RENESAS

ARM® System Solutions

ARM® system solutions by Renesas Electronics

Renesas is a major supplier of microcontrollers to the embedded market. Besides offering a very wide choice of 8-bit, 16-bit and 32-bit microcontrollers based on its own proprietary CPU architectures like 78K and V850, Renesas is also a key player for providing complex system-on-chip devices based on ARM CPU cores in combination with the AMBA bus architecture.

Renesas, an ARM Silicon Partner for many years, is a licensee of most ARM cores from the classical ARM7, ARM9 or ARM11 families to the latest Cortex family cores including the M3, R4F, A5, A8, A9... Renesas has launched dozens of successful ARMbased design implementations using various advanced process technologies, from robust 0.35 µm to very high-end 40 nm design rule processes.

For your next ARM-based system-on-chip design, Renesas' expertise and comprehensive system offering can help you achieve the optimum solution.

Benefits

ARM CPU cores
- Very broad range of high-performance ARM CPU core silicon implementations
- ARM Silicon Partner – leading ARM partner for ARM11 MPCore multi-core implementations

ARM system function blocks
- Wide portfolio of IP system function blocks for system extensions in addition to the ARM IP blocks.
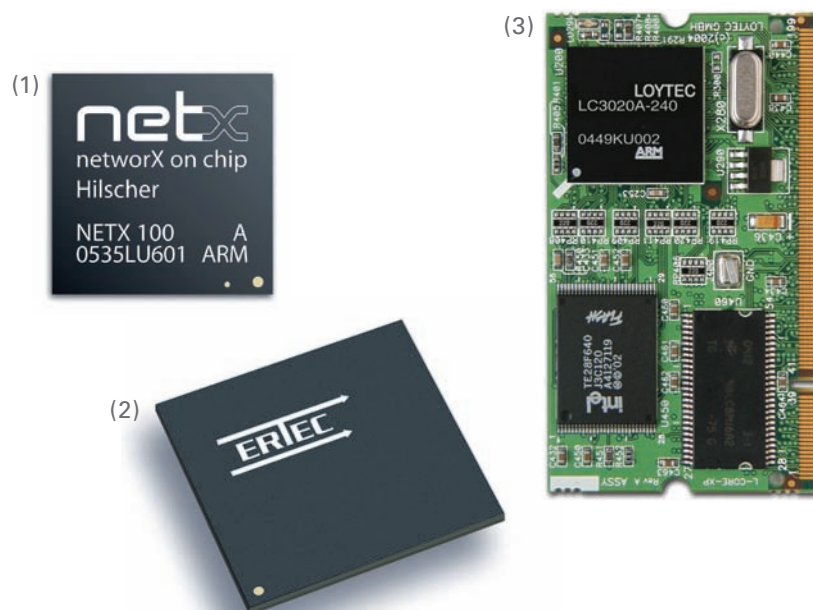
ARM system architecture
- Huge experience in designing and developing complex, high-performance ARM systems

ARM system development platforms
- Comprehensive development environments for early system-level HW/SW verification

ARM system development support
- Deep ARM system and architecture expertise available locally from RENESAS
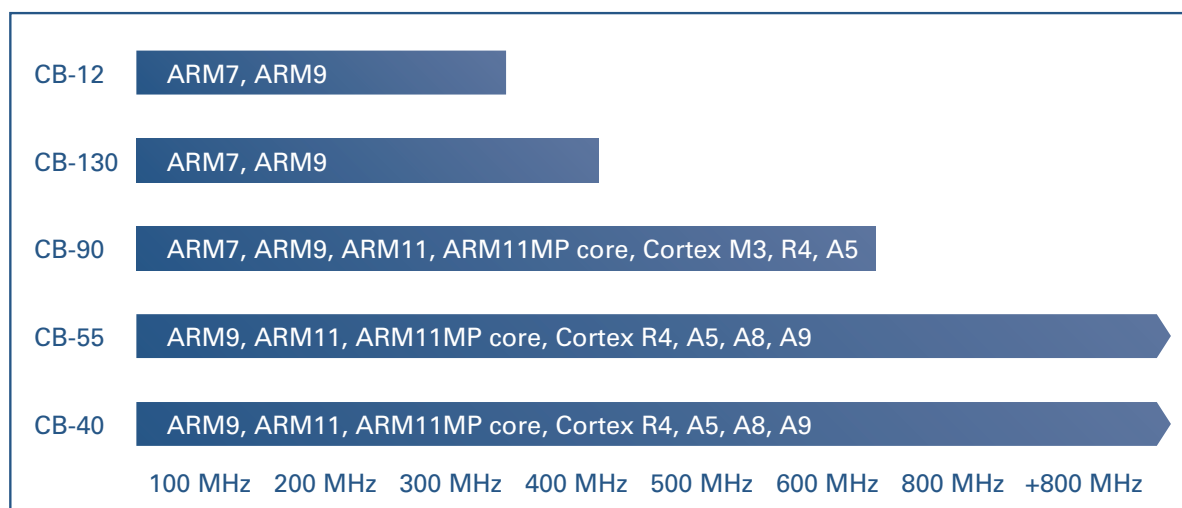
Successful ARM system implementations by Renesas Electronics Europe in industrial automation (1, 2) and building management (3) applications.

