RTMs 5
+ EPICS 7 (libcom)
RTEMS 5

- RTEMS 5 (formerly known as RTEMS 4.12 aka RTEMS 4.11.99)
- Still not released. Release will become 5.1
  (see: https://devel.rtems.org/wiki/Release)

### Supported Releases

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### Milestone 5.1

No date set

Total number of tickets: 620  - closed: 573  - in progress: 45  - new: 2

93%
RTEMS Libbsd

- Tracking latest FreeBSD
  - Started with FreeBSD 6, now at 12
- SMP performance improvement with self contained object
- Configuration follows FreeBSD system administration
- Simplified initialization via /etc/rc.conf
- USB with these Device Classes:
  - Input, Serial, Networking, Wlan, Storage
- Flattened Device Tree (FDT)
- MMC (eMMC)

- Networking:
  - IPv6, IPv4, IPsec, Packet Filter
  - Wireless
  - OpenCrypto, OpenSSL
  - Drivers: RE, FXP, E1000, DC, SMC, Broadcom, plus some SoC specific including QorIQ DPAA and 10GigE
  - Commands: tcpdump, ifconfig, route, ping
  - mDNSResponder (Bonjour)
  - DHCPD
  - VLAN

- Over 50 examples and tests

"Not at the moment. I am blocked by libbsd and the FreeBSD 12 release which is 4th Dec 2018 ...

https://www.freebsd.org/releases/12.0R/schedule.html

This is something that I did not really appreciate until recently.” (Chris Jones)
RTEMS Improvements

- SMP performance and stability improvements
  - SPARC, ARM, PowerPC, and RISC-V
- POSIX improvements
  - Headers now in Newlib which eases building third party packages including GNU Ada and FORTRAN
  - POSIX now enabled by default
  - 64-bit time_t (2038 here we come!)
- Self-contained objects added
- C11 thread support
- JFFS2 updated to upstream
- Flattened Device Tree (FDT) support
- xz decompression support
- 64-bit PowerPC support added

- Build system improvements
  - Removal of pre-installing header files
  - Flattening of library build under cpukit
  - Massive improvements in parallelism
- Test suite improvements
  - Improved annotation of test executable for test auditing
  - Addition of 90+ test executables
- Documentation
  - New Users Guide to help getting started
  - New RTEMS POSIX Compliance
  - Newlib libc/libm docs on path to be included in RTEMS POSIX Guide
- Many examples added
Welcome to the RTEMS Documentation Project

RTEMS documentation is written in reStructuredText and built using the Sphinx tools which are available for most host systems. The documentation source is available from the rtems-docs.git Git repository and the RTEMS Wiki details how to build the documentation.

The documentation project is open and welcomes new documents, chapters as well as any fixes no matter how big or small. If you see something wrong please create a ticket and if possible attach a patch.

If you need any help please ask on the RTEMS Users mailing list. You can join the list here.

Development

The Master branch of the documentation is the development source. You can access the latest documents below. Click below.

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https://docs.rtems.org/
Architecture and BSP Highlights in 5.1

- **Added:**
  - Architectures: RISC-V 32 and 64 bit
  - BSPs: atsamv, imx7, qoriq_e500, qoriq_e6500 (32 and 64 bit), at697f, gr712rc, gr740, ut699, ut700

- **BSPs supporting SMP:**
  - SPARC (1-4 cores): GR712C and GR740
  - PowerPC (1-24 cores): QorlQ (e.g. P1020, P2020, T2080, T4240, etc)
  - ARMv7-A (1-4 cores): Altera Cyclone V, Xilinx Zynq, Raspberry Pi2
  - RISC-V

- **Removed:**
  - Architectures: AVR, H8/300, M32C, and M32R
  - BSPs: gba, gp32, nds, Edison, gen68302, idp, mvme136, od368302, sim68000, simcpu32, genmongoosev, ep1a, mbx8xx, sis
Recent RTEMS Mission Launches

**NASA Parker Solar Probe**
- Launched 12 August 2018
- SPARC Flight Computer runs RTEMS
  w/Saurabh Gadia’s GSoC 2015 project backported to 2011 version

**NASA ICESat-2**
- Launched 15 September 2018
- Advanced Topographic Laser Altimeter System (ATLAS)
  runs RTEMS on a mix of SPARC and PowerPC CPUs

**DLR Eu:CROPIS**
- Launched 19 November 2018
- SPARC based life-support, growing tomatoes in space

**ESA BepiColombo**
- Launched 8 October 2018
- RTEMS on at least MERTIS (MERCury Radiometer and Thermal infrared Imaging Spectrometer)

**UAE KhalifaSat**
- Launched 29 October 2018
- SPARC LEON3 based imaging
RTEMS does not provide any form of memory management or processes. In POSIX terminology, it implements a single process, multithreaded environment. This is reflected in the fact that RTEMS provides nearly all POSIX services other than those which are related to memory mapping, process forking, or shared memory.

