

Cortex-M1: The First ARM Processor Designed for Implementation in FPGA

Cortex-M1: 第一款专为FPGA设计的ARM处理器

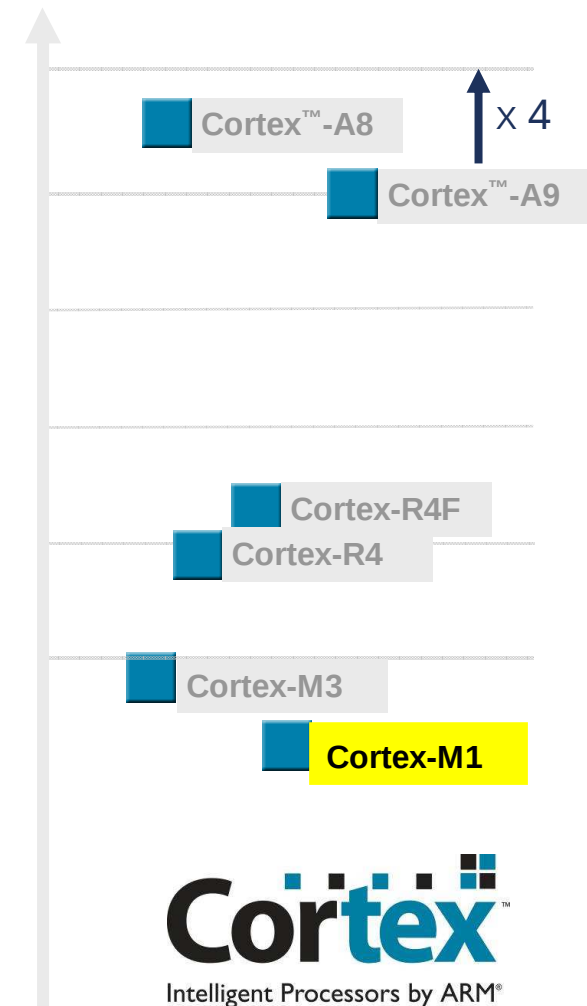
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ARM中国

2007年12月

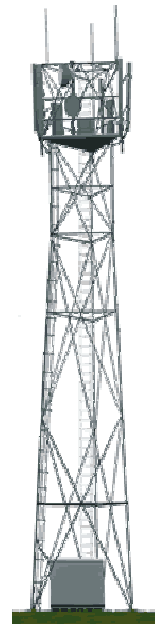
ARM Cortex 系列处理器

- Common architecture across the performance spectrum
 - Thumb®-2 blended 16/32-bit ISA
 - Performance and efficiency
- Three ARM Cortex profiles
 - Applications (A profile)
 - Real-time (R profile)
 - Microcontroller (M profile)
- ARM Cortex-M1 Processor
 - Smallest ARM processor
 - Upwards compatible with Cortex range
 - Designed for implementation in FPGA



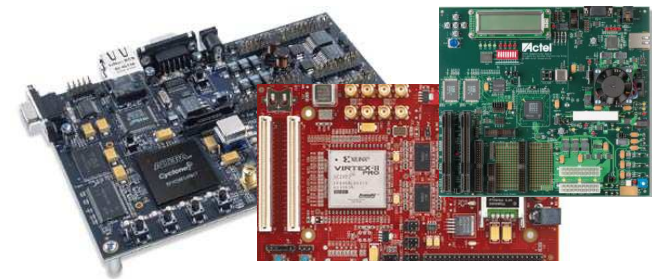
ARM Cortex-M1 的应用

- FPGA are an ideal implementation route for
 - Embedded systems shipping in volume
 - Basestations, Automotive infotainment, Industrial control, Aero, camera, medical equipment, etc.
 - Rapid development of time-to-market critical designs
 - Initial product runs, design entry, prototyping
 - Long-life applications – no risk of obsolescence
- Powerful risk reduction strategy
 - ARM processors proven in billions of ARM powered devices
 - Broad development tools and OS support
 - First class ARM support team
 - Coupled with low-risk of FPGA deployment