ARM® CPU cores

Each System-on-Chip design by Renesas is specific to one certain customer, incorporating a custom CPU core configuration using a specific process technology to deliver the required CPU/system performance.

Whether your SoC performance needs are general purpose or high performance, RENESAS can provide an ARM CPU core that fits your system requirements.

The table below shows the availability for each ARM CPU core in the various RENESAS process technologies ranging from the 150 nm process (CB-12) to the latest 40 nm process (CB-40) for very high performance.

CB-12	ARM7, ARM9
CB-130	ARM7, ARM9
CB-90	ARM7, ARM9, ARM11, ARM11MP core, Cortex M3, R4, A5
CB-55	ARM9, ARM11, ARM11MP core, Cortex R4, A5, A8, A9
CB-40	ARM9, ARM11, ARM11MP core, Cortex R4, A5, A8, A9

100 MHz   200 MHz   300 MHz   400 MHz   500 MHz   600 MHz   800 MHz   +800 MHz

ARM® system function blocks

High-performance system solutions include more than just a CPU. It is the skilful connection of all the different function blocks with the CPU that guarantees the rated data throughput. As a leading vendor of cell-based ASICs, Renesas has a huge variety of function blocks for generating complete system solutions.

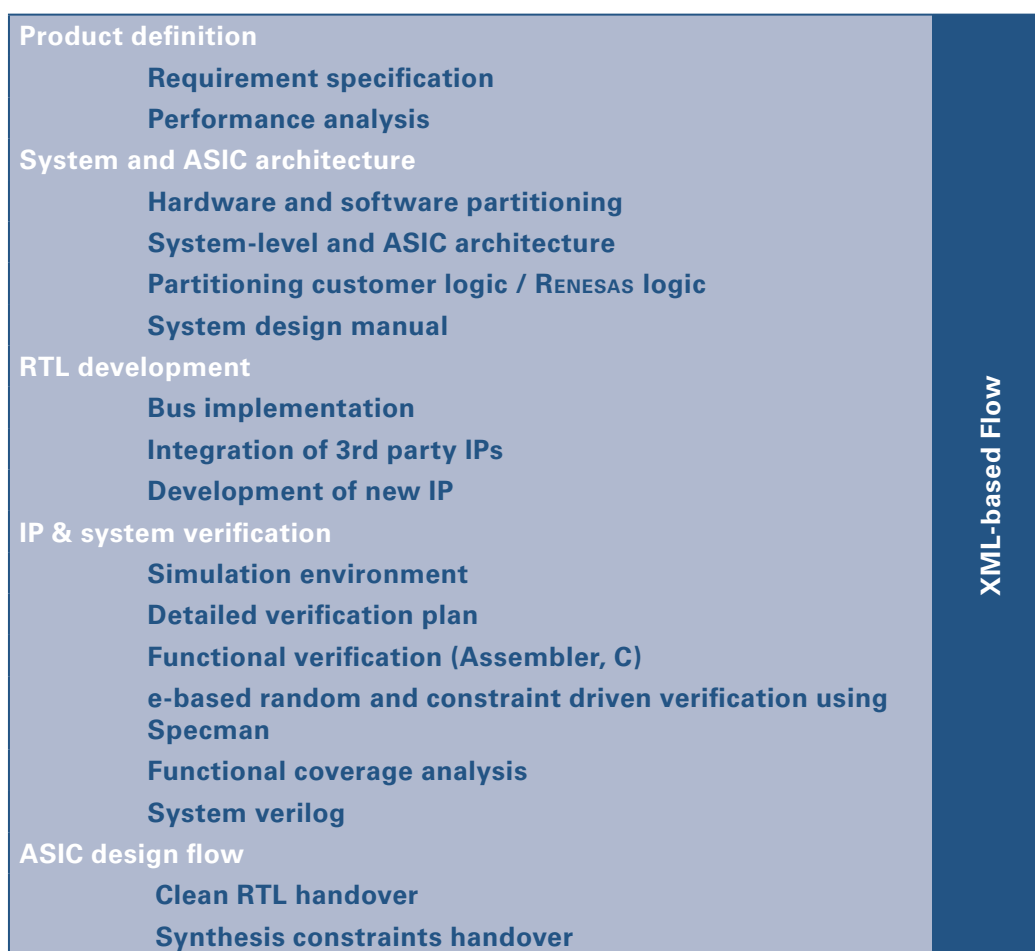|	Function blocks for building ARM-based system solutions
High-performance peripherals	Multi-port memory controller, DMA controller, Interrupt controller
High-perfomance connectivity	10/100M Ethernet MAC and PHY, USB2.0, PCI Express, High-speed SerDes, IEEE1394, GbE
Application peripherals	CAN2.0 controller, Colour LCD controller, MediaLB IF controller, Security cores
Basic peripherals	USB1.1, UART, Timer, PWM, GPIO, SPI, I2C
Analogue cores	A/D converter, D/A converter, PLLs (clock dithering), Power-on-Reset
Bus architecture	Advanced AMBA bus architectures, applying (multilayer) AHB and APB busses AXI Network-on-chip (NOC)

