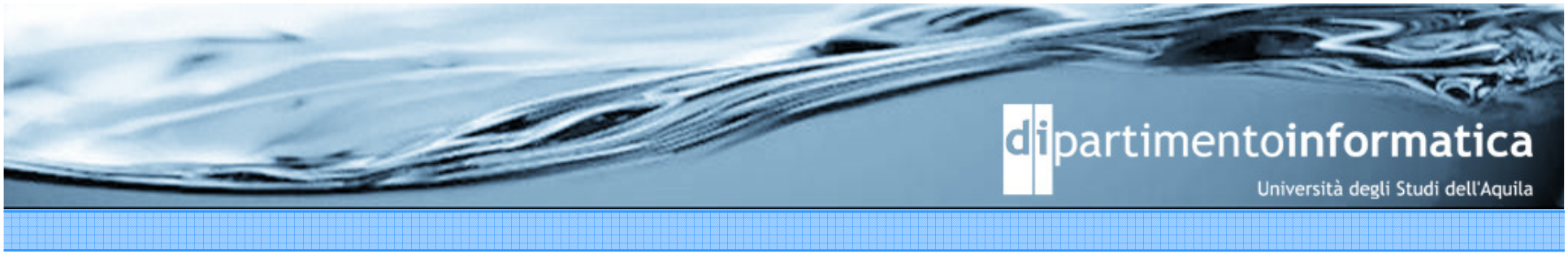


# MOSQUITO

## MOdel driven conStruction of QUeuIng neTwOrks

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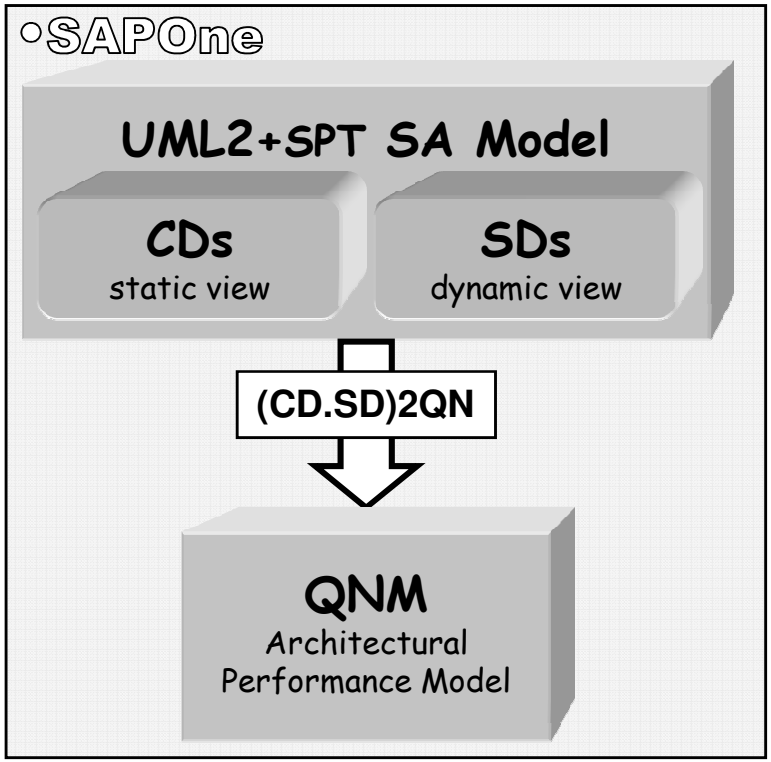
# Problem: Model Driven Performance Engineering

- **GOAL**: Supporting **Performance Engineering (PE)** of distributed component-based applications in Model Driven Processes;
- **SAP·one** (Software Architecture Performance Analysis) and **PRIMA-UML** (PeRformance IncreMental vAlidation in UML) are two **methodologies supporting PE** for component-based systems;
- **MOSQUITO** (MOdel driven conStruction of QUeuIng neTwOrks) **is** a **web service CASE tool** for SAP·one and PRIMA-UML. It allows the **automated generation of** XML-based **performance models** (EG, QN) starting **from** an **EclipseUML-based** system design **model**.

