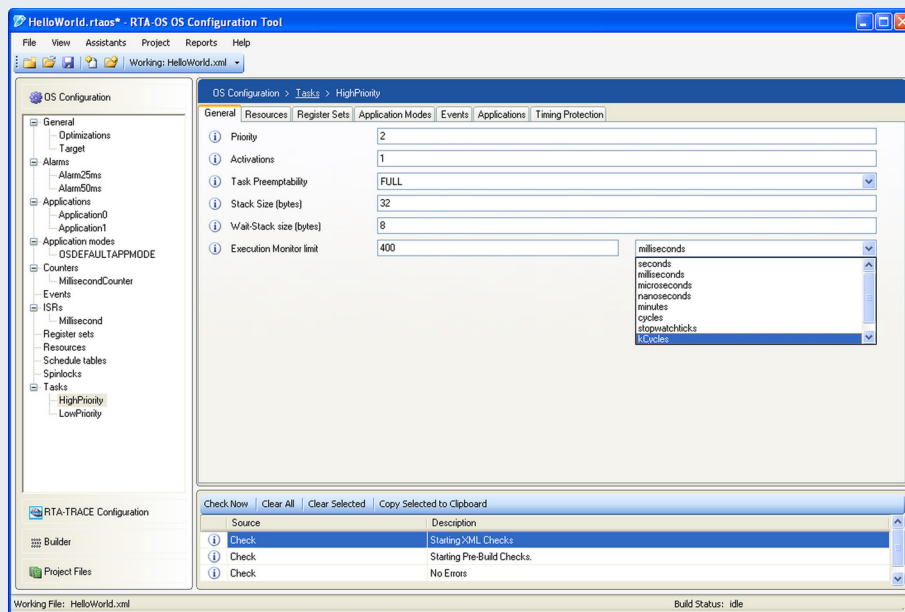


RTA-OS

Renesas R-Car x3 Cortex-R7 with the ARM Compiler



Features at a Glance

AUTOSAR R4.3 compliant
Multicore OS

Supports all scalability
classes

MISRA-C:2012 compliant

RTOS overhead:
4 bytes RAM
0 bytes ROM

Category 2 ISR latency:
294 CPU cycles

RTA-OS

RTA-OS is the new generation operating system from ETAS that conforms to the AUTOSAR OS specification and builds on the benefits of the successful RTA-OSEK product. It provides a toolsuite that includes a PC-based graphical configuration tool and adaptive OS generation capabilities to deliver flexible, fast solutions for a wide range of automotive microcontrollers.

The graphical configuration tool allows all OS objects to be configured, and creates AUTOSAR conformant XML files describing the OS configuration. In addition, it provides automatic verification against the AUTOSAR XML schema and allows users to create projects for easy management of multiple files.

RTA-OS improves on RTA-OSEK in several areas, including better runtime performance and smaller memory footprint,

support for multiple processor environments, and automatic support for up to 1024 tasks. The powerful performance analysis tools developed for RTA-OSEK have been updated for RTA-OS to allow hard real-time requirements to be met.

RTA Product Family

RTA-OS integrates seamlessly with other tools in the RTA product family, including:

- RTA-RTE – a mature, robust production quality AUTOSAR RTE Generator.
- RTA-TRACE – a software logic analyser that allows the runtime behaviour of RTA-OS to be observed.

Microcontroller Support

RTA-OS supports all variants of the Renesas R-Car x3 Cortex-R7 family of microcontrollers.

Release testing has taken place using the RCarH3R7 and RCarV3HR7 variants.

Compiler Toolchain

RTA-OS for the Renesas R-Car x3 Cortex R7 has been developed with the ARM v6.6 compiler.

Due to the adaptive code generation of RTA-OS, it is possible to use other versions of this compiler to build applications.

ORTI Debugger Support

RTA-OS can generate OSEK Runtime Interface information for the Lauterbach debugger.

Interrupt Model

RTA-OS supports a multi-level interrupt model on the R-Car x3 Cortex R7, with 16 or 32 interrupt priority levels (14 or 30 levels of category 1 or 2 interrupts).

Memory Model

RTA-OS supports the single memory model provided by the ARM compiler.