ARM® system development support

You can rely on Renesas to design your next ARM-based system-on-chip. Renesas' dedicated engineering teams can provide high levels of expertise on ARM designs including specification, design and chip-level implementation of complex ARM systems.

System-level support

A Renesas design team located at the European Technology Centre (ETC) supports all tasks, from system design planning and design verification and simulation to layout and GDSII interfacing. Reputable external design partners are also qualified. State-of-the-art tools from reputable partners like Cadence, Synopsys and Mentor are supported.

ARM system development capabilities at Renesas

Product definition
- Requirement specification
- Performance analysis

System and ASIC architecture
- Hardware and software partitioning
- System-level and ASIC architecture
- Partitioning customer logic / Renesas logic
- System design manual

RTL development
- Bus implementation
- Integration of 3rd party IPs
- Development of new IP

IP & system verification
- Simulation environment
- Detailed verification plan
- Functional verification (Assembler, C)
- e-based random and constraint driven verification using Specman
- Functional coverage analysis
- System verilog

ASIC design flow
- Clean RTL handover
- Synthesis constraints handover

XML-based Flow

HW/SW implementation support

The Technical Product Support (TPS) team at Renesas Electronics Europe supports customers who are working on hardware and software emulation using the development boards supplied by Renesas. Customers can call on this pool of expertise if they have questions connected with hooking up the development boards to their system environment. The people in this Renesas team are experts in making hardware and software work together, including operating systems. Our ARM implementations are supported by various operating system vendors.

