

jpf-rtembed

The rtembed extension is aimed at verification of Java programs for real-time and embedded platforms, such as RTSJ and SCJ.

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Features

Currently, the extension includes the following components:

- implementation of a significant part of RTSJ API and its semantics (e.g., region-based memory model),
- implementation of a significant part of SCJ API and its semantics (levels 0 and 1 are supported),
- RTSJ-compliant scheduler based on thread priorities, periods and releases, and limited preemption,
- abstraction of real time clock based on thread periods and numbers of past thread releases,
- thread scheduling for SCJ and model of time based on WCET for bytecode instructions on the JOP processor (<http://www.jopdesign.com>),
- a listener that detects invalid usage of scoped memory areas (including private and mission memory areas in SCJ), and
- a general optimization of state space traversal based on platform-specific restrictions of concurrency.

Related publications:

Pavel Parizek and Tomas Kalibera. Platform-Specific Restrictions on Concurrency in Model Checking of Java Programs, In Proceedings of the 14th International Workshop on Formal Methods for Industrial Critical Systems (FMICS), LNCS, vol. 5825, 2009.

<http://d3s.mff.cuni.cz/~parizek/papers/fmics09.pdf>

- Tomas Kalibera, Pavel Parizek, Michal Malohlava, and Martin Schoeberl. Exhaustive Testing of Safety Critical Java, In Proceedings of the 8th International Workshop on Java Technologies for Real-time and Embedded Systems (JTRES 2010), ACM, 2010.

<http://d3s.mff.cuni.cz/~parizek/papers/jtres10.pdf>

Running

The extension behavior can be configured via a number of properties. Value of the `rtembed.scheduler.processors` property states how many processors a platform has (i.e., how many threads can run in parallel). The `rtembed.scheduler.timeslicing` property states whether JPF should simulate a platform that employs time-preemption (time slicing), and the `rtembed.scheduler.backbranches` property specifies whether JPF should consider back-branches as thread yield points. Other properties are related to various aspects of RTSJ-compliant and/or SCJ-compliant scheduling and semantics, and generally should be set to 'true'.

Specifically, to run the extension in the RTSJ mode, you need to specify the following properties as a part of JPF configuration:

```
+listener=gov.nasa.jpf.rtembed.memory.MemoryAreasChecker,\
    gov.nasa.jpf.rtembed.scheduling.SchedulingDataManager,\
    gov.nasa.jpf.rtembed.time.TimeDataManager
+vm.scheduler_factory.class=gov.nasa.jpf.rtembed.scheduling.RTSJSchedulerFactory
+vm.insn_factory.class=gov.nasa.jpf.rtembed.restrictpar.PlatformSpecificInstructionFactory
+rtembed.scheduler.processors=1
+rtembed.scheduler.timeslicing=false
+rtembed.scheduler.backbranches=false
+rtembed.scheduler.threadpriorities=true
+rtembed.scheduler.scopedmemaware=true
+rtembed.scheduler.priorityinheritance=true
+rtembed.scheduler.timemodel=true
```

To run the extension in the SCJ mode, you need to provide the following configuration:

```
+listener=gov.nasa.jpf.rtembed.memory.MemoryAreasChecker,\
    gov.nasa.jpf.rtembed.scheduling.SchedulingDataManager,\
    gov.nasa.jpf.rtembed.time.TimeDataManager
+vm.scheduler_factory.class=gov.nasa.jpf.rtembed.scheduling.SCJWCETSchedulerFactory
+vm.insn_factory.class=gov.nasa.jpf.rtembed.scheduling.SCJInstructionFactory
+rtembed.scheduler.processors=1
+rtembed.scheduler.timeslicing=false
```

```
+rtembed.scheduler.backbranches=false
+rtembed.scheduler.threadpriorities=true
+rtembed.scheduler.scopedmemaware=true
+rtembed.scheduler.priorityinheritance=true
+rtembed.scheduler.timemodel=true
+rtembed.timemodel.class=gov.nasa.jpfrtembed.time.JopTiming
+rtembed.timemodel.cpubfreq.mhz=40
+rtembed.timemodel.print=true
+rtembed.scheduler.gentcginsn=true
```

You also need to apply JPF on the `javax.safetycritical.SCJRuntime` class and pass the name of the main application class as an argument.

Repository

The Mercurial repository can be found on <http://babelfish.arc.nasa.gov/hg/jpf/jpf-rtembed>