RTEMS closely corresponds to POSIX Profile 52 which is "single process, threads, filesystem”

Therefore very fast task switches

Super easy to program e.g. DMA (on PCI and VMEbus) with the help of devLib2

Can be run on embedded (small) systems
Details: Cavity stabilization

- For cavity stabilization we are using an Agilent High Resolution VMEbus Laser Axis Board (Interferometer).

- Integrated into the VME-bus System which holds the MAXv-Card. This allows fast in-loop-control on the IOC running RTEMS.
Details: Machine Protection

- Continuously monitoring electron beam from gun to dump
- Struck 3316 digitizer compares signals from transformer toroids and Faraday cup of the beam dump with expectation values, EPICS device support uses Ethernet-UDP
- If comparison fails, RF will be switched off
EPICS V4 inside

“fast STM” - control

- X, Y, Z (const. height)
- X, Y (coarse STM)
- I/V, LockIn, other

Gateway

pva2pva

NTNDAarray

VMEbus

Highland V375, 4-channel arbitrary waveform generator, 15 MHz point step rate
struck SIS3316, 16 channel digitizer, 14bit, 250 MS/s per channel, 64 MSamples memory/ch

MVME2500, QoriQ, 8GB,
4 Gbit/s Ethernet

MVME6100, PowerPC, 2GB, 2 Gbit/s Ethernet, 2 PMC-X
Will us LoRaWAN to send the data
The RTEMS shell commands will be provided in the Epics shell e.g. directory commands like

- **blksync** - sync the block driver
- **cat** - display file contents
- **cd** - alias for chdir
- **chdir** - change the current directory
- **chmod** - change permissions of a file
- **chroot** - change the root directory
- **cp** - copy files
- **dd** - convert and copy a file
- **debugrfs** - debug RFS file system
- **df** - display file system disk space usage
- **dir** - alias for **ls**
- **fdisk** - format disks
- **hexdump** - format disks
- **ln** - make links
- **ls** - list files in the directory
- **md5** - display file system disk space usage
- **mkdir** - create a directory
- **mkdos** - DOSFS disk format
- **mknod** - make device special file
- **mkrfs** - format RFS file system
- **mount** - mount disk
- **mv** - move files
- **pwd** - print work directory
- **rmdir** - remove empty directories
- **rm** - remove files
- **umask** - Set file mode creation mask
- **unmount** - unmount disk

https://docs.rtems.org/branches/master/shell
• Most of the existing libcom (posix) is used for RTEMS 5 with only some minor changes, does not interfere with existing RTEMS 4.x

In CONFIG.Common.RTEMS
...
# CONFIG_SITE.Common.RTEMS
#
# Site-specific information for all RTEMS targets
#-------------------------------------------------------

# RTEMS Series and Version

#RTEMS_S SERIES = 4.9
#RTEMS_VERSION = 4.9.2

#RTEMS_S SERIES = 4.10
#RTEMS_VERSION = 4.10.2

#RTEMS_S SERIES = 5
#RTEMS_VERSION = 5

In CONFIG.Common
...
# vpath directories
POSIX_YES = os/posix
OS_IMPL_DIRS = $(if $(OS_API),os/$(OS_CLASS)-$(OS_API),os/$(OS_CLASS)
GENERIC_SRC_DIRS = .. $(SRC_DIRS)
OS_SRC_DIRS += $(foreach dir, $(GENERIC_SRC_DIRS), $(addprefix $(dir)/, $(OS_IMPL_DIRS) $(POSIX_VAR_POSIX) os/default ))
OPEN ISSUES

• EPICS 7 at all works well

• Problems with mixed up output on console (RS232)
  overlapping output is happening on stdout and stderr

• Lack of a dynamic link loader, no gdb

• “A shell and loading may just be part of that. Debugging? Tracing? etc.
  A wishlist for that would be great. We can turn them into tickets at least.
  Getting them funded would be even better. :)” (Joel Sherill)