The two support teams also work closely together to ensure a smooth design-in and a first-time-right system development.
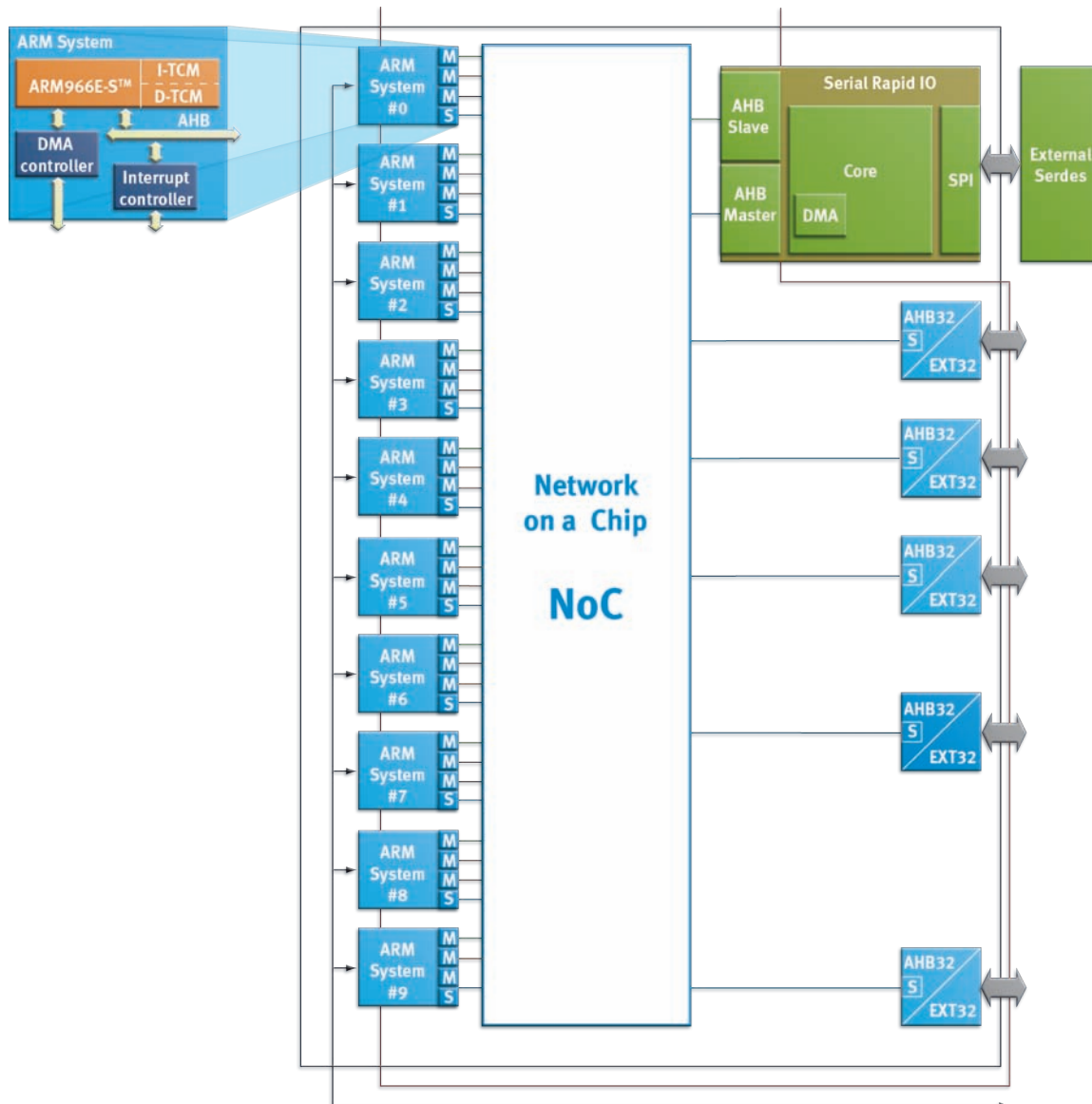
ARM® system architecture

While CPU speed is a major factor in the performance of a CPU-core-based system, it is not the only factor. Even more important is the architecture that connects the CPU with the peripherals in the system. The choice of the cache memories and the tightly-coupled memories (TCM) are also key considerations in the design of the system architecture, as are the operating system and the software running on the system.

At Renesas, we have a very deep understanding of how to develop these high-performance system architectures based on the AMBA bus architecture.

A good example of Renesas' ARM system development expertise is illustrated by the block diagram below.

This architecture, using 10 ARM966-E-S CPU cores, has been developed and implemented successfully by

Renesas for a networking application. Such architecture based upon Network-on-Chip (NoC) technology is nowaday commonly used by Renesas into various application fields : Networking, PLCs, Consumer, industrial... making this ARM systems even more performant.

Furthermore, Renesas' considerable experience is used to verify these complex designs prior to their actual implementation in silicon. No effort is spared to ensure that an architecture that performs well during simulation will exhibit the same behaviour in silicon ensuring a high level of quality and reliability.