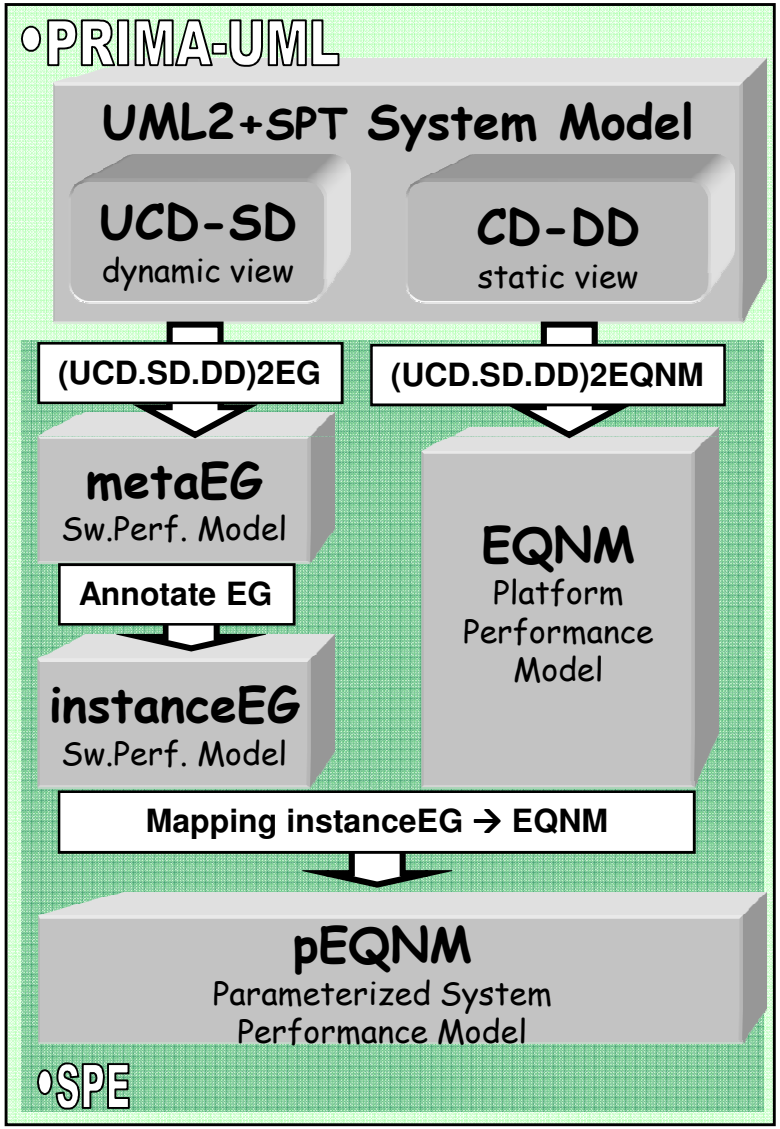
# The Methodologies: SAP·one

- **INPUT:**
  - **UML** Design Model representing a **Software Architecture** (Component and Sequence Diagrams)
  - Performance additional info (by PAprofile ⊂ UML SPT)
- **OUTPUT:**
  - **Queuing Network Model (QNM)** representing an Architectural Performance Model (Service Center = UML Component)
- **GOAL**: It allows to **distinguish different architectural choices**



