# RTEMS Development Roadmap

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# Outline

- Community Driven Focus
- Project Process Improvement Efforts
- 4.9 and 4.10 Updates
- Development Head (4.11) Improvements
- Wish List for Future Improvements
- OAR Legacy Support Releases
- OAR Support Subscriptions
- Conclusion

# Community Driven Focus

- Without users, project has no reason to exist!
- Users drive requirements
  - Please let us know what you need
- Users provide or fund many improvements
  - Again those reflect your requirements
- Most bug reports are from users

**RTEMS Evolves to Meet Your Needs**

# Participate in Student Programs

- Attracts next generation of developers
  - As users and developers of RTEMS
- Promotes RTEMS to students
  - For use in projects and research
- Forces RTEMS Project to evaluate
  - Ease of getting started for new users
  - Approachability of email list and IRC channel

# RTEMS Project Participation

- Google Summer of Code (2008-2011)
  - Almost thirty students over the four years
- Google Code-In (2010)
  - High school students did ~100 tasks for RTEMS
  - Included only twenty FOSS projects
- ESA Summer of Code In Space (2011)
  - First year and only twenty FOSS projects involved

rtems
Real-Time Executive for Multiprocessor Systems

# Project Process Improvement Efforts

- New website in Drupal
  - Old site used MetaHTML which is now unmaintained
  - Now looks fresher and is easier to update
- Build bot for regression testing
  - Each check in will be tested for regressions
  - Automated test of all configurations impacted tested
- Transition from CVS to git
  - Driven by build bot which needed atomic change sets

# Establish Tool Evaluation Process

- RTEMS Project is over twenty years old
  - Very long time in computing terms
- New approaches and tools introduced
  - Doxygen did not exist when project began
- New tools available to address old needs
  - For example, RCS -> CVS -> SVN -> git, etc.
- Tools may fall out of favor or unmaintained
- Unplanned transitions are PAINFUL
  - GNATS -> Bugzilla was too late

# Evaluation Process Goals

- Recognize when a
  - tool is becoming or has become unmaintained
  - superior tool becomes available
- Transitions need to be planned not forced
- Goal is to produce a high quality real-time operating system – not support tools
  - We need to stay in the “sweet spot”

# 4.9 and 4.10 Updates

- 4.9 Release Branch Updates
  - 4.9.5 and 4.9.6 released addressing ~30 PRs
- 4.10 Release Branch Updates
  - 4.10.0 and 4.10.1 released
  - 4.10.1 addressed ~30 PRs
    - Added TLL6527M BSP
    - Included updates on other BSPs
- RAD750 BSP available for 4.10 but under ITARS
  - If interested, contact OAR for details

# Development Head (4.11) Changes

- Pluggable Scheduler Infrastructure
  - Multiple single-core Schedulers now in tree
    - Deterministic Priority Scheduler
    - Simple Priority Scheduler
    - Earliest Deadline First (EDF)
    - Constant Block Scheduler (CBS)
  - RTEMS Scheduler Simulator to aid in writing one

- Initial SMP Support
  - Tested up to 4 cores on LEON3 and pc386
  - Plenty of room for improvement

# More 4.11 Changes

- Sixty-Four Bit Internal Time
  - Represents nanoseconds since POSIX epoch
  - 584.55 years before overflow
- ARM Cortex-M3 Support
- SPARC64 Port Added
- Improved NIOS II Support
  - External interrupt controller support

# New BSPs in 4.11

- ARM
  - Thorn TLI800
  - Stellaris LM3S6965
- LM32
  - Milkymist
- SPARC64
  - Niagara
  - UltraSPARC III
- PowerPC
  - DP2
  - Phytec  MPC5554
  - MPC5674 EVB
  - MPC8309 SOM
  - QorIQ
  - Qemu PREP
  - Qemu Altivec

# Wish List for Future Improvements

- Coverage
- Capture Engine
- Run-Time Loader
- TCP/IP Stack Upgrade
- USB Stack
- Multi I/O API

