetual license offers an ARM Partner the necessary rights to perpetually design and manufacture ARM technology-based products.

Term License

- This license is suitable for a Partner who wishes to design a number of ARM technology-based products within a specified time-frame (usually three years). The manufacturing rights are perpetual.

Per Use License

- The Per Use license is available on selected ARM IP and gives an ARM Partner the right to design a single ARM technology-based product within a specified time-frame (usually three years). The manufacturing rights are perpetual.

ARM also enables ARM semiconductor and design Partners to gain access to ARM processor IP through the ARM Processor Foundry Program.

In addition, ARM physical and selected processor IP to be downloaded via the ARM DesignStart Program, and supports academic study by providing an opportunity for universities to gain access to ARM IP including the ARM University DesignStart Program.