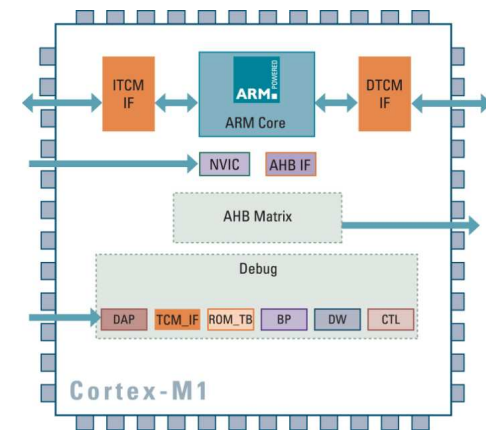
ARM Cortex-M1 处理器

- High frequency, low area microcontroller processor for FPGA
 - Between 70MHz – 200MHz (depending on FPGA device)
 - Capable of delivering over 0.8 DMIPS/MHz efficiency
 - Cortex-M1 upwards compatible with Cortex family on ASIC/ASSP/MCU
 - Performance will continue to increase as FPGA technology progresses
- Optimised for synthesis on multiple FPGA types
 - Xilinx (e.g. Spartan-3, Virtex-5)
 - Altera (e.g. Cyclone-II, Stratix-III)
 - Actel (M1 ProASIC3 and M1 Fusion)



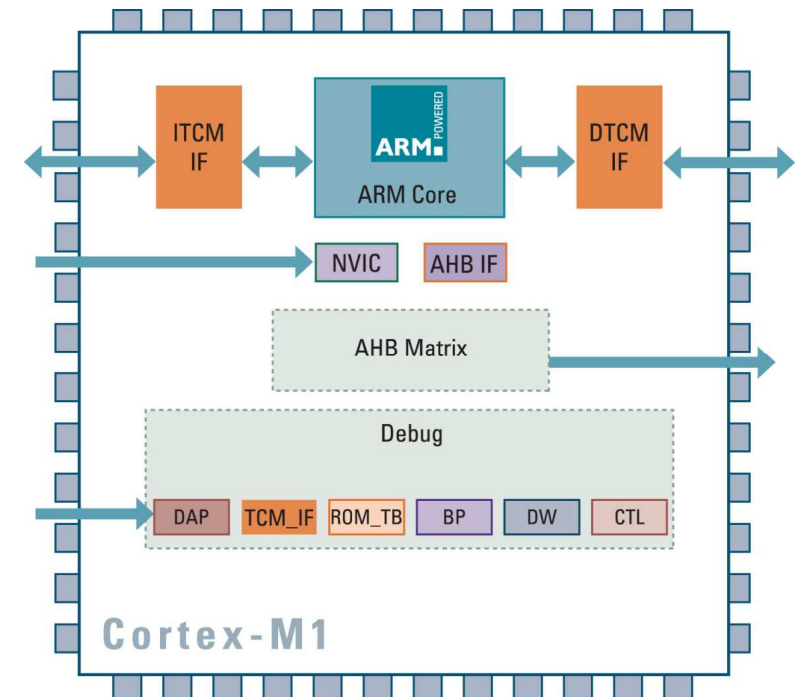
ARM Cortex-M1 处理器概况

- 32-bit RISC processor
 - 3-stage pipeline, Von Neumann architecture
- Tightly Coupled Memories
 - Internal FPGA block RAM used as single-cycle access memory
 - ITCM, DTCM configurable to 0k,1k,2k,4k... to ...512k, 1024kBytes
- Debug via JTAG or SWD
 - 2 watchpoints, 4 breakpoints (hardware)
 - Debug removable for cost reduction and security
- Integrated Operating System support
 - Removable System Timer
 - Optional Software Interrupt (SVC) instruction



ARM Cortex-M1 处理器概况

- AMBA AHB-lite 32-bit bus interface
 - Connection to external memory and peripherals
- Integrated Interrupt Controller
 - Configurable 1 to 32
 - Each interrupt can have 4 priority levels
 - Non-Maskable Interrupt (like FIQ)
- Big or little endian
- Multiplier
 - Fast option uses FPGA DSP blocks
 - Small option uses adder to save area / DSP block use
 - Either option, program function is the same
 - No need for software modifications



ARM Cortex-M1 实现

- Speed targeted synthesis run results
 - For smallest configuration (0k TCM, no debug)
 - Assuming fastest commercial speed grade
 - Xilinx and Altera results are beta

FPGA type	Example		Speed	Area (LUTS)
65nm	Altera Stratix III	Xilinx Virtex-5	200 MHz	1900
90nm	Altera Stratix II	Xilinx Virtex-4	150 MHz	2300
65nm	Altera Cyclone III		100 MHz	2900
90nm	Altera Cyclone II	Xilinx Spartan-3	80 MHz	2600
130nm	Actel ProASIC3	Actel Fusion	72 MHz	4300 tiles

ARM Cortex-M1 指令

- Instruction Set Architecture
 - Based on ARMv6 16-bit Thumb
 - Additional 32-bit Thumb-2 instructions for interrupt handling
- Ideal C compiler target
 - Reduces time-to-market and improves code quality
 - Interrupt service routines can be coded directly as C functions
 - No need for assembler, easily portable code

