Towards Specification and Verification Frameworks for Concurrent Real-Time Systems

CISTER Research Center in Real-Time & Embedded Computing Systems

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The Problem

- Concurrent real-time systems are growing dramatically, both in size and complexity
- Verification, already challenging, is highly impacted from this growth
- Integrated frameworks are fundamental to tackle all the intricacies of these systems
- Formal languages that specify both timed and functional properties (at the source-level)

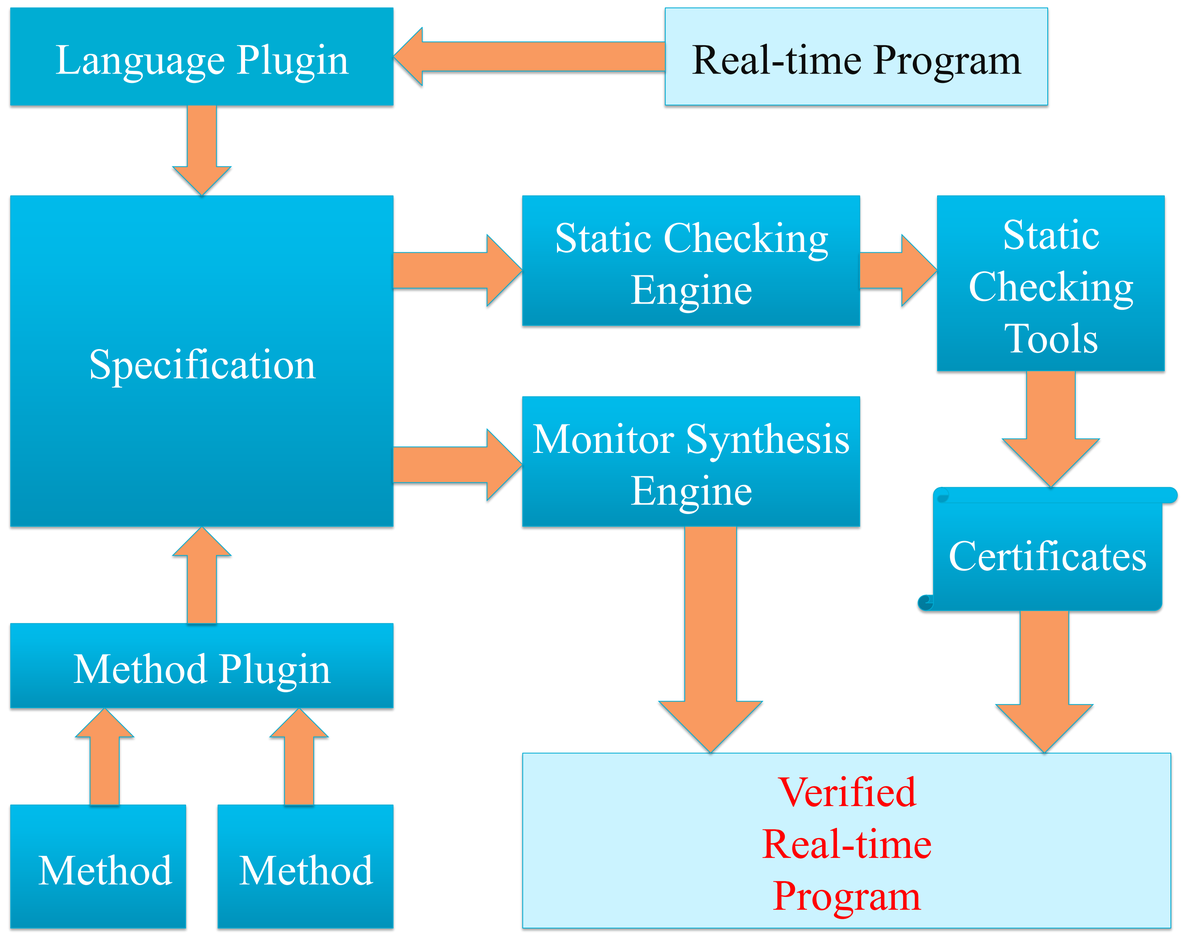
Proposed Approach

- Support the use of several techniques in cooperation
- Hybrid frameworks: both static and run-time verification
- Address mainly the temporal correctness of source-level, real-time programs
- Programming language independency
- Fostering the use of tools that have been proved valuable (theorem provers, model checkers, deductive verification frameworks)

Preliminary Ideas

- Regular expressions as formally verified models for lightweight and expressive runtime monitoring systems
- Timed and hybrid logics as a high-level specification for monitoring synthesization
- Integration of both methods (and possibly others in the future) in a single formal specification language
- Focus on real-time design patterns

The Approach in a Picture



Example Specification

- Example using temporal logic as underlying method:

```
mon Monitor_A
  head <...>
    gen model l.mtl of X as lmtl; -- Construct Model
  spec
    smemory is lmtl.sat[sread implies true until<=10
        mwrite];
  oper
    set sampled 5 to smemory;
    change smemory period to 5 in checkpoint_1;
```

Final Remarks

- First prototype of the specification language
- Model of runtime monitor system based on timed regular expressions extended with Boolean assertions
- Currently defining a formal logic to express and reason about lazy linear hybrid automata

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