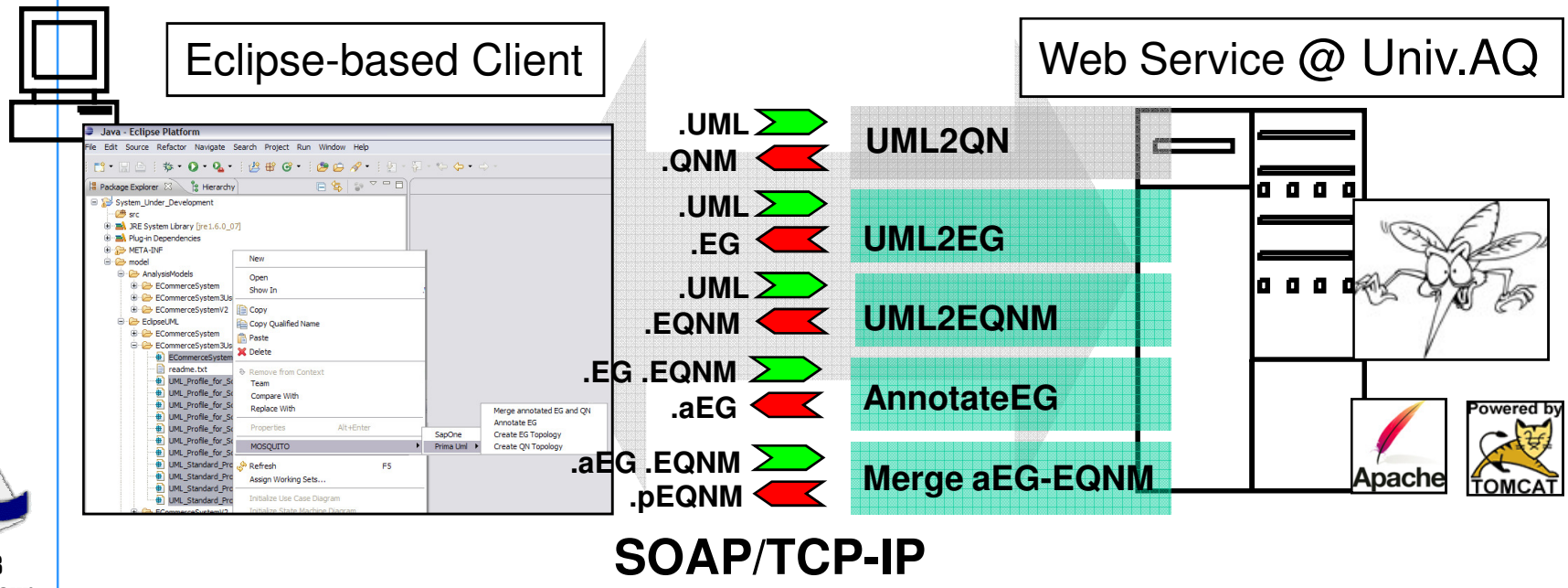
# The Methodologies: PRIMA-UML

- **INPUT**:
  - **UML** System Model (UCD, CD, SD, DD)
  - **Performance additional info** (by PAprofile ⊂ UML SPT)
- **INTERMEDIATE MODEL**:
  - **Execution Graphs**: flows of component operation invocations (metaEG) and sw resource consumption (instanceEG)
- **OUTPUT**:
  - **Extended Queuing Network Model** (Service Center = Hw resource)
- **GOAL**: It allows to distinguish different system (hw/sw) configurations.



# MOSQUITO for SAP·one and PRIMA-UML

- MOSQUITO is a **Web Service CASE tool**.
- Its **client-side is a Eclipse plug-in** that invokes remote model2model transformations on the server-side located at University of L'Aquila.