ADC	ADD	ADR	AND	ASR	32-bit BL
B	BIC	BKPT	BLX	BX	DMB
CMN	CMP	CPS	CPY	EOR	DSB
LDM	LDR	LDRB	LDRH	LDRSB	ISB
LDRSH	LSL	LSR	MOV	MUL	MRS
MVN	NEG	NOP	ORR	POP	MSR
PUSH	REV	REV16	REVSH	ROR	
RSB	SBC	SEV	STM	STR	
STRB	STRH	SUB	SVC	SXTB	
SXTH	TST	UXTB	UXTH	WFE	
WFI	YIELD				

支持ARM Cortex-M1 的工具

ARM RealView Compiler Tools 3.1

- Deliver up to 0.8 DMIPS/MHz performance with Cortex-M1
- New MicroLib C libraries to further enhance code density

■ ARM RealView Development Tools 3.1

- Comprehensive software development and debugging environment
- Leading support for ALL ARM processors
- For all ARM software development... ASIC/ASSP and FPGA



■ ARM RealView MDK

- Cost-efficient Development tool with RealView Compiler
- ARM brings a large ecosystem to FPGA



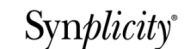
RealView®
Tools by ARM®

广泛的第三方支持

- ARM Connected Community
- Broad tools and RTOS support at launch
 - ARM Connected Community has 400 members
 - ARM brings a large ecosystem to FPGA
 - Popular development tools, RTOSes, synthesis tools...

- Benefit to customers

- Reuse of familiar tools for ASIC/ASSP/MCU
- Easy migration of RTOS systems to FPGA
- Time-to-market, reduced risk
- Unprecedented flexibility and choice



第三方工具/操作系统支持状况

Vendor	Product name	Schedule
ARM RealView®	RVDS, RVI	Now
Keil (ARM)	RealView MDK	Now
CodeSourcery	Sourcery++	Now
GNU	Gcc/gdb	Now
IAR Systems	Embedded Workbench	Now
Pls Development Tools	Universal Debug Engine	Now
Segger/IAR	J-Link/J-Trace	Now

Vendor	Product name	Schedule
Keil	RTX kernel	Now
Express Logic	ThreadX	Now
IAR Systems	PowerPac	Contact
Linux (ARM)	uClinux	Q208
Mentor Graphics	Nucleus	Contact
Micrium	uC/OS-II	Now
Segger	EmbOS	Contact
WindRiver	VxWorks	Contact



业务模式一：Cortex-M1 RTL license

- RTL license available directly from ARM
 - Flexible and fully configurable
 - Same RTL can be targeted at any FPGA device
- Vendor independent synthesis
 - Synplify Pro and Mentor Precision supported
- System design environment support
 - SPRIT Consortium IP-XACT deliverables included
 - Enables support for drag'n'drop hardware design
 - E.g. Mentor Platform Express

Actel

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业务模式二

■ Available from Actel

- Actel have licensed Cortex-M1 from ARM
- Actel's customers get Cortex-M1 at no license fee
- Delivered to Actel's customers as encrypted bitfiles



■ Actel CoreConsole

- Graphical design entry tool from Actel
- Includes peripheral IP and ARM Cortex-M1 integration

