The OMPCM Simulator for Model-Based Software Performance Prediction

A Model-Driven Approach for Combining Network and Software Architecture Simulation

Jörg Henß, Philipp Merkle and Ralf H. Reussner | March 5, 2013
Motivation: Palladio Component Model

- Palladio Component Model (PCM)
  - Component-based software architecture
  - Captures performance-relevant behaviour
  - Prediction of performance and reliability
- Tool Support
  - Eclipse-based UI: Palladio-Bench
  - Simulators and analytical solvers

www.palladio-simulator.com
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Problem: Only trivial simulation for network communication

→ Use existing network simulation
Model-driven Process

- Integrates OMNeT++ with the PCM
- Model-driven approach
  - SimCore intermediate model
  - Model transformations
- Integrated seamlessly
  - No manual editing required
  - Launch OMPCM from Palladio-Bench
  - Import simulation results
Model-driven approach

SimCore Model

- Simplistic intermediate model
  - Comprises reduced set of operations
  - Remove redundancies
  - Complex operations are composed
- Simplifies simulation development
Model-driven approach

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Model-to-Model Transformation (QVT-O)

- Converts Palladio to SimCore
- Creates NED compatible model
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Model-to-Text Transformation (Xtext)

- Creates a textual NED File
- Derived from adapted NED grammar
Implementation

OMPCM SimCore: Provides control-flow elements, message position denotes current instruction

OMPCM Net: Bridges between SimCore and INET, provides component proxies
Validation

- Based on comparison to reference simulator
  - Uses MediaStore case-study
  - Single user and multi user scenarios
  - Response time & resource utilisation

→ OMPCM yields consistent Results

- Simulation up to 20% faster
- Differences due to different PRNGs

Influence of Network:
- Scenarios are sensitive to network
- Simulation takes ~10 times longer
Conclusion and Future Work

Contributions

- Software architecture performance simulator based on OMNeT++
  - Detailed simulation of network influences
  - Usable for load generation on existing network models
- Model-driven process
  - Uses model transformations
  - Enables seamless integration
  - Can be applied to other domains

Future Work

- Further studies on impact of network influences
- Integration of the OverSim network implementation
First results - 10 vs. 100Mbps vs 1Gbps

Cumulative Distribution Function

Motivation Overview Transformations Implementation Validation Conclusions

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First results(3)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Mean</th>
<th>Stddev</th>
<th>Variance</th>
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<tbody>
<tr>
<td>10Mbps</td>
<td>209.099</td>
<td>168.4204</td>
<td>28365.4144</td>
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<tr>
<td>100Mbps</td>
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<td>1Gbps</td>
<td>9.7218</td>
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Table: MediaStore response times