*MOSQUITO* - MOdel driven conStruction of QUeuIng neTwOrks

# Conclusions and Future Works

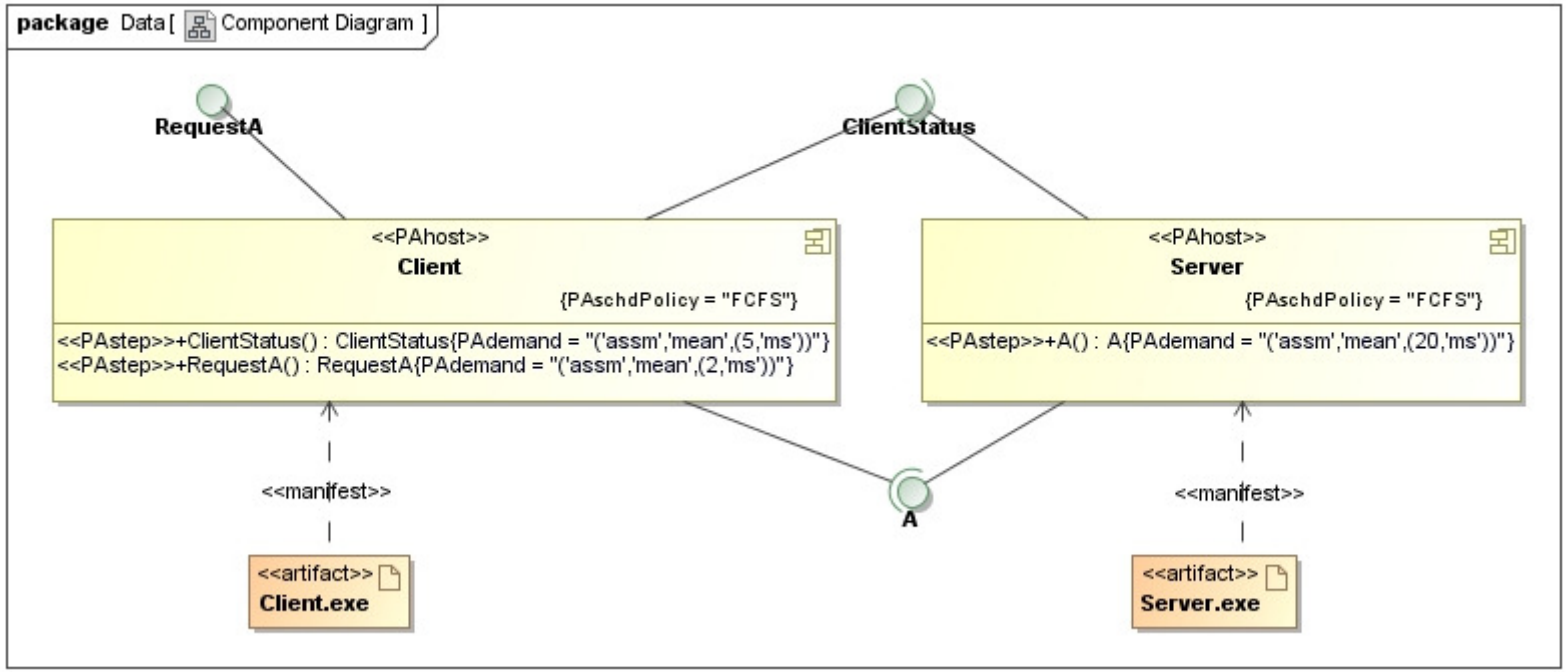
- Replace SPT with **MARTE**.
- Adoption of a Model Management Platform (an Eclipse-based one, e.g. **AMMA**);
- Using a DSL for model2model transformation specification in place of OO Programming Languages (e.g. replace Java with **ATL**)
- Integrating MOSQUITO with other Model Generator Tool for **other Non Functional Analyses** (e.g Reliability using the **DAM** (sub)profile for MARTE);
- Integrating analysis results interpretation.