# Coverage Status

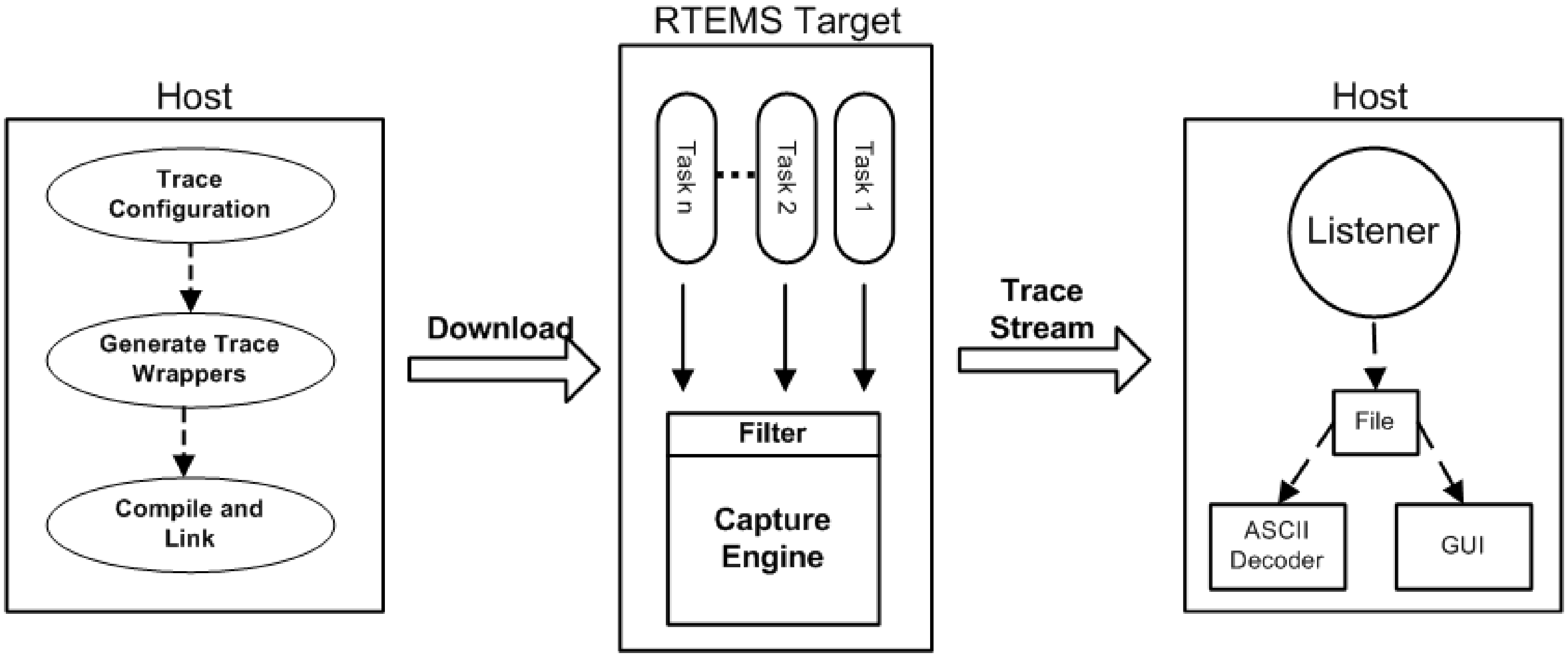
- Instruction and branch level coverage reports for
  - Ten BSPs covering six architectures
- Initial focus was RTEMS "*Proper*" at -Os
  - score, rtems, posix, and sapi
  - Instruction coverage only – hovers near 100% now
- Current effort is broader
  - Branch taken/not taken coverage of RTEMS "*Proper*"
  - CPU Kit except networking and shell
- Reports now included with releases

# Coverage Wish List

- Output from *covoar* in *gcov* format
  - Enables use of tools that support *gcov* format
- Output from *covoar* in *gperf* format
- Assistance from domain experts to
  - Get DC and MC/DC coverage reports from *covoar*
  - Produce reports in formats useful to RTEMS users
- Help from any user to improve coverage
  - Submit test cases… please