ARM® system development platforms

Developing complex ARM-based system architectures from scratch is not trivial. Renesas supports developers from the start by offering comprehensive development platforms.
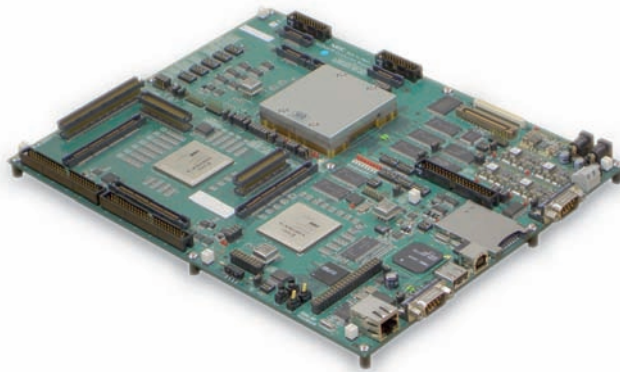
The basis of these platforms is a prototype chip that contains the relevant ARM CPU core. In some cases, this prototype chip represents just the CPU core with caches and tightly-coupled memories, in other cases, the prototype chip is already a complete ARM-based system.

Common to all development platforms is the connection of the prototype chip to some FPGA(s) that accommodate all the system peripheral blocks and the customer-specific logic. The CPU and FPGA(s) I/Os are routed to the outside world.

This set-up in combination with SDRAM, Flash and SRAM memories on the same development board allows the developer to build a functional 1:1 replacement of the final chip long before any silicon is fabricated. Being able to verify both the hardware and software while development is still in progress leads to huge confidence in design integrity.

The diagram shows Renesas' "AMY" ARM926EJ-S/ARM946E-S development board featuring a single prototype chip including an ARM926EJ-S and an ARM946E-S CPU core with caches, TCMs plus interrupt controller, memory controller and DMA controller.

– ARM development platforms

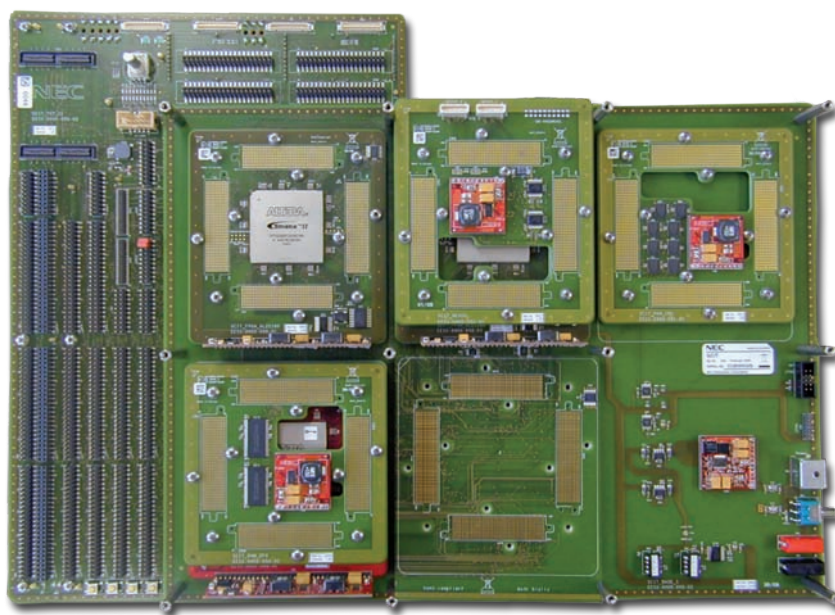"AMY" ARM926EJ-S™/ARM946E-S™ development board

ARM™ MP-Core evaluation board

Block diagram of
development platform

– SCIT - Scalable and configurable intermediate tool

An other excellent example of our ARM-based system development expertise is the SCIT platform. The SCIT emulation environment is an FPGA based high-performance ASIC prototyping system. It fully complies to all ASIC prototyping needs, including hardware and software co-development, proof-of-concept studies, IP development and end user evaluations. Thus, it is the ideal board to develop advanced ARM based solutions.

Furthermore the flexibility of the SCIT emulation environment allows the use of the same board for several projects or configurations by replacing daughter boards containing I/O and/or custom subsystems. This environment has carefully been designed for maximum performance, with respect to signal integrity, speed and other critical issues.

ARM® System Solutions

FSC
www.fsc.org
MIX
Paper from
responsible sources
FSC® C017894

Renesas Electronics Europe
www.renesas.eu