# Example 1: MagicDraw UML Model

- **Step 1**: Use Case Diagram with Operational Profile

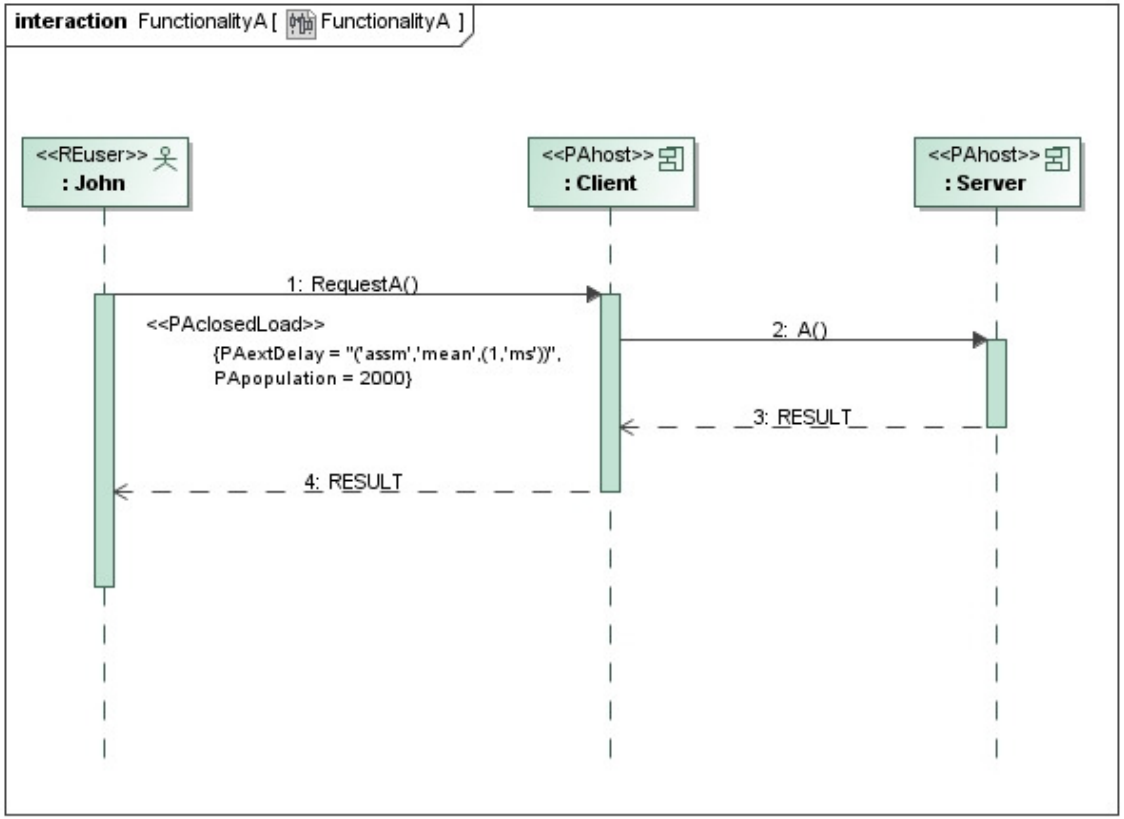
# Example 1: MagicDraw UML Model

- **Step 2**: Component Diagram with Performance characterization of Components



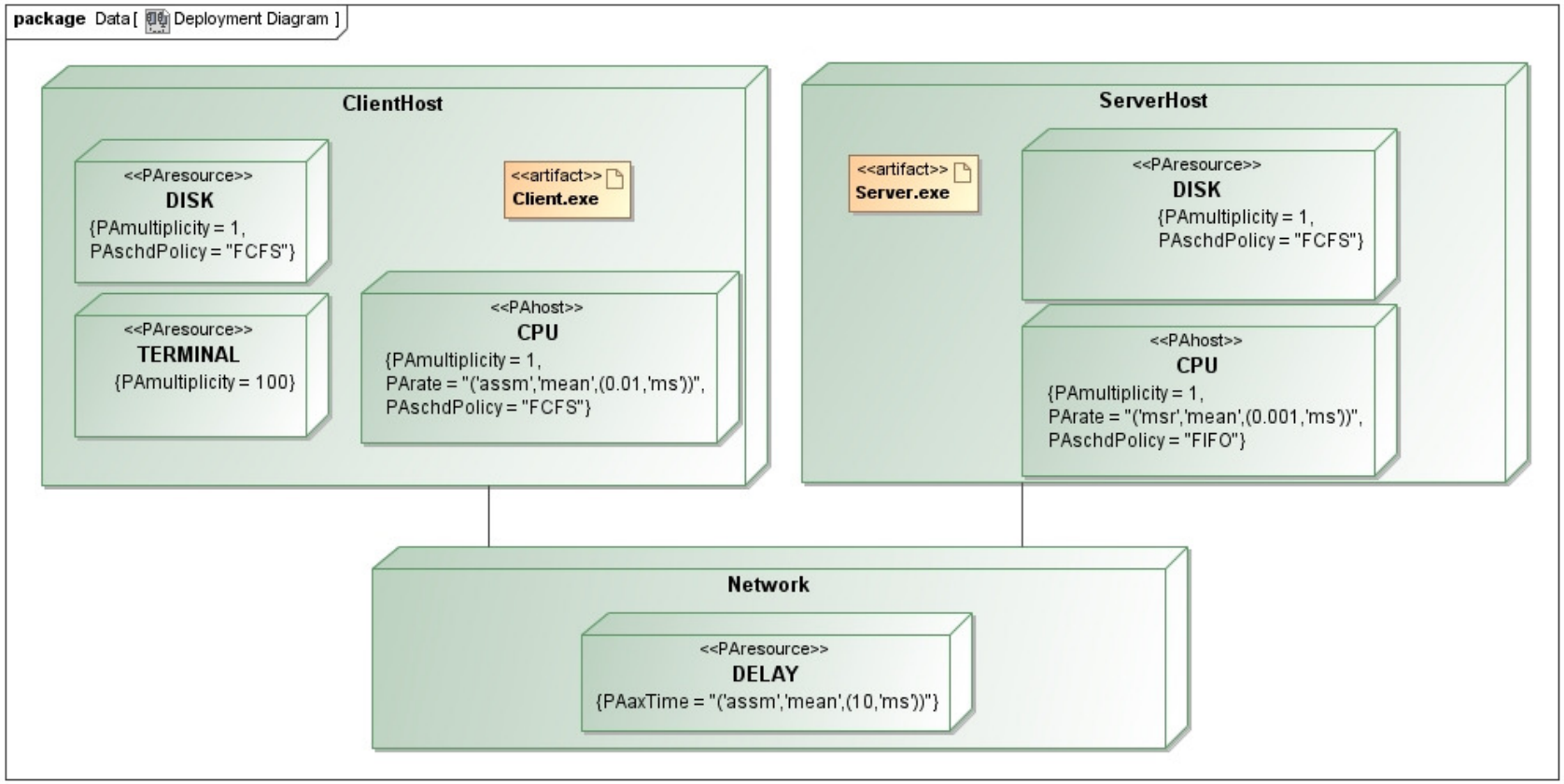
