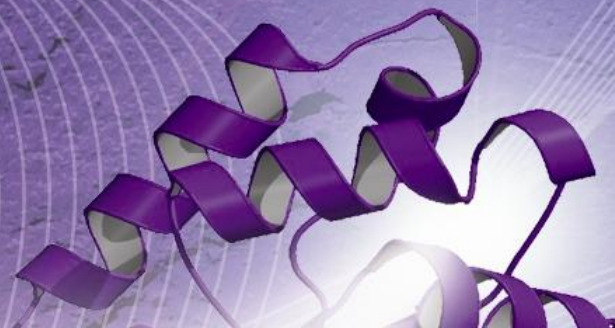




# ***RTEMS for Real-Time Control***

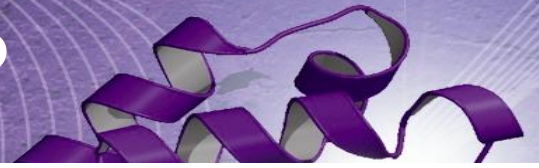
Workshop Report

Chaired and Disorganized by Glen Wright

PCaPAC Conference

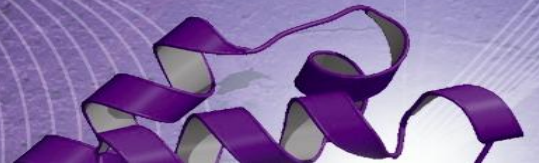
October 5, 2010

# *What is Real-Time?*



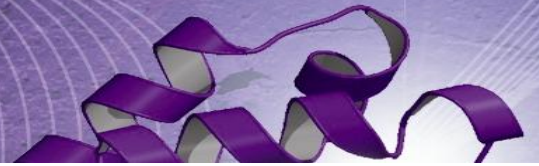
- A Real Time system is defined as having **“operational deadlines from event to system response”** (Wikipedia)

# *What is RTEMS?*



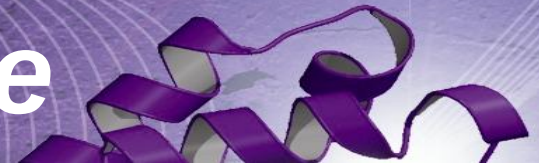
- *Real Time Executive* for *M*ultiprocessor Systems
- Originally developed by OAR Corp. for U.S. Military
- Available as Free Open Source Software
- Uses Freely available tools to build an application

# *RTEMS workshop*



- 3 Parts:
  1. How RTEMS has been used, is being used, and will be used at the CLS
  2. How RTEMS is used at other facilities
  3. How to develop RTEMS applications

# CLS – *historical use*



- RTEMS has been used with the CLS Embedded Rack-mount Output Controller (EROC)
- The EROC uses an MC68360 @ 25MHz, limited amount of memory, no disk drives
- Typically used to interface between an RS232 serial line device and EPICS – does not have a Real-Time requirement

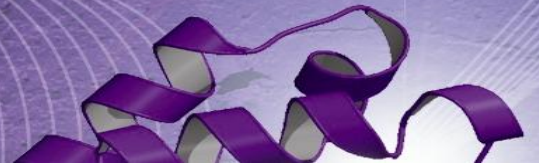
# CLS – Current RTEMS

- RTEMS is used for the Orbit Correction System, which does have a real-time requirement to collect input, perform calculations, and output magnet settings
- Runs on a COTS pc386 system, RTEMS 4.10, SIS 1100 PCI-to-VME driver customized for RTEMS,

# *CLS – RTEMS Future on Beamlines*

- CLS is considering whether RTOS is a necessary component of “fast” data acquisition

# ***RTEMS workshop***



- 3 Parts:
  1. How RTEMS has been used, is being used, and will be used at the CLS
  2. How RTEMS is used at other facilities
  3. How to develop RTEMS applications

# *RTEMS at other Facilities*

- Many individuals at the workshop were more interested in how they might possibly use RTEMS.
- Note to Glen – take better notes!

