OMPCM

An OMNet++ simulator for Palladio

Jörg Henß | November 9, 2012
Yet another Simulation?

Network support
Communication essential for distributed systems
State of Palladio networking insufficient

Idea
Create simple simulation platform
experiment with performance influence of networks
rapid prototyping of new simulation elements

→ use a full fletched network simulation framework!
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OMNeT++

- implemented in C++
- matured network model
- many experimental extensions
- advanced visualisations
- uses textual syntax for model definition
- academic license
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Good match for palladio

- module/component based
- has notion of interfaces and ports
- Eclipse based IDE
Problem

- Palladio has high simulation complexity
- many modeling elements
- simulation semantics “underspecified”
Simplified Model

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The RISC Idea
- simplicity and regularity
- used as internal microcode engine
- include only those instructions really used
- complex instructions mapped to simple ones

→ create SimCore model for Palladio
Examples: Branch
Examples: ExternalCall

DownloadSCA_vMVroGF7Ed60Nobv0olepQ_enter

DownloadSCA_vMVroGF7Ed60Nobv0olepQ_request_NUMBER_OF_ELEMENTS

DownloadSCA_vMVroGF7Ed60Nobv0olepQ_ExternalCall

DownloadSCA_vMVroGF7Ed60Nobv0olepQ_exit
Examples: ExternalCall

```
ExternalAction

sender
receiver
```
# Simulation Prototype

## OMPCM-Variables
- Stack handling
- Evaluation of stochastic expressions (StoEx-C)

## OMPCM-Core
- Dynamic behavior (ExtQueueing)
- Represents SimCore

## OMPCM-Net
- Network bindings

## OMNeT++
- Provides static structure
- Textual syntax & IDE

Motivation | Principles | State of Development | Evaluation | Conclusion
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OMPCM network elements

- component proxy
- proxy client
- app server
- call handler
Workflow

transform models

import results
Transformation

Translation of Palladio models to OMNeT++

- OMNeT++ based on a grammar
- derive metamodel using XText
- M2T transformation for free

SimCore Transformation

- QVT-O M2M transformation
- ~ 2800 Lines of Code
- modular designed: with and w/o full network model
Support OMNeT++ SCAVE format (experimental)

- visualise results using SensorFramework
- compare runs e.g. to SimuCom
Some Results

Histogram

Cumulative Distribution Function

- Response Time of defaultUsageScenario
- mediastoreRepository.defaultUsageScenario.ClosedWorkloadDriver_defaultUsageScenario_TyVminusMFb6365ActL8Gd1_A-work

Motivation  Principles  State of Development  Evaluation  Conclusion

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Some Results cont’d

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Simulation Performance

Simulation time
- SimuCom 7.38s
- OMPCM (no net): 6.29s
- OMPCM (net): 24m 55s

Generated events
- OMPCM (no net): 124272
- OMPCM (net): 96374348

Memory footprint
- SimuCom: ???
- OMPCM: ~80 MB
Evolved Questions

- connection strategies
  - pooling
  - connection per request
  - connection per call

- how handle limited sockets
  - too realistic?

- how model different kinds of clients
  - client communication even relevant for us?
  - modeling the internet delay space
  - possible solution: Lookup table for network setup

- replication of server nodes
  - load balancing
  - content switching
Conclusion

Insights

- OMNeT++ is versatile
- detailed network simulation is expensive
- many aspects of networking still unclear in Palladio

Roadmap

- automate transformation using WFE
- validate implementation → call for case studies
- create a simple native network scheduler for Palladio
Experiments

- Client communication
  - Central client population
  - Distributed client population
  - No client communication

- Influence of bandwidth
  - 10Mbps vs. 100Mbps

- Removal of network layers
  - Raw TCP communication

- Influence of packet errors/reliability
  - Currently not working
First results - 10 vs. 100Mbps

Workload duration

- Standard
- Combined
- Raw
- No Network

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First results(2)

[Diagram showing two graphs with axes ranging from 0 to 120 on the x-axis and from 0.00 to 0.30 on the y-axis. The graphs compare 'No Network' and 'Standard' with 'Raw' and 'Combined' data sets.]

Motivation Principles State of Development Evaluation Conclusion
### First results(3)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>10Mbps</th>
<th>100Mbps</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Net</td>
<td>Full Net</td>
</tr>
<tr>
<td>Time</td>
<td>00:00:03</td>
<td>00:06:14</td>
</tr>
<tr>
<td>Requests</td>
<td>1002</td>
<td>311</td>
</tr>
<tr>
<td></td>
<td>00:00:03</td>
<td>00:12:49</td>
</tr>
<tr>
<td>Request</td>
<td>1002</td>
<td>585</td>
</tr>
</tbody>
</table>

**Table:** Simulation times and throughput