# Example 1: MagicDraw UML Model

- **Step 3**: Sequence Diagram for each functionality with workload definition.



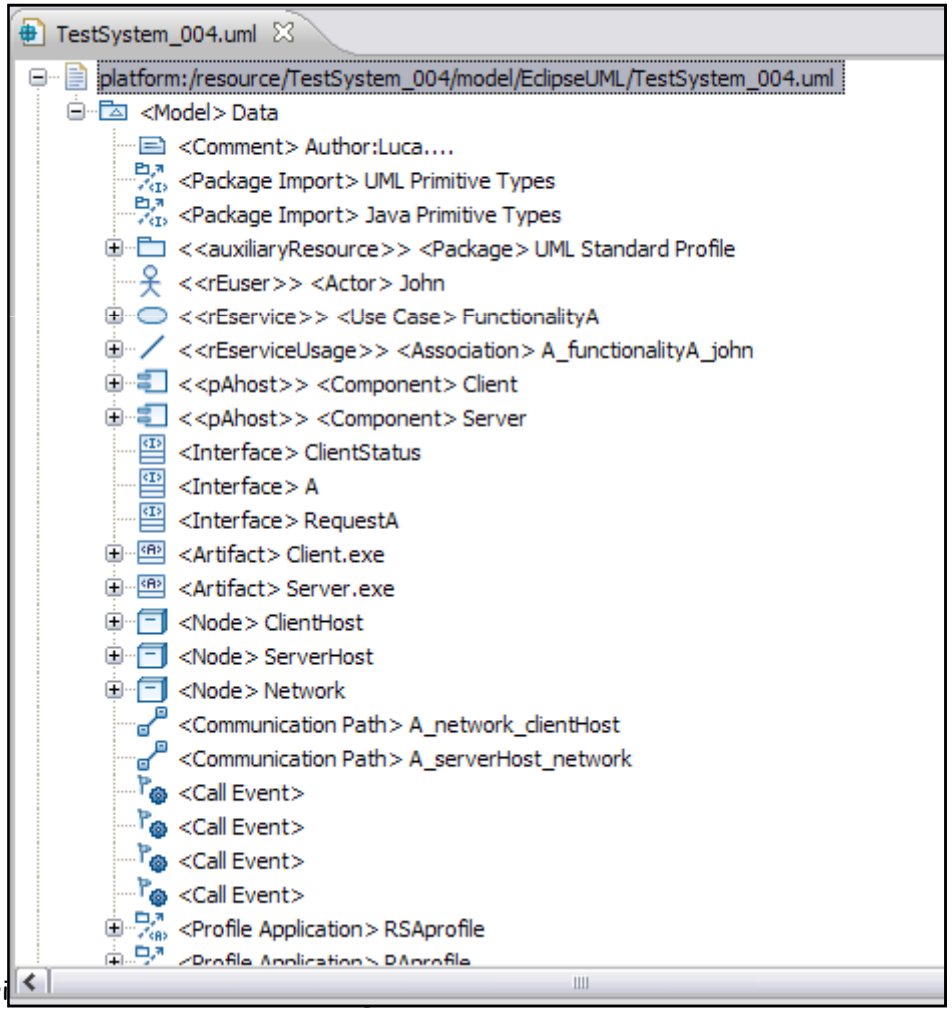
# Example 1: MagicDraw UML Model

- **Step 4**: Deployment Diagram with hardware resources specifications.