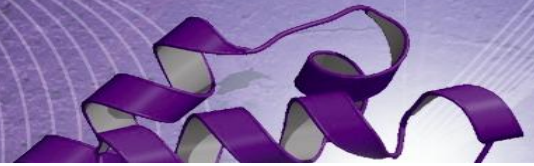
# *Alternate Real-Time Solutions*

- VxWorks – commercial application development environment that targets essentially the same CPU families as RTEMS
- FPGA – push the real-time aspects of the problem to the hardware level
- Other hardware – solve the real-time issue before the data gets to the software

# *Solution in search of a problem?*

- How often is RTEMS used?
- How often is RTEMS used for a real-time application?

# Stumbling Blocks



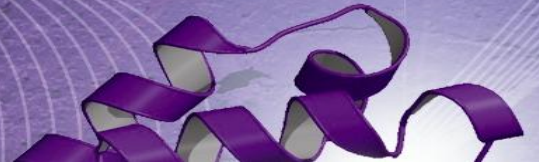
- Missing any significant on-line training
  - Check out 'eLearning' page at [www.rtems.com](http://www.rtems.com)
- Documentation trails releases (4.9.4 documented at [rtems.com](http://rtems.com), 4.10 available, 4.11 under development)
- Finding what versions of what tools work with each version of each release on different development environments can be an issue

- Suggestion – if at all possible, use a development environment that has ready-to-install binaries of the different tools.

# *What hardware to use?*

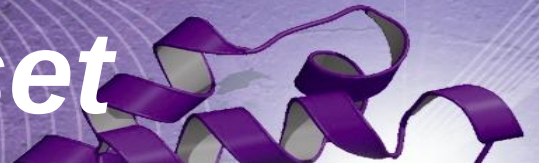
- If you're asking the question, then try and use "common" hardware for which you can find collaborators
- If you've got the experience, or want to gain it, try some of the less commonly used hardware!

# ***RTEMS workshop***



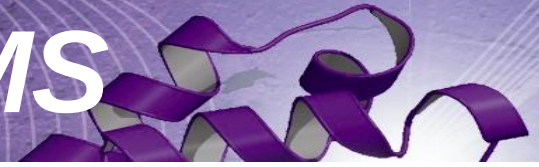
- 3 Parts:
  1. How RTEMS has been used, is being used, and will be used at the CLS
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# Downloading Toolset



- gcc and associated files available prebuilt for a number of linux distributions, Windows, and Solaris
- Source files available for other distributions – try and match the version numbers for the tools of a particular distribution to keep it simple!

# *Downloading RTEMS*



- RTEMS source can be downloaded and built with the toolkit just installed

# *Using an emulator for testing*

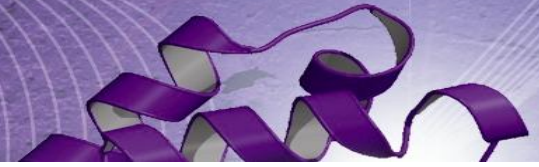
- The QEMU emulator can be easily set up for testing RTEMS applications.
- QEMU allows simulating a number of common CPUs
- Limitation – can't easily set it up to test Input or Output hardware with your system.

# Debugging

- RTEMS has 'gdb' hooks to allow remote gdb debugging of an application.
- Gdb with ddd and remote debugging can provide an environment where you can debug from your desktop.

# *Demos run with QEMU*

- “Hello PCaPAC 2010”
- “ 0012ACCHPPaello” – using 3 tasks, event notification, and a semaphore to control the speed and display of a string sort



- [www.rtems.com](http://www.rtems.com)
- <http://www.eetimes.com/design/embedded/4025952/Develop-an-RTOS-on-Solaris-with-RTEMS> (step by step RTEMS tools build and install on a solaris system, using QEMU)
- (Real Soon Now) scripts used to set up demos