■ Further information

- Information on www.actel.com

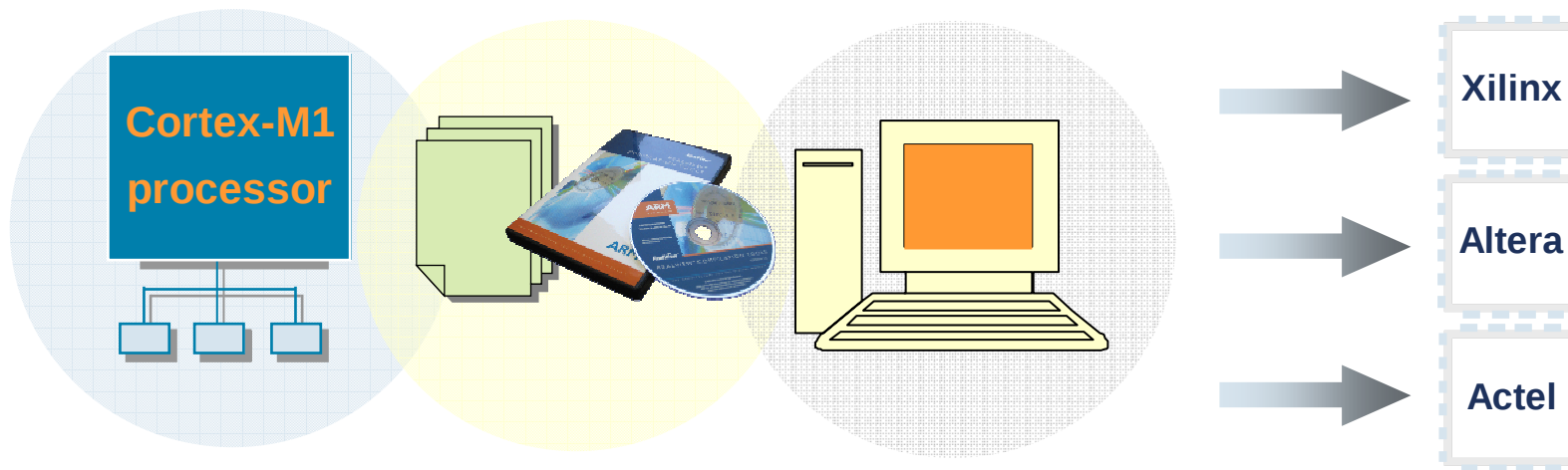
FPGA Device

Actel M1 ProASIC3

Actel M1 Fusion

ARM Cortex-M1: 快速上市的FPGA方案

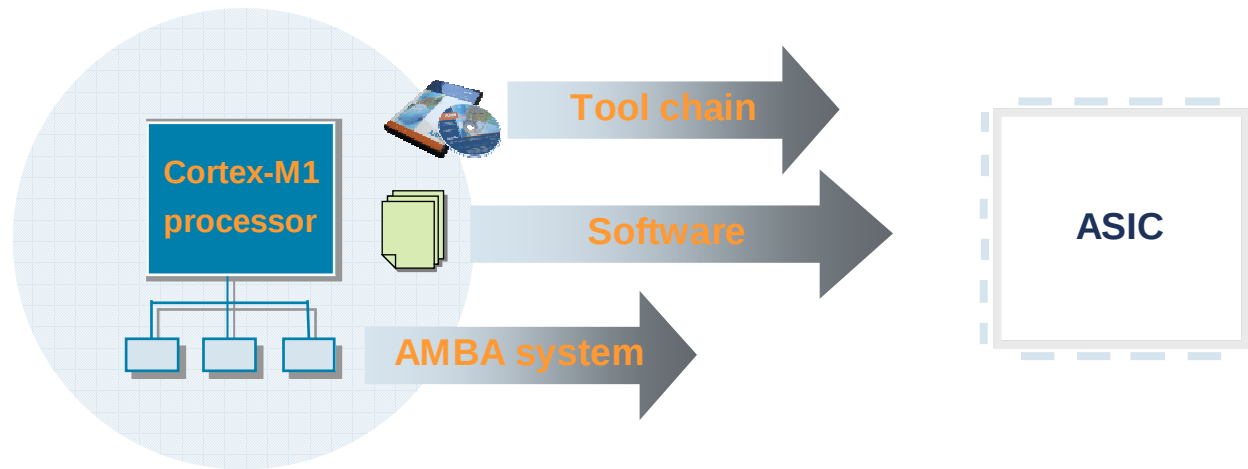
Freedom to Reduce Costs and Time-to-Market



- Rationalize across multiple projects on FPGA, ASIC/ASSP or MCU
 - Single RTL source for any FPGA device (Xilinx, Altera, Actel...)
 - Reuse existing ARM tools and expertise
 - Consolidate software base and development tools
 - Port to cheaper or more optimal FPGA devices as they are released

ARM Cortex-M1: 方便地从FPGA向ASIC的迁移

Freedom to Reduce Costs Further in the Future



- Design entry, prototyping and production with Cortex-M1 on FPGA
- Migrate easily to ARM Cortex-M3 on ASIC in the future
 - Benefit from efficient, low-power ASIC optimised Cortex-M3 design
 - Processor AMBA AHB bus interface allows system design reuse
 - Software compatibility allows code reuse
 - Cortex-M1 and Cortex-M3 both supported across popular tools and OSes

ARM Cortex-M1 总结

- The first ARM processor designed for FPGA
 - Compatibility and ecosystem across FPGA, ASIC/ASSP/MCU
 - Low-cost entry for designers wanting to create ARM SoC
 - Migration from MCU or to ASIC/ASSP
- Actel lead partner and first licensee
 - Available to Actel users for no license fee
- ARM will license RTL directly to end users
- <http://www.arm.com/fpga>
 - For more information