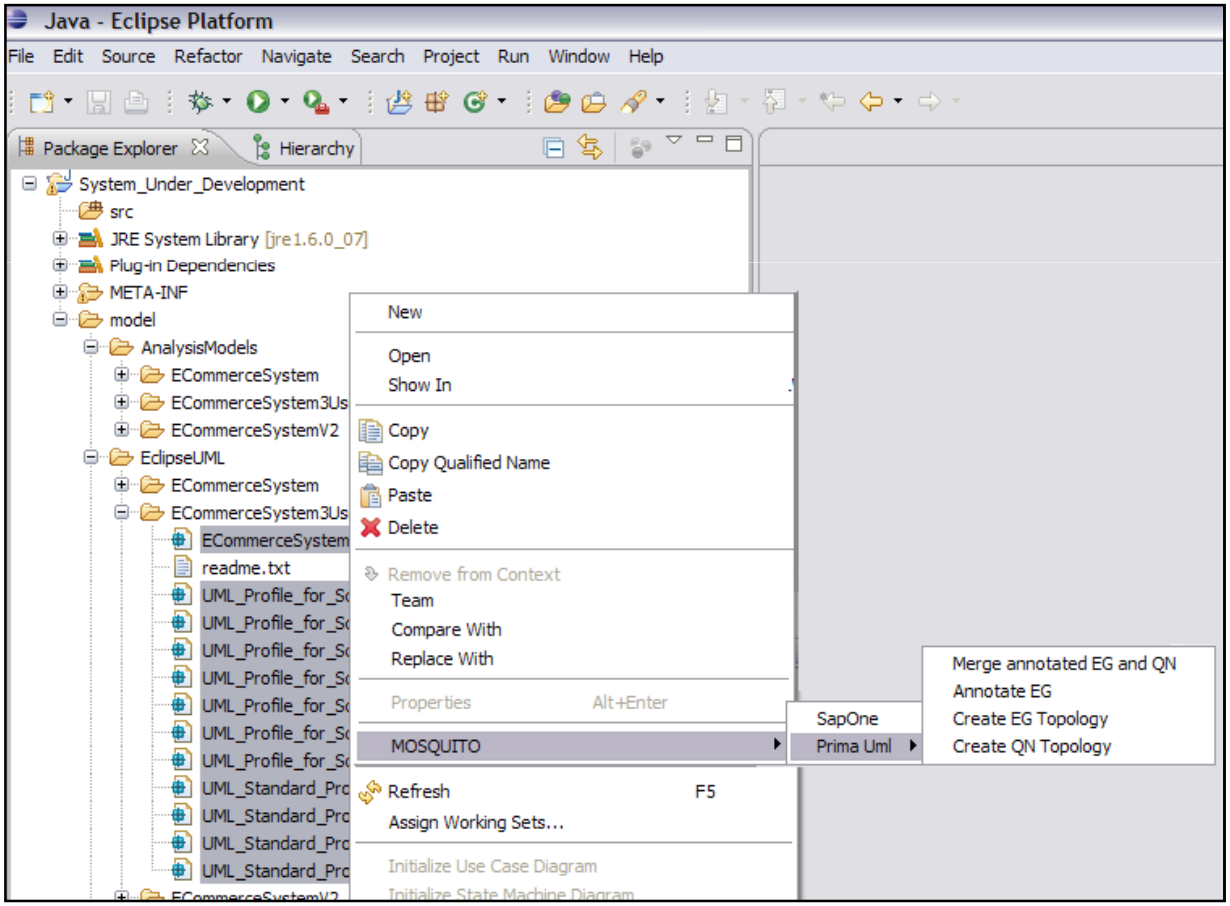
# Example 1: Eclipse UML Model

- **Step 5**: Save UML Model as Eclipse UML one (.uml)



# Example 1: MOSQUITO Client

- **Step 6**: Invoke UML2AnalysisModels remote transformations through MOSQUITO Client Eclipse plug-in.

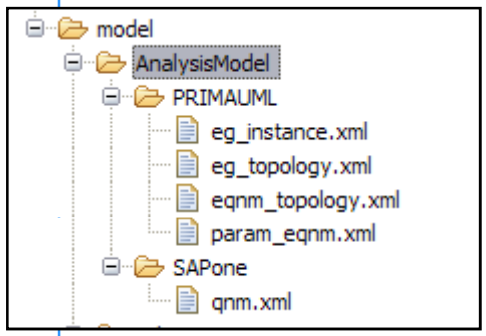





*MOSQUITO* – MOdel driven conStruction of QUeuIng neTwOrks

# Example 1: MOSQUITO Client

- **Step 7**: Save XML-based Analysis Models according to the applied performance methodology.

