ERC32 Evaluators' Workshop

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Experiences

ERC32 Evaluation programme

- AdaWorld
- WCETE
- ERC32 Target Simulator
- Schedulability Analyser/Scheduler Simulator

ERA Application SW development

- AdaWorld
- Schedule tool by CRI
- SPARC Instruction Simulator (sis)
- HRT Model

AdaWorld

General

- Validated Ada83 compiler
- Few problems faced when porting the ASW SL V0

Real-Time extensions

- Absolute delays and real-time clock ensure correct triggering of cyclic activities.
- Passive tasks and immediate priority ceiling protocols provide data protection and synchronization with an overhead that is bounded and less than when using Ada tasking.

AdaWorld

Possible improvements

- Synchronization provided by passive tasks is not optimal. Better solution would be to provide Ada95 suspension objects or optimize passive tasks by letting the signal operation execute the body for any task waiting on a wait operation, thus avoiding unnecessary context switches.
- Constraint, that exceptions may not be propagated from passive tasks should be removed.
- Constraints should be verified statically whenever possible.
- Compiler/binder should determine maximum needed stack size for each task.
- Compiler/binder output should report all memory used (heap, stack, global data, and code).

WCETE

Features

- Determines worst case execution times for cyclic and sporadic tasks, and protected actions
- Provides output in a format that can be read by the Schedulability Analyser
- Allows only a very restricted subset of Ada (excluding e.g. integer multiplication/division, and array assignment)

Possible improvements

- The subset must be extended. The current subset prevented an actual evaluation. One may still doubt whether the method can be used in practice.

ERC32 Target Simulator

Features

- Allows development without target hardware
- Provides better execution control than target hardware
- Non-intrusive debugging interfaced to AdaProbe
- Powerful interface allows environment simulation in TCL
- Timing behaviour closely follows ERC32 (FP operations only exception)

Possible improvements

- Execution speed (simulated time/experienced time ratio 1:500, measured on a SPARCstation 4)
- Easier interface to launch a stand-alone test without GUI

SPARC Instruction Simulator

Features

- Simulates ERC32 with 2 infinitely fast UARTs
- Uses command line interface
- Only intrusive debugging via ALSYMONITOR
- Execution speed (simulated time/experienced time ratio 1:25, measured on a SPARCstation 4)

Possible improvements

- Provide non-intrusive interface to AdaProbe by emulating ALSYMONITOR in simulator
- Optional true timing behaviour on FP operations (will affect simulator performance)

Schedulability Analyser

Features

- Deadline Monotonic (Arbitrary Deadline) Scheduling
- Concludes if a given set of threads are schedulable by performing a calculation that would be cumbersome to do by hand.
- Reads blocking times and worst case execution times produced by WCETE. Deadlines and periods defined by user

Possible improvements

- Model and algorithm must be documented
- Synchro objects are not handled correctly
- Modes for WCETs would make more realistic results

Scheduler Simulator

Features

- Simulates a possible execution corresponding to critical instant for the lowest priority task (all tasks released simultaneously)
- Display of a possible execution as Gantt chart or event list

Possible improvements

- The simulation seems to be wrong
- Critical instant should be task dependent. I.e. critical instant for highest priority task should be the situation where all lower priority tasks have just entered a protected operation.

HRT Development Model (as used for ERA SW)

Features

- Allows robust design that can accommodate changes without major impact
- Statically analysable real-time behaviour provides a predictable system
- Provides early and easy control of real-time requirements.
- Makes real-time problems easily locatable thus helping the solution

Problems

- “Non-deterministic” execution time due to ERC32 (floating point operations and register window traps)
- ERA SW produced by 3 parties all contribute to schedulability

Conclusion

AdaWorld	Very useful, but requires support contract since errors still exist.
WCETE	Usefulness unknown (currently not useful)
Target Simulator	Will be very useful after a mandatory speed improvement (of a factor of 15 or more)
sis	Very useful
Schedulability Analyser	Will be very useful when described problem is corrected.
Scheduler Simulator	Useful for education only and only after correction.
HRT Development Model	Very useful