Maximum Number of OS Objects Allowed by RTA-OS

| | BCC1 | BCC2 | ECC1 | ECC2 |
|---------------------------------------|------|-----------------------|------|------------|
| Max. no. of tasks | | Up to 1024 | | |
| Max. tasks per priority | | Up to 1024 | | |
| Max. queued activations | 1 | $2^{32}-1$ | 1 | $2^{32}-1$ |
| Max. events per task | n/a | n/a | 32 | 32 |
| Max. alarms | | $2^{32}-1$ | | |
| Max. software counters | | $2^{32}-1$ | | |
| Max. hardware counters | | $2^{32}-1$ | | |
| Max. nested resources | | $2^{32}-1$ | | |
| Max. standard resources | | $2^{32}-1$ | | |
| Max. internal resources | | Not limited by RTA-OS | | |
| Max. application modes | | $2^{32}-1$ | | |
| Max. schedule tables | | $2^{32}-1$ | | |
| Max. expiry points per schedule table | | $2^{32}-1$ | | |

Memory Overhead of RTA-OS

| Memory Type | Overhead (bytes) |
|-------------|------------------|
| RAM | 4 |
| ROM/Flash | 0 |

In addition to the OS overhead, each object used by an application has the following memory requirements:

| Object | RAM (bytes) | ROM (bytes) |
|----------------|-------------|-------------|
| Task | 0 | 20 |
| Category 2 ISR | 0 | 8 |
| Resource | 0 | 8 |
| Alarm | 12 | 2 |
| Counter | 0 | 20 |
| Schedule Table | 16 | 16 |
| Expiry Point | 0 | 4 |

Performance

The following table gives the key RTA-OS kernel performance data measured in CPU cycles. All measurements were taken on a RCarH3R7 on R-CarH3-SiP Salvator-X EDVBwith a 800MHz clock speed.

| Task Type | Execution Time | Ref. |
|---|----------------|------|
| Pre-emption | 237 | A |
| Normal Termination | 153 | B |
| Task Switch | 186 | C |
| ChainTask | 318 | D |
| WaitEvent | 453 | E |
| SetEvent | 588 | F |
| Schedule | 243 | G |
| ReleaseResource | 231 | H |
| Category 2 ISR Entry Latency | 294 | I |
| Category 2 ISR Exit Latency resuming interrupted task | 204 | J |
| Category 2 ISR Exit Latency with task switch | 210 | K |
| Category 1 ISR Latency | 273 | L |

The following figures illustrate how the RTA-OS kernel overheads are allocated during the operations given in the above table:

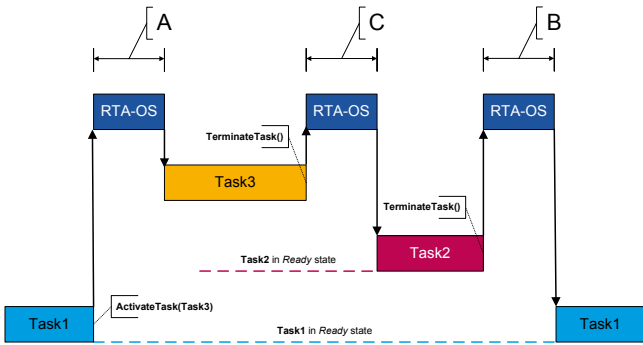


Figure 1 - Task1 is preempted by Task3, followed by a task switch and then normal termination of Task2

