Karlsruhe Institute of Technology

Software Design and Quality

OMPCM

An OMNet++ simulator for Palladio

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CHAIR FOR SOFTWARE DESIGN AND QUALITY

Yet another Simulation?

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Network support

- Communication essential for distributed systems
- State of Palladio networking insufficient
- No good understanding of network effects

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Idea

Create simple simulation platform

- experiment with performance influence of networks
- rapid prototyping of new simulation elements

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$\rightarrow$ use a full fletched network simulation framework!

OMNeT++

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

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

Simplified Model

Problem

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

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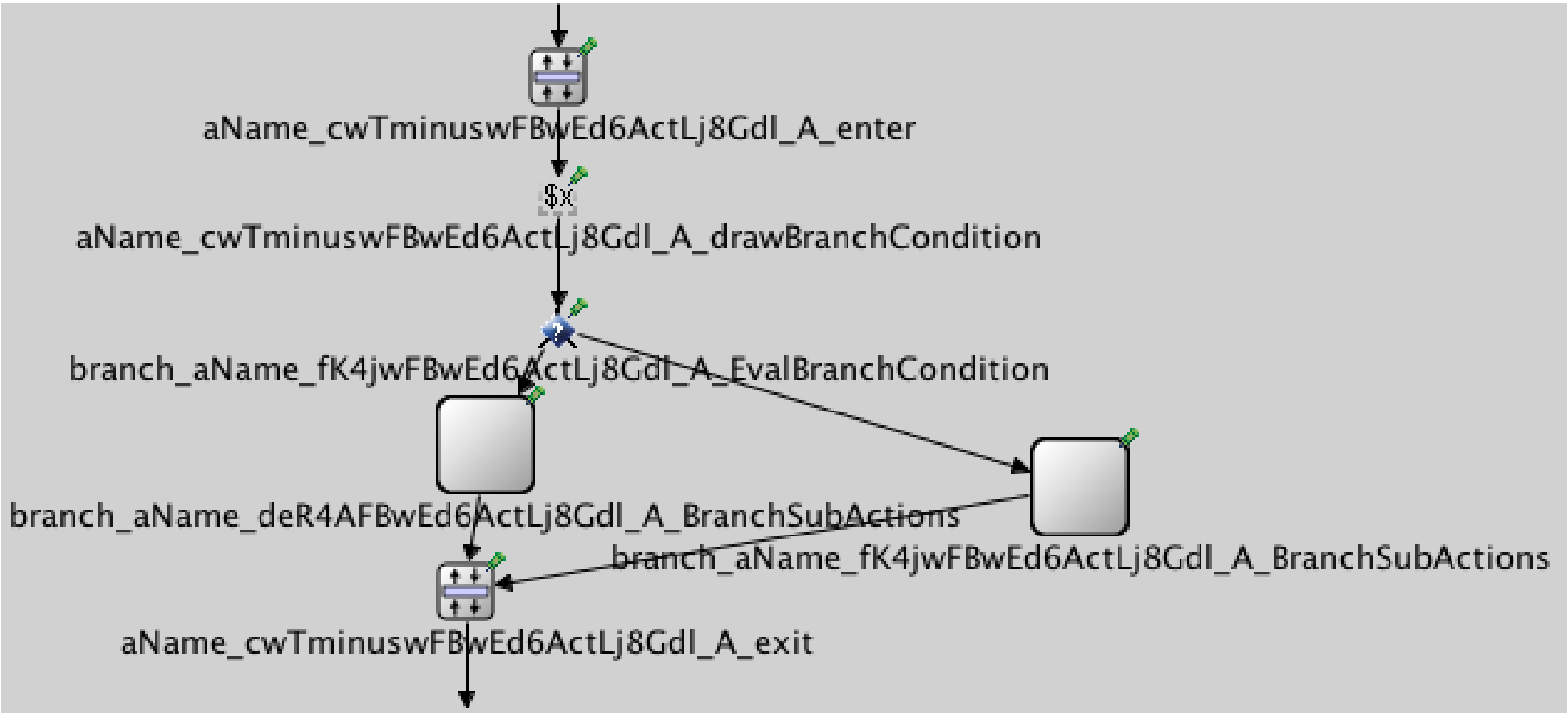
The RISC Idea

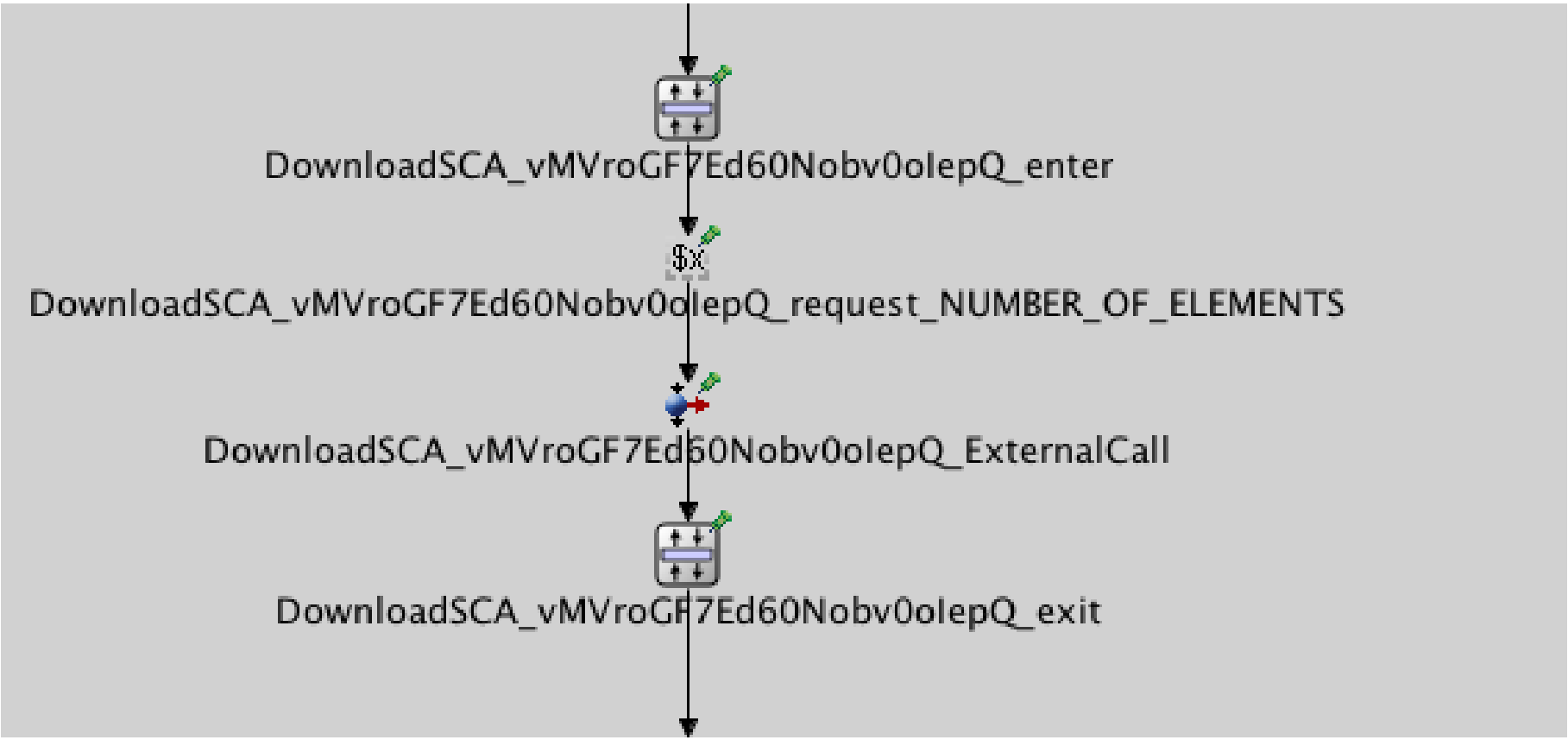
- simplicity and regularity
- used as internal microcode engine
- include only those instructions really used
- complex instructions mapped to simple ones

→ create SimCore model for Palladio

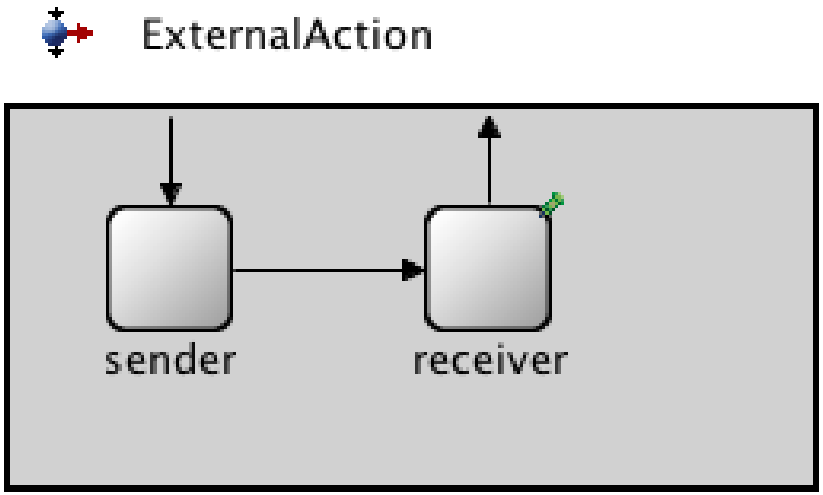
Examples: Branch



Examples: ExternalCall



Examples: ExternalCall



Simulation Prototype

OMPCM-Variables

- Stack handling
- Evaluation of stochastic expressions (StoEx-C)

OMPCM-Core

- Dynamic behavior (ExtQueueing)
- Represents SimCore

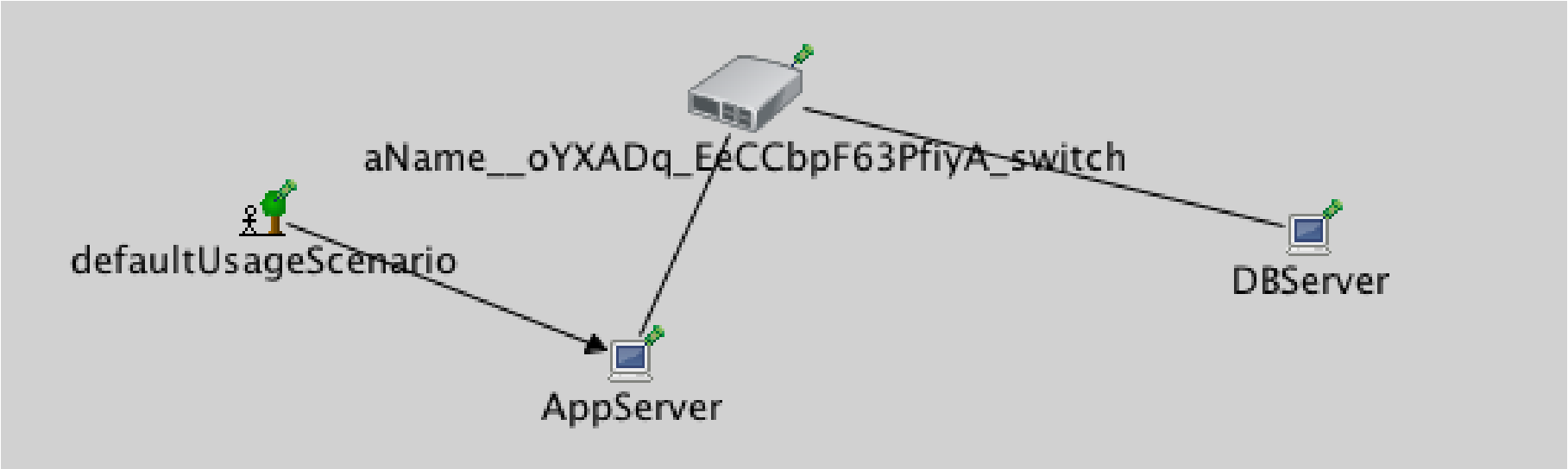
OMPCM-Net

- Network bindings

OMNeT++

- Provides static structure
- Textual syntax & IDE

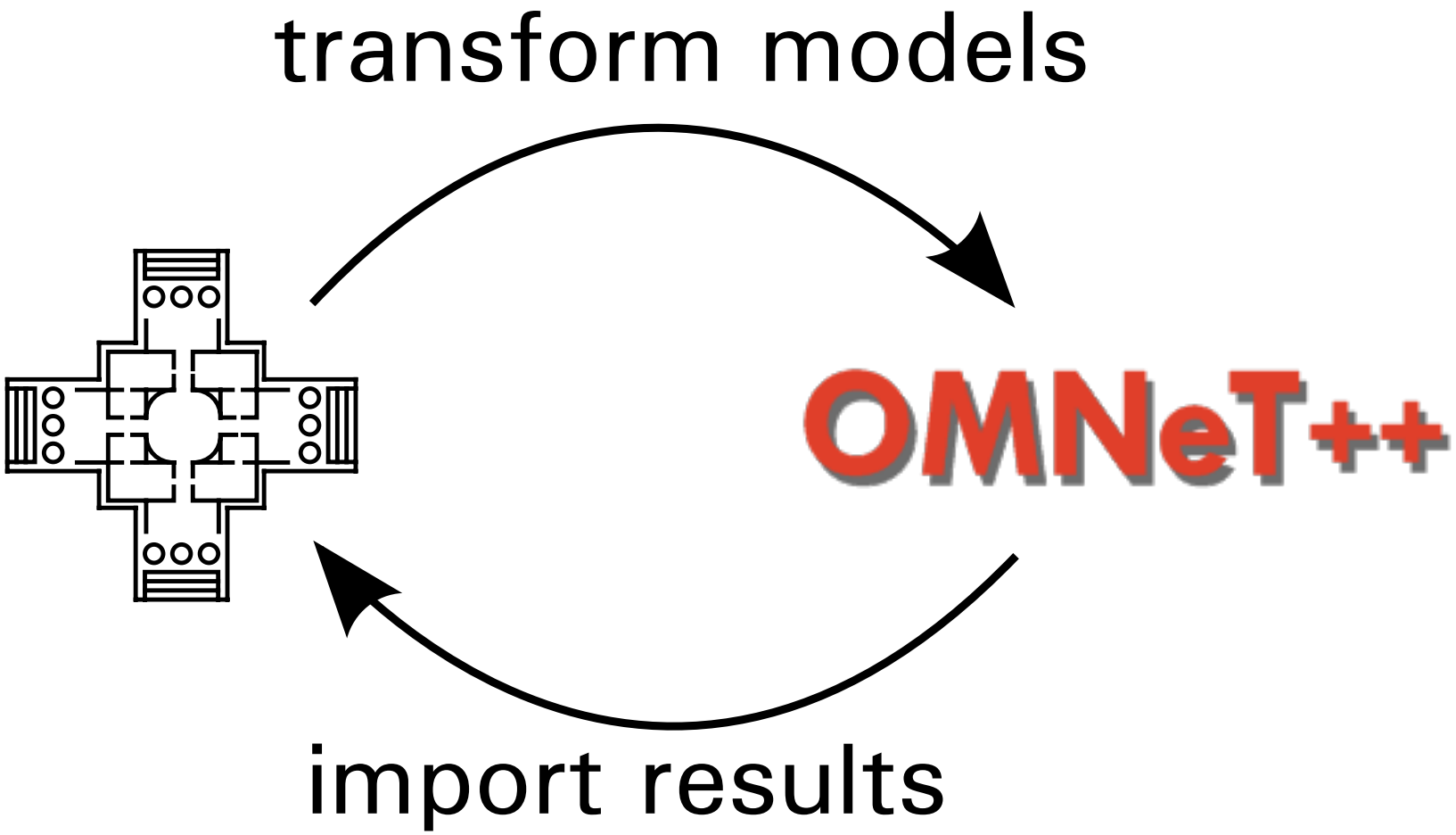
OMPCM-Net



OMPCM network elements

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

Workflow



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
- $\sim$ 2800 Lines of Code
- modular designed: with and w/o full network model

Result Importer

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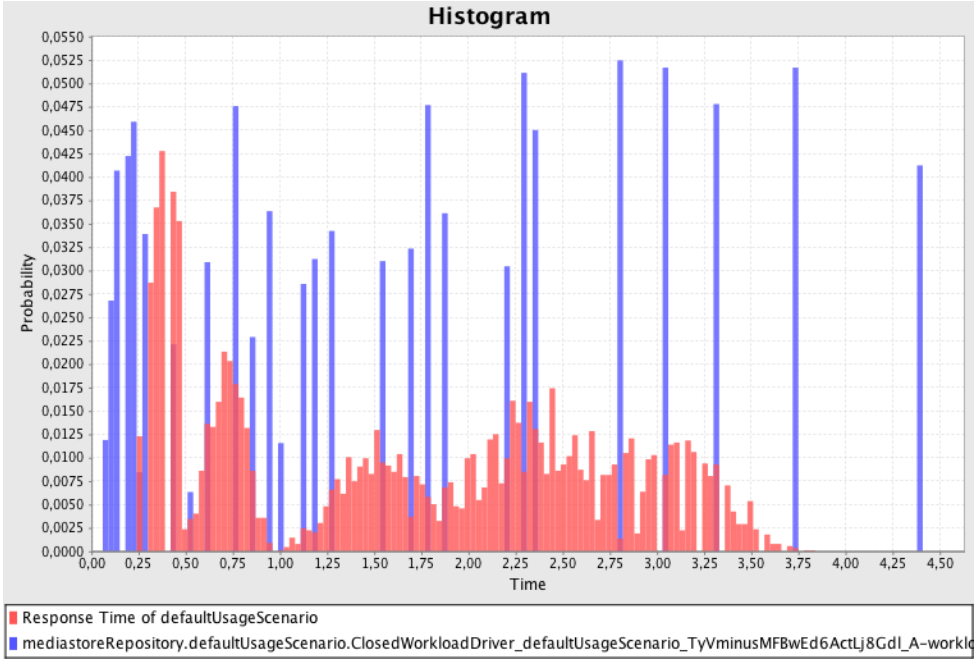
Project Explorer | Experiments View

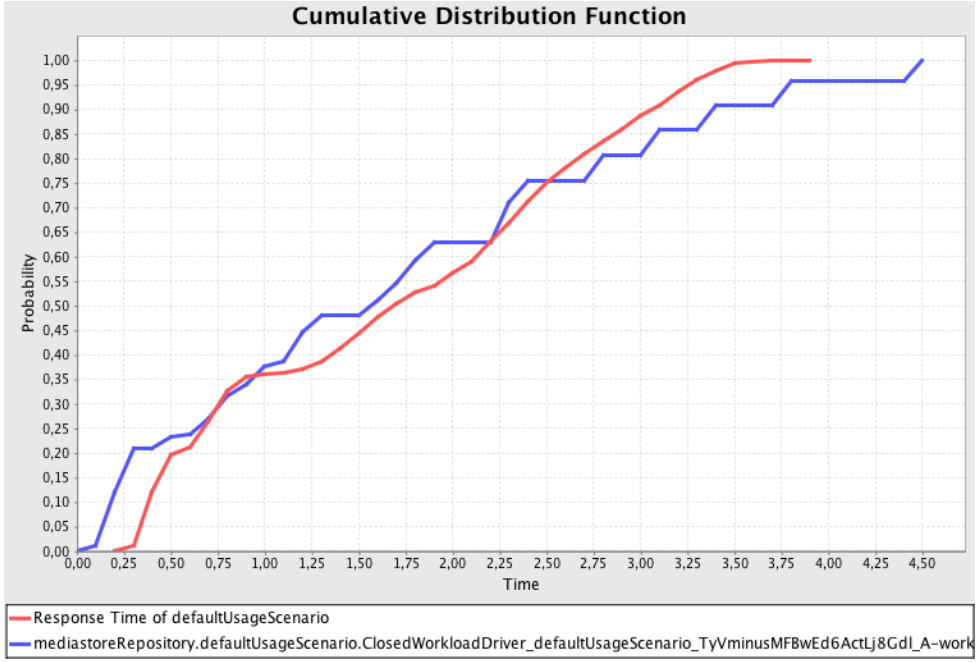
- File Datasource [1] - /Users/joerg/Documents/work/PCM-TestWS/UML2RDBMS/db
- Memory Datasource [0] -
- Scave Datasource [3] -
  - ScaveImport-/Users/joerg/Documents/work/PCM-TestWS/Validate-PCM/ned/results
    - Experiment Runs
      - Simple-0-20121108-11:45:23-14640 [ID:0]
        - defaultRepository.aName.assemblyContainer_aName_Mm1WUCjuEeKeJpnvJSDp1A.Allocation_Assembly_bar_bar_bar_d4minuszkCjuEeKeJpnvJSDp1A.
        - defaultRepository.aName.resourceContainer.CPU__NuapcCjuEeKeJpnvJSDp1A-queueLength:vector [ID:0]
        - defaultRepository.aName.resourceContainer.CPU__NuapcCjuEeKeJpnvJSDp1A-serviceTimeOfJob:vector [ID:2]
        - defaultRepository.aName.resourceContainer.HDD__QfhfICjuEeKeJpnvJSDp1A-queueLength:vector [ID:1]
        - defaultRepository.defaultUsageScenario.ClosedWorkloadDriver_defaultUsageScenario_k3qc8CjuEeKeJpnvJSDp1A-workloadTime:vector [ID:4]
    - Sensors

Support OMNeT++ SCAVE format (experimental)

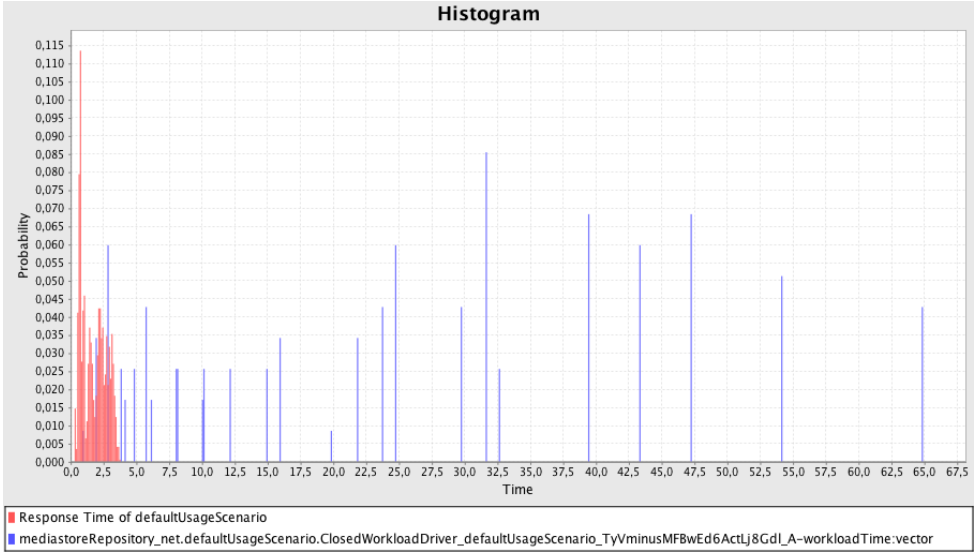
- visualise results using SensorFramework
- compare runs e.g. to SimuCom

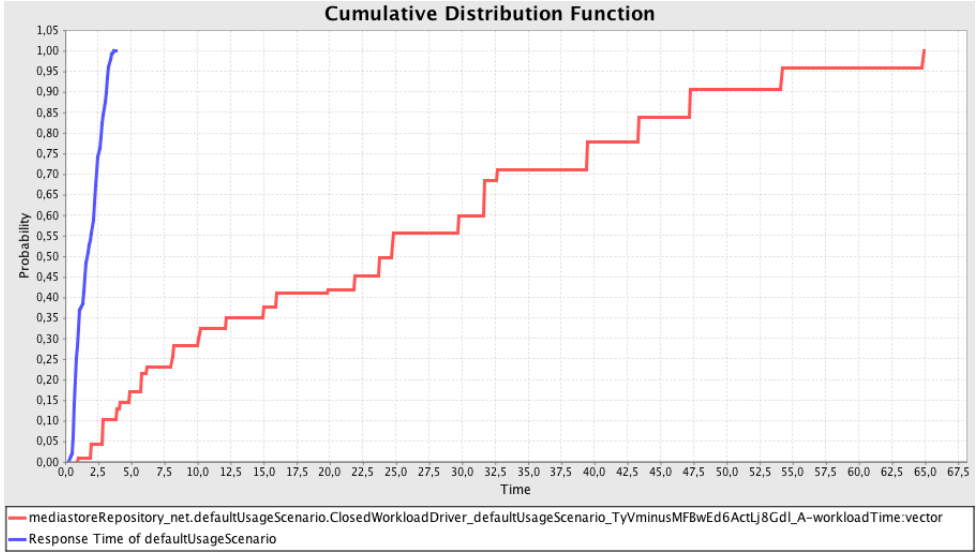
Some Results





Some Results cont'd





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

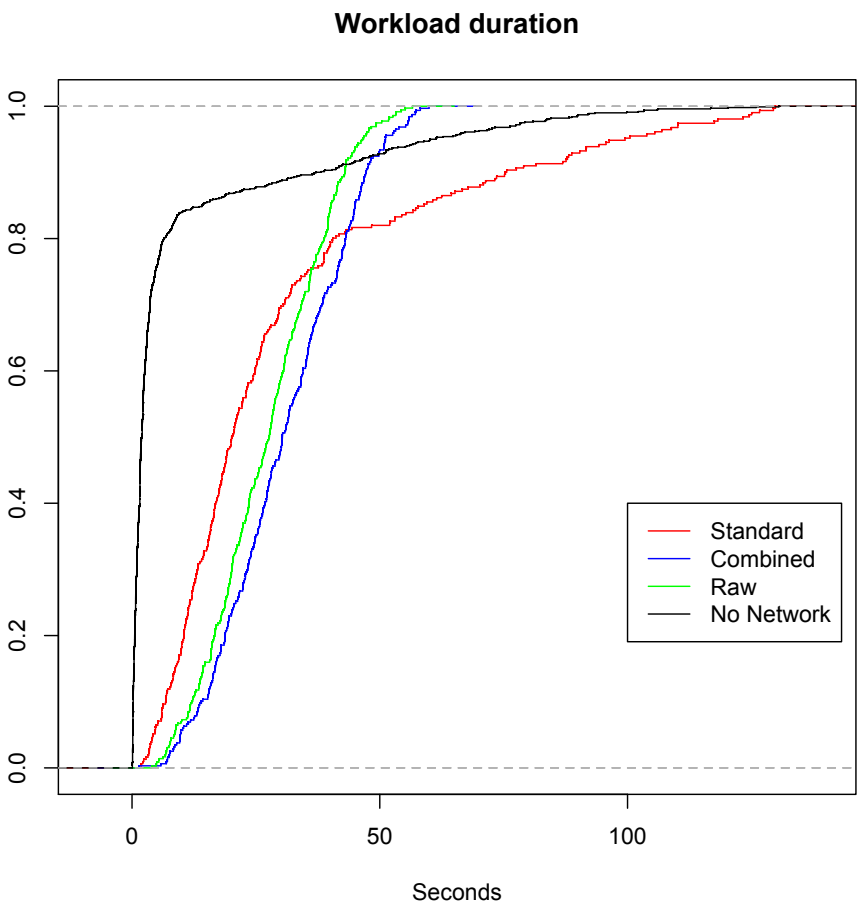
Roadmap

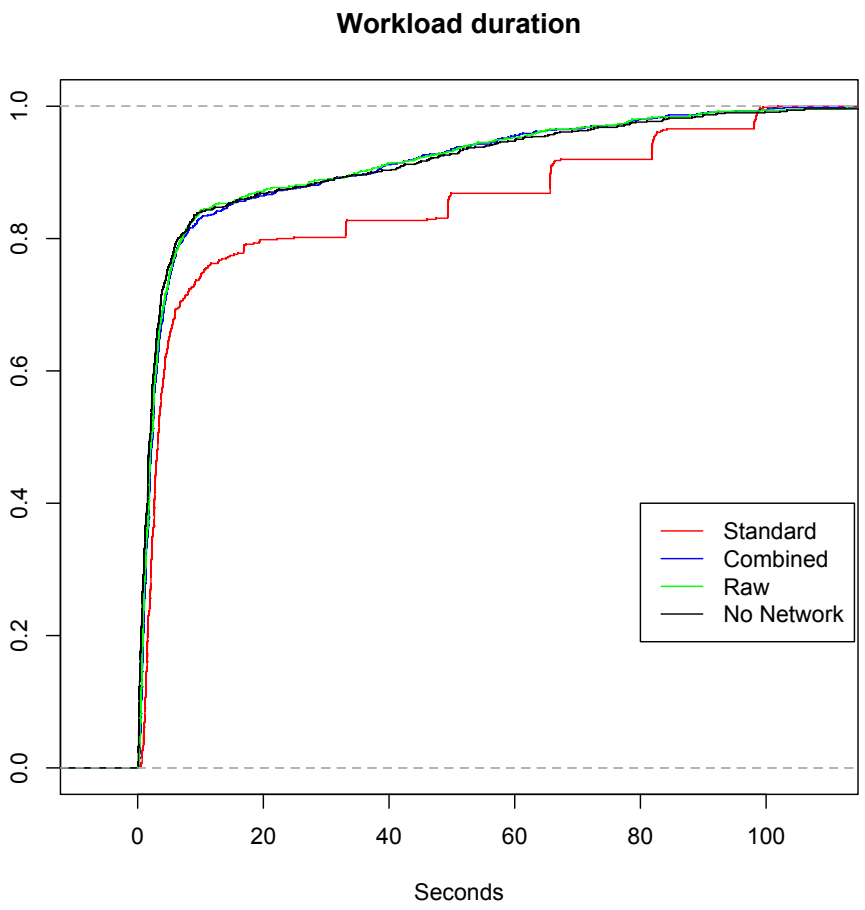
- automate transformation using WFE
- validate implementation $\rightarrow$ call for case studies
- create a simple native network scheduler for Palladio

Experiments

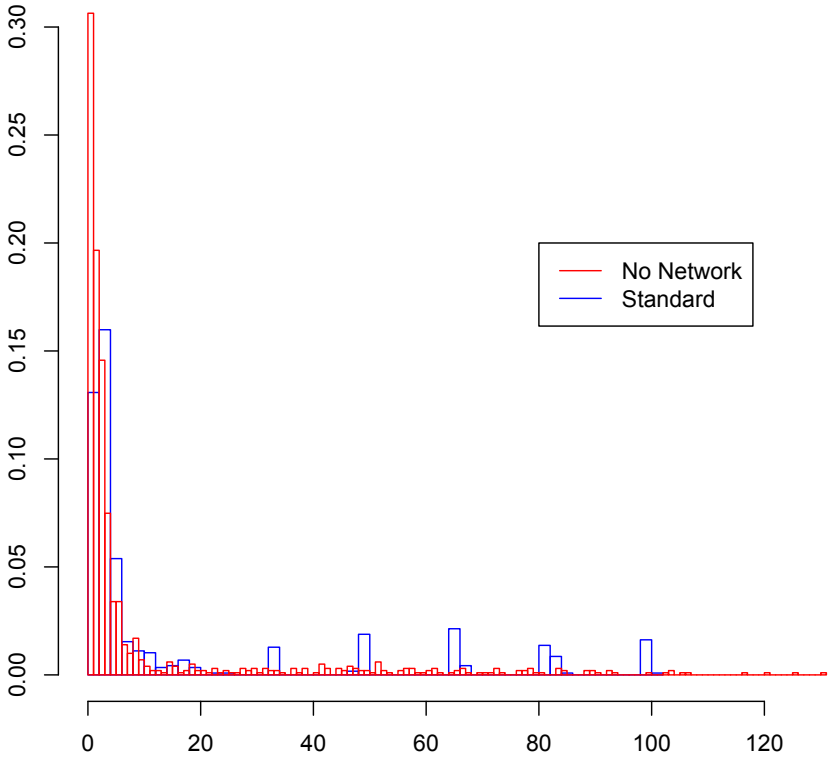
- Client communication
  - Central client population
  - Distributed client population
  - No client communication
- Influence of bandwidth
  - 10Mbps vs. 100Mbps
- Removal of network layers
  - Raw TCP communication
- Influence of packet errors/reliability
  - Currently not working

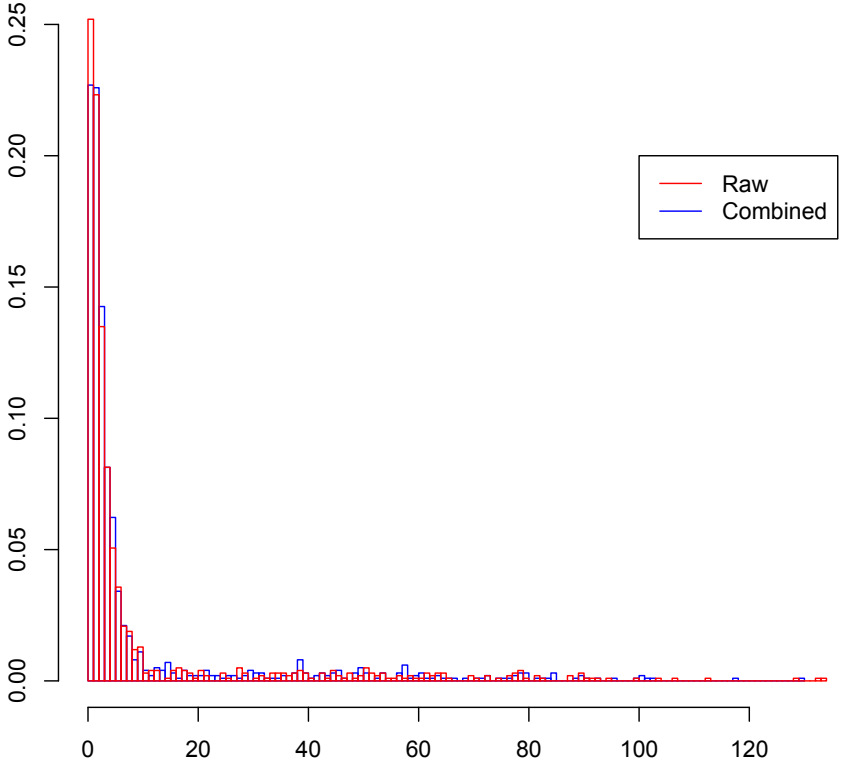
First results - 10 vs. 100Mbps





First results(2)





First results(3)

Scenario 10Mbps	No Net	Full Net	Combined	CU w/o SW	RAW
Time	00:00:03	00:06:14	00:05:12	-	00:01:45
Requests	1002	311	318	-	357
100Mbps					
Time	00:00:03	00:12:49	00:18:34	00:14:13	00:04:52
Request	1002	585	996	1000	1008

Table : Simulation times and throughput