**Coverage is a long journey with many small steps**

# Capture Engine



- Generation – Need tool to assist in trace configuration
- Capture – Need feedback from real use cases
- Analysis – Need GUI tool for visualization of traces

**All will require user support to accomplish!**

# Run-Time Loader

- Standards based using the dlopen family of calls.
- Implemented as a run-time link editor (RTL). Locates and fixes up ELF object files in the target.
- Rejected the shared library model found on Unix due to performance and complexity. RTEMS is a ‘single process’ and the sharing code support offers nothing.
- Developed for RTEMS with a small target foot print. Designed to avoid the heap fragmenting when loading a number of object files. Minimal resident overhead.

# Run-Time Loader

- Object files can be loaded from archives or as separate files from the file system
- The link editor loads and locates ELF object files resolving symbols and loading the symbol table with public symbols. There is a small amount of architecture specific code.
- Exported base image symbols can be linked to the base image using a 2 pass link process or loaded via an object file created post the base image linking.

# Run-Time Loader To Do

- Dependency processing is incomplete
- Need to support C++
- Only supports a few architectures
- Documentation is lacking
- Host side tool to link could have more features
  - Identify unused methods in executable
- Feedback and support from users needs

# TCP/IP Stack Upgrade

- Based on a current FreeBSD kernel.
  - The latest kernels support threading to aid SMP.
- Provide a adaption layer for FreeBSD kernel services such as threads, mutex and condition variables.
- Bus space API for hardware IO, DMA and interrupt abstraction. Map the FreeBSD Bus Space API to an RTEMS Score API. This aids porting drivers to RTEMS. See http://www.rtems.org/wiki/index.php?title=BusSpaceAPI
- Large project with numerous complex issues and needing user funding to pull all the pieces together.

# USB Stack

- Based on a current FreeBSD kernel.
- Attempt to NOT modify the FreeBSD sources to improve the ability to import updates.
- Support via Bus Space API for FreeBSD drivers such as EHCI.
- Port of class layers such as mass storage.
- Recent port available in Bugzilla
  - However Score support for a Bus Space API is needed before being accepted into the source tree.

# RTEMS Multi I/O API

- Want standard RTEMS API for boards with
  - Discrete I/O, DACs, and ADCs
- Current status
  - multiio CVS module available with shell commands and support for two boards
- Next steps
  - Feedback from users on API and features
    - May require more development
  - Once API is settled, then must be documented

# OAR Legacy Support Releases

- Community supports
  - Development head (e.g. 4.11), and
  - Two release branches (currently 4.9 and 4.10)
- OAR offers legacy support for older branches
  - Currently available for 4.6, 4.7, and 4.8
    - 4.6.9 includes 54 fixes not in 4.6.6
    - 4.7.5 includes 34 fixes not in 4.7.3
    - 4.8.4 includes 22 fixes not in 4.8.2
  - Branch supported as long as needed by users

# OAR Support Subscriptions

- Bring RTEMS into your project faster and simpler
- Direct Contact with the RTEMS Engineers
- Timely Responses from the RTEMS Engineers
  - normally less than 24 hours
  - always within 2 business days
- Rapid Problem Response
  - solutions as quickly as technically possible
- Assistance with the RTEMS Environment

**Now includes subscription to easy to install DVD with the RTEMS Development Environment**

# How to Get Your Feature Merged

- RTEMS is free software
  - You are free to modify or add to it
- No guarantee anything will get merged
  - Must meet coding and design standards
- Improve your situation!!!
  - Get a core developer involved
  - Support them implementing your feature
- Recent user funded projects
  - RFS, Run-Time Loader, and SMP

# Conclusion

- RTEMS Project is driven by user needs
- Continual effort to improve our processes
- Improvements will continue with user support
- Current and legacy release support available

**Please Support RTEMS Enhancement Activities**