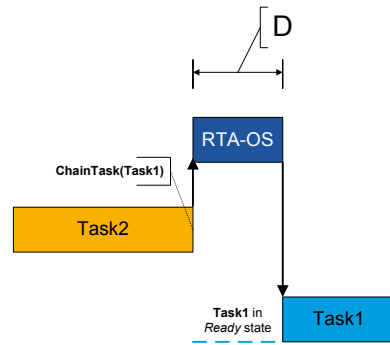


Figure 2 - Task2 chains Task1

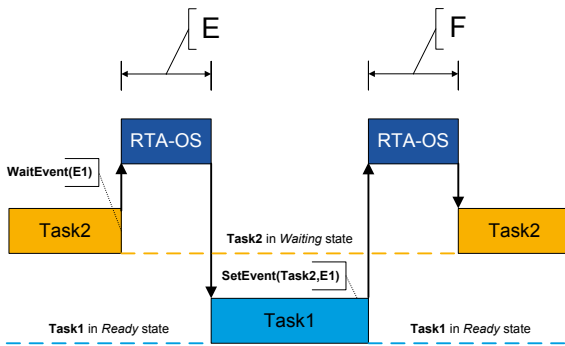


Figure 3 - Task2 waits for an event set by Task1

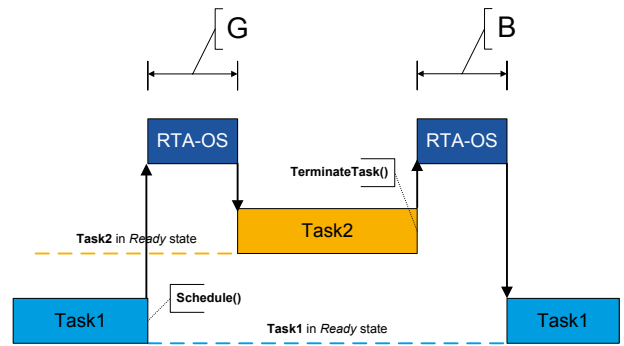


Figure 4 - Task1 allows cooperative scheduling by Task2

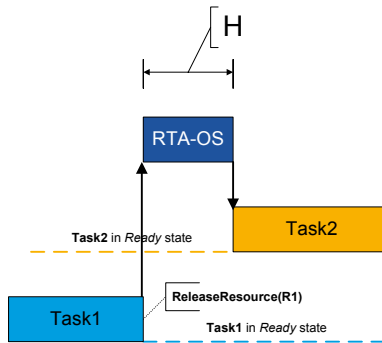


Figure 5 - Task1 releases a resource

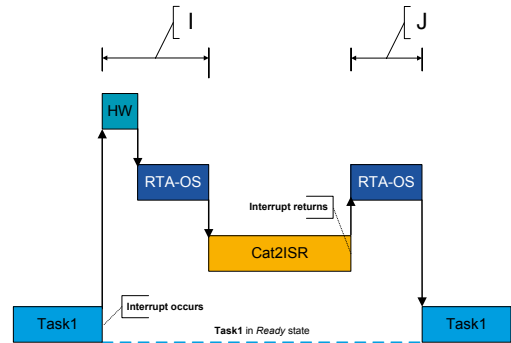


Figure 6 - Category2 ISR entry and exit latency

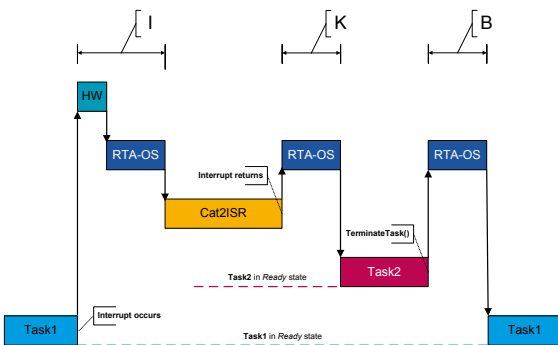


Figure 7 - Category2 ISR switches to Task2

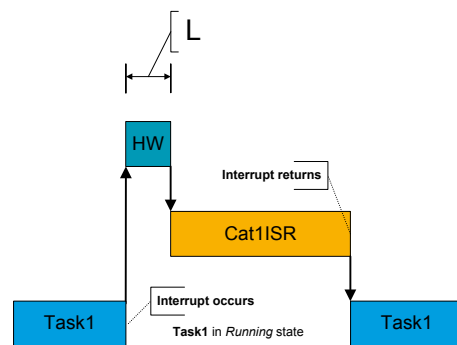


Figure 8 - Category1 ISR entry latency

Order Information

To use RTA-OS it is necessary to purchase a development license for the tools together with an add-on license for the R-Car x3 R7 port. Machine-named, user-named and floating licenses are available.

To use any operating system code generated by RTA-OS in ECU applications, a valid production license is required. Please contact your local ETAS Sales Office for details of production licenses for RTA-OS.

RTA-OS Tools Order Information

| Item | Characteristics | Object |
|---------------|---|----------------------------|
| F 00K 107 119 | Machine-named license for RTA-OS for Windows PC | LD_RTА-OS_VRTA_SC34_LIC-MP |
| F 00K 107 120 | User-named license for RTA-OS for Windows PC | LD_RTА-OS_VRTA_SC34_LIC-UP |
| F 00K 107 121 | Floating license for RTA-OS for Windows PC | LD_RTА-OS_VRTA_SC34_LIC-CP |
| F 00K 107 136 | Product CD for RTA-OS | LD_RTА-OS_VRTA_SC34_PROD |

RTA-OS Renesas R-Car x3 R7 ARM Port Order Information

| Item | Characteristics | Object |
|---------------|--|----------------------------|
| F 00K 111 731 | Machine-named license for RTA-OS for MAKER DEVICE Scalability Classes 1 & 2 | ES_RTА-OS_PORT_SC12_LIC-MP |
| F 00K 111 732 | User-named license for RTA-OS for MAKER DEVICE Scalability Classes 1 & 2 | ES_RTА-OS_PORT_SC12_LIC-UP |
| F 00K 111 733 | Floating license for RTA-OS for MAKER DEVICE Scalability Classes 1 & 2 | ES_RTА-OS_PORT_SC12_LIC-CP |
| F 00K 111 734 | Machine-named license for RTA-OS for MAKER DEVICE Scalability Classes 1 to 4 | ES_RTА-OS_PORT_SC34_LIC-MP |
| F 00K 111 735 | User-named license for RTA-OS for MAKER DEVICE Scalability Classes 1 to 4 | ES_RTА-OS_PORT_SC34_LIC-UP |
| F 00K 111 736 | Floating license for RTA-OS for MAKER DEVICE Scalability Classes 1 to 4 | ES_RTА-OS_PORT_SC34_LIC-CP |
| F 00K 111 745 | Product CD for RTA-OS for MAKER DEVICE | ES_RTА-OS_PORT_PROD |

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