

Master Thesis:

A Comprehensive Grid and Network Simulation Tool for Workflow based Applications

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Introduction

Implementation

GWS

GSS

Demonstration

Conclusion

Road Map I

Introduction

Implementation

GWS

GSS

Demonstration

Conclusion

Introduction

Implementation

GWS

GSS

Demonstration

Conclusion

Introduction

Simulating Workflow Applications

- ▶ Model parallel and distributed systems
- ▶ Task execution simulation
- ▶ Data transfer simulation

GSWS

- ▶ Simulates workflow based applications on defined network topologies
- ▶ Uses the ns2 network simulator for network simulation

Introduction

Implementation

GWS

GSS

Demonstration

Conclusion

Motivation

Related Work

- ▶ Bricks
- ▶ GridSim (SimJava)
- ▶ SimGrid
- ▶ GridNet (NS2)

Conclusion

- ▶ Simulate scheduling algorithms
- ▶ Simulate data replication strategies
- ▶ Use no packet Abstraction
- ▶ Have no appropriate packet schedulers
- ▶ Lack modeling network devices
- ▶ Have no protocol stacks
- ▶ Use no application models

Introduction

Implementation

GWS

GSS

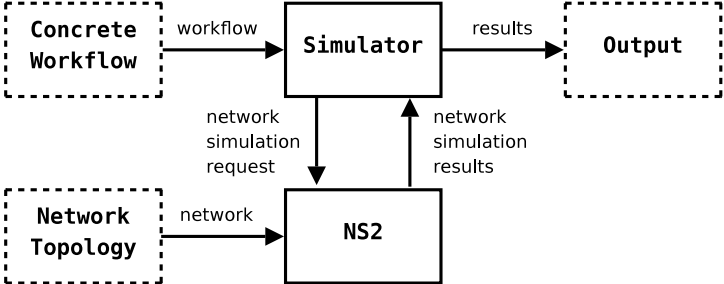
Demonstration

Conclusion

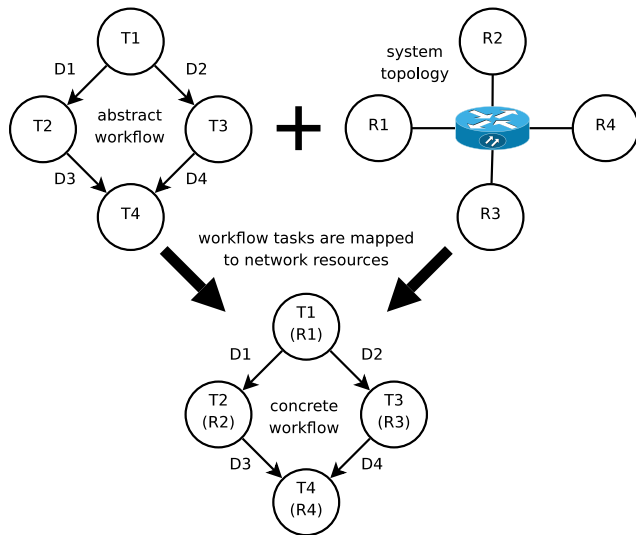
Grid Scene Workflow Simulator (GSWS)

- ▶ Grid Workflow Simulator (GWS)
 - ▶ Workflow task execution simulation
 - ▶ Workflow data transfer simulation
- ▶ Grid Scene Simulator (GSS)
 - ▶ Workflow scenario simulation
 - ▶ Simulating various workflows
 - ▶ Parametrised workflow simulation

Grid Workflow Simulator



Workflow Foundations



```
<gridWfSim>
  <compRes>
    <resDef id="1">
      <name>Workstation1</name>
      <mapping>n(1)</mapping>
      <cpus>1</cpus>
      <mem>1</mem>
      <costs>1.0</costs>
    </resDef>
  </compRes>
</gridWfSim>
```

Introduction

Implementation

GWS

GSS

Demonstration

Conclusion

Job Definitions

```
<gridWfSim>
  <compJobs>
    <jobDef id="1">
      <resId>1</resId>
      <prio>0</prio>
      <timing>
        <submit>0.0s</submit><wait>2.5s</wait>
        <run>6.0s</run>
      </timing>
      <spec>
        <dataDeps><dataId>4</dataId></dataDeps>
        <cpus>1</cpus><mem>1</mem>
      </spec>
    </jobDef>
  </compJobs>
</gridWfSim>
```

[Introduction](#)[Implementation](#)[GWS](#)[GSS](#)[Demonstration](#)[Conclusion](#)

```
<gridWfSim>
  <compData>
    <dataDef id="1">
      <dataSize>10Mb</dataSize>
      <sourceJobId>1</sourceJobId>
      <sinkJobId>2</sinkJobId>
    </dataDef>
  </compData>
</gridWfSim>
```

Introduction

Implementation

GWS

GSS

Demonstration

Conclusion

Topology & Traffic Definitions

```
Agent/TCP set window_ 100
Agent/TCP set packetSize_ 1500

array set n {}
createDumpbellTopo n 2 10Mb 10ms DropTail \
                    1Mb 1ms DropTail

set traffic(1) [paretoTraffic $r1 $r2]
set traffic(2) [paretoTraffic $r1 $r3]
$ns at $now "$traffic(1) start"
$ns at $now "$traffic(2) start"
```

[Introduction](#)[Implementation](#)[GWS](#)[GSS](#)[Demonstration](#)[Conclusion](#)

Simulator

- ▶ Uses workflow data to generate TCL script for ns2 network simulator.
- ▶ Data transfers are realised as FTP-Data-Transfers.
- ▶ Init ns2 networks simulator.
- ▶ Starts with job scheduling.

Job-Scheduler

- ▶ Checks resource parameters before executing a job on a specific resource.
- ▶ Job-Queue: FIFO with priorities.

Job-Scheduler-Loop

- ▶ Schedules workflow jobs
- ▶ Sends data transfers start requests to ns2.
- ▶ Gets responses back from ns2.
- ▶ Runs until all data transfers are finished.

[Introduction](#)[Implementation](#)[GWS](#)[GSS](#)[Demonstration](#)[Conclusion](#)

Results

Introduction

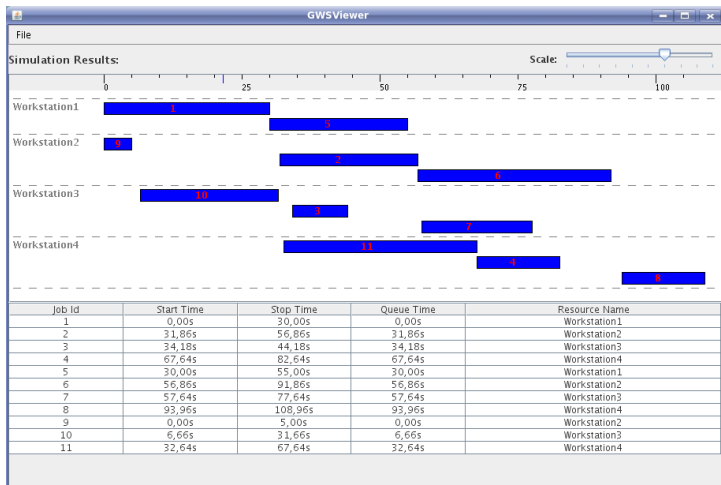
Implementation

GWS

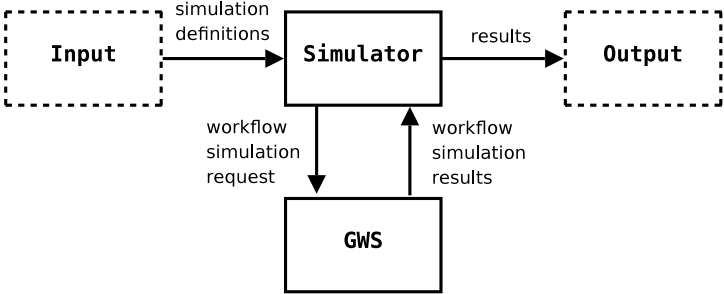
GSS

Demonstration

Conclusion



Grid Scene Simulator



Scenario Definition I

```
<gss>
  <scenes>
    <sceneDef id="1">
      <input>
        <path>testdata/scene1</path>
        <wf>wf.xml</wf>
        <topo>topo.tcl</topo>
        <traffic>traffic.tcl</traffic>
      </input>
      <output>
        <path>gen/scene1</path>
        <script>script.tcl</script>
        <results>results.xml</results>
      </output>
    </sceneDef>
  </scenes>
</gss>
```

Introduction

Implementation

GWS

GSS

Demonstration

Conclusion

Scenario Definition II

```
<loops>
  <loop id="1">
    <var id="1">
      <tclVar>starnum</tclVar>
      <start>2</start>
      <stop>3</stop>
      <step>1</step>
    </var>
  </loop>
</loops>
</sceneDef>
</scenes>
</gss>
```

Introduction

Implementation

GWS

GSS

Demonstration

Conclusion

- ▶ Parses and generates all workflow scenarios
- ▶ Uses the GWS to simulate all workflow scenarios

Simulator-Loop

- ▶ Init GWS
- ▶ Parses input files for workflow scenario
- ▶ Simulate loops iteratively
- ▶ Update workflow variables based on loop definitions
- ▶ Simulate updated workflow scenario with GWS.

Introduction

Implementation

GWS

GSS

Demonstration

Conclusion

Results

Introduction

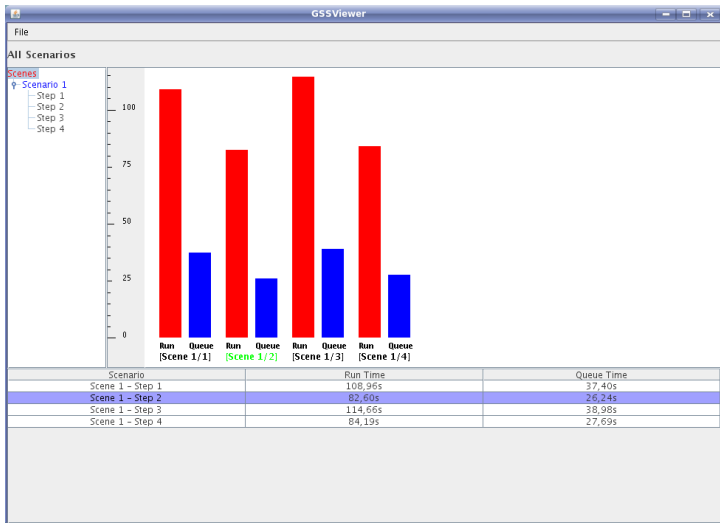
Implementation

GWS

GSS

Demonstration

Conclusion



Introduction

Implementation

GWS

GSS

Demonstration

Conclusion

LIVE DEMONSTRATION!

Conclusion

Grid Workflow Simulator (GWS)

- ▶ Simulate workflow based applications on defined network topologies
- ▶ Task execution simulation
- ▶ Data transfer simulation based on ns2

Grid Scene Simulator (GSS)

- ▶ Simulates various workflows
- ▶ Parametrised workflow simulation
- ▶ Graphical User Interfaces to analyse results

Introduction

Implementation

GWS

GSS

Demonstration

Conclusion

The End

Introduction

Implementation

GWS

GSS

Demonstration

Conclusion

Thank you for your attention!