CosyVerif: An Open Source Extensible Verification Environment

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CosyVerif

Motivation

Many tools for distributed systems verification

- Relying on different formalisms
- Solving different problems
- Running on different OS
- Requiring some difficult installation procedures

$\rightsquigarrow$ Needs for:

- A unified representation
- Interoperability and tool integration
- For users: Easy installation and use
- For developers: Easy integration of tools

Outline

1. The CosyVerif Environment
2. Integrated Tools
3. Summary and Evolutions

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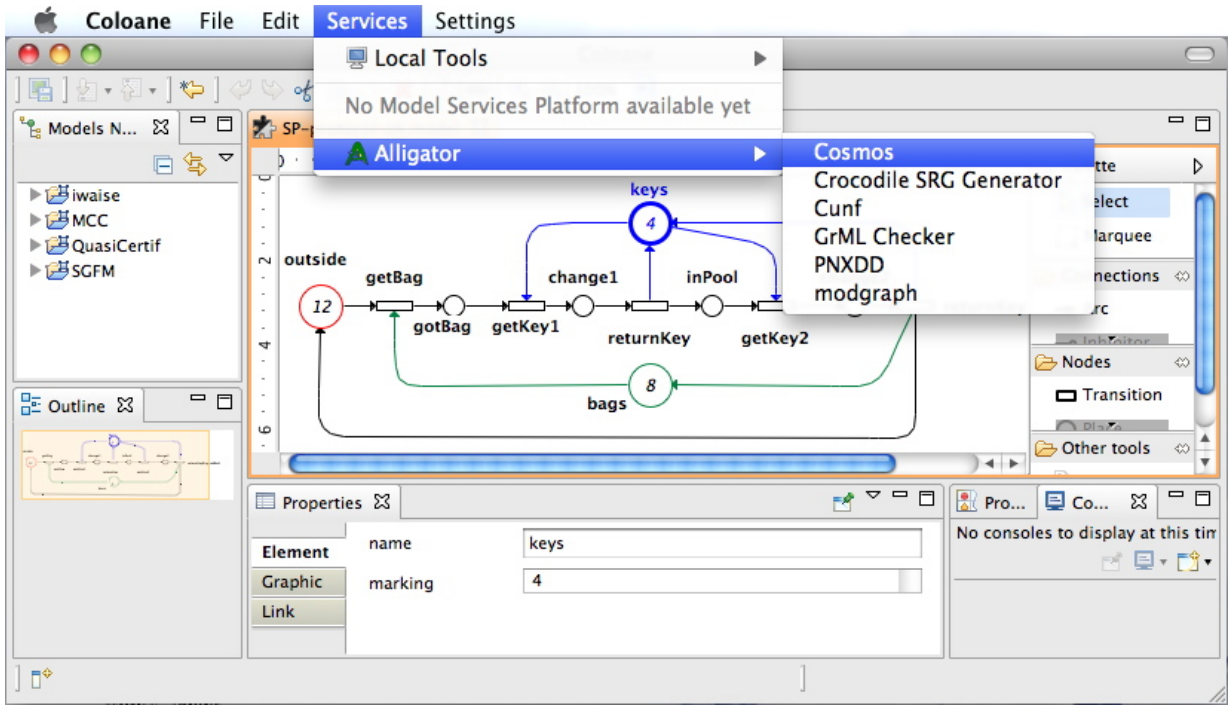
A Common and Reusable Syntax

- *CosyVerif* relies on reusable and extensible formalisms
  [André et al., 2013]
- FML (Formalism Markup Language)
  - Describes formalisms (meta-models)
- GrML (Graph Markup Language)
  - Describes models
- Advantages
  - Unified model representation
  - Easy addition of new formalisms
- Applications: set of formalisms
  - Large family of (timed) automata and Petri nets

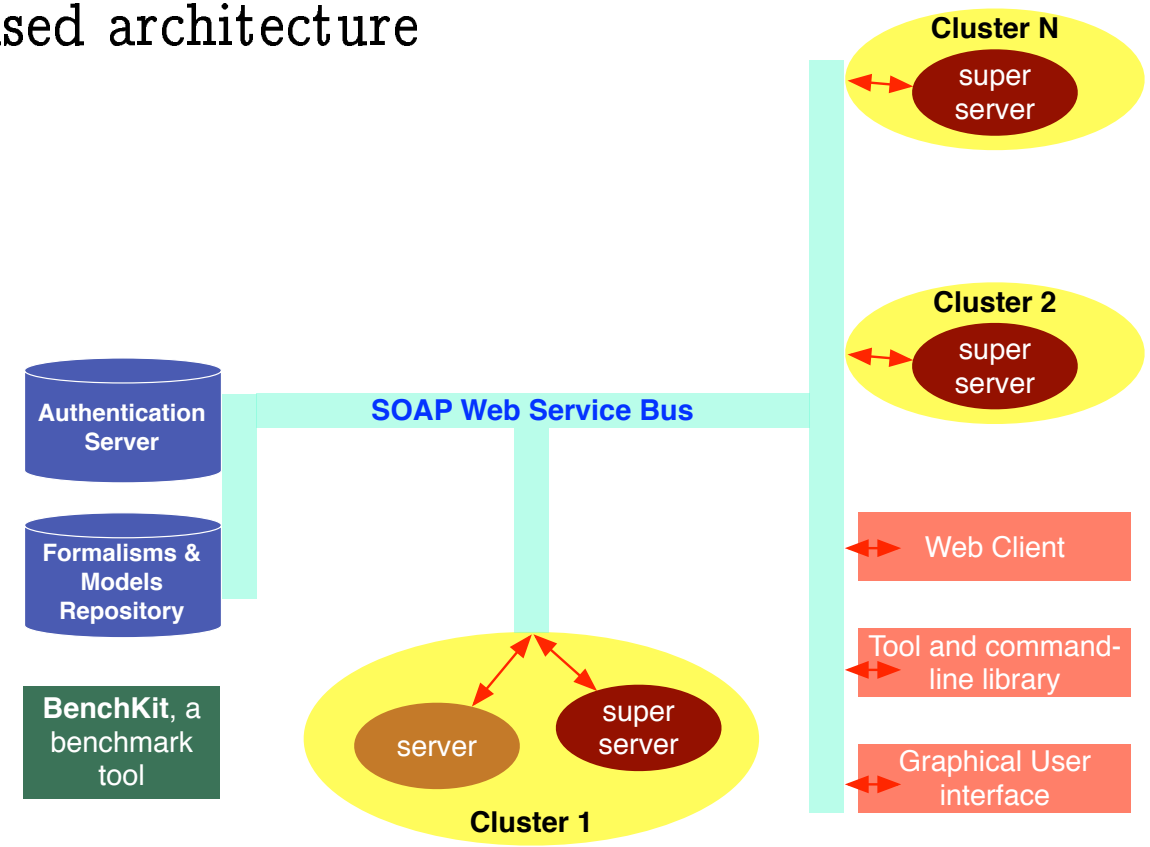
Web-services Client-Server Architecture

- Easy to install: simple and light multi-platform client connecting to servers



Web-services Client-Server Architecture

- Tool invocation through Web services transparent to the end-user
- Cloud-based architecture



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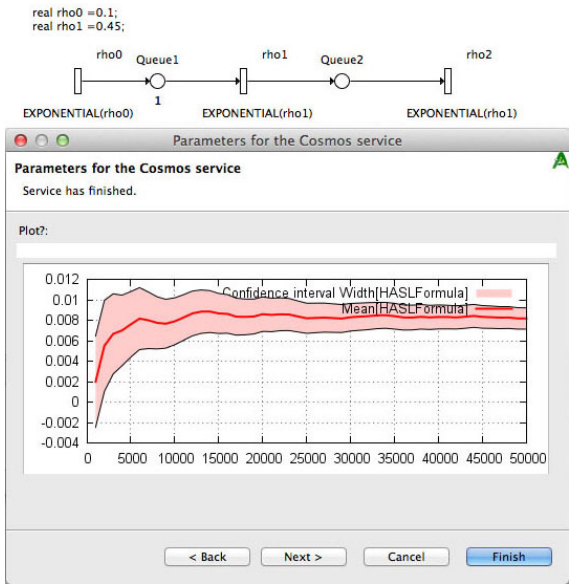
Tools Integration in CosyVerif

Numerous tools integrated to CosyVerif

- One official client: Coloane (platform-independent)
- 6 tools and 9 integrated services
  - Integration via Web services: easy to use and compose
- Multiple formalisms supported (Petri nets and extensions, hybrid automata, timed automata. . . and more!)

Statistical model checker [Ballarini et al., 2011]

- Input: Generalised Stochastic Petri Nets with general distribution (GSPN) and a Hybrid Automaton Stochastic Logic (HASL) formula
- Output: Statistical estimation of the formula with a confidence interval



State space generation & CTL verification [Colange et al., 2011]

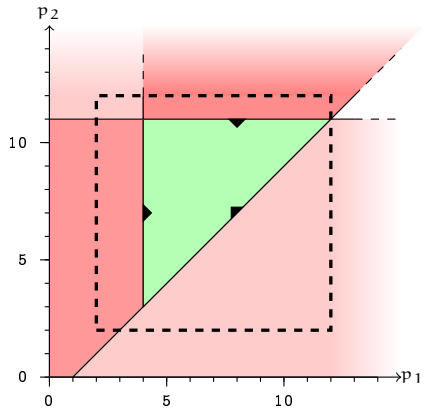
- Symbolic/symbolic approach based on Symmetric Nets with Bags [Haddad et al., 2009]
- Two symbolic techniques to counter state space explosion
  1. symmetries to reduce the reachability graph [Chiola et al., 1991]
  2. hierarchical Set Decision Diagrams to store the reachability graph [Couvreur and Thierry-Mieg, 2005]

Unfolding-based verification of Petri nets with read arcs (contextual nets) [Baldan et al., 2012]

- Features
  - Unfolding construction tool [Rodríguez et al., 2011]
  - Reachability and deadlock checking tool [Rodríguez and Schwoon, 2012]
- Characteristics
  - Unfoldings fully represent the state space of a c-net by a partial order rather than by a set of interleavings
    - ★ Often exponentially smaller than the state space, and never larger
  - c-net unfoldings can be exponentially more compact than those of corresponding Petri nets [Baldan et al., 2012]

Parameter synthesis for real-time systems [André et al., 2012]

- Quantitative robustness analysis
  - "Can we increase some of the timing delays such that the system still behaves well?"
- Schedulability analysis
- Hybrid system verification



Construction and analysis of modular state spaces

[Lakos and Petrucci, 2004]

- Modular State Spaces for Synchronised Automata
  - synchronisation structure
  - only reachable parts of the automata
- Analysis
  - forward and backward reachability
  - deadlock-checking
  - liveness

State space generation and CTL formulæ evaluation on P/T nets [Hong et al., 2012]

- Handles Symmetric Nets through their unfolding into an equivalent P/T net
- Exploits hierarchy: a state is seen as a tree, where the leaves correspond to place markings
- Relies on Set Decision Diagrams [Couvreur and Thierry-Mieg, 2005]

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An Open Environment

- Entirely open source
- Open to contributions
  - Tool integration
  - Alternative clients
  - New formalisms
- A repository of models using a common syntax
  - Coming from the integrated tools, and the model checking contests [Kordon et al., 2013]

Recent and Ongoing Evolutions

- Asynchronous tool invocation
  - Get the result later (e.g., by email)
- Federation of servers and use of clusters
  - Enable load balancing
- Repository of formalisms and models
- Command-line version of the underlying platform

Future Evolutions

- Enhanced interaction between tools
  - Output of a tool as input of another one
- Handling semantics (bridges between formalisms)
  - Also allows system simulation
- Handling heterogeneous models (mixing different formalisms)

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Try it!

http://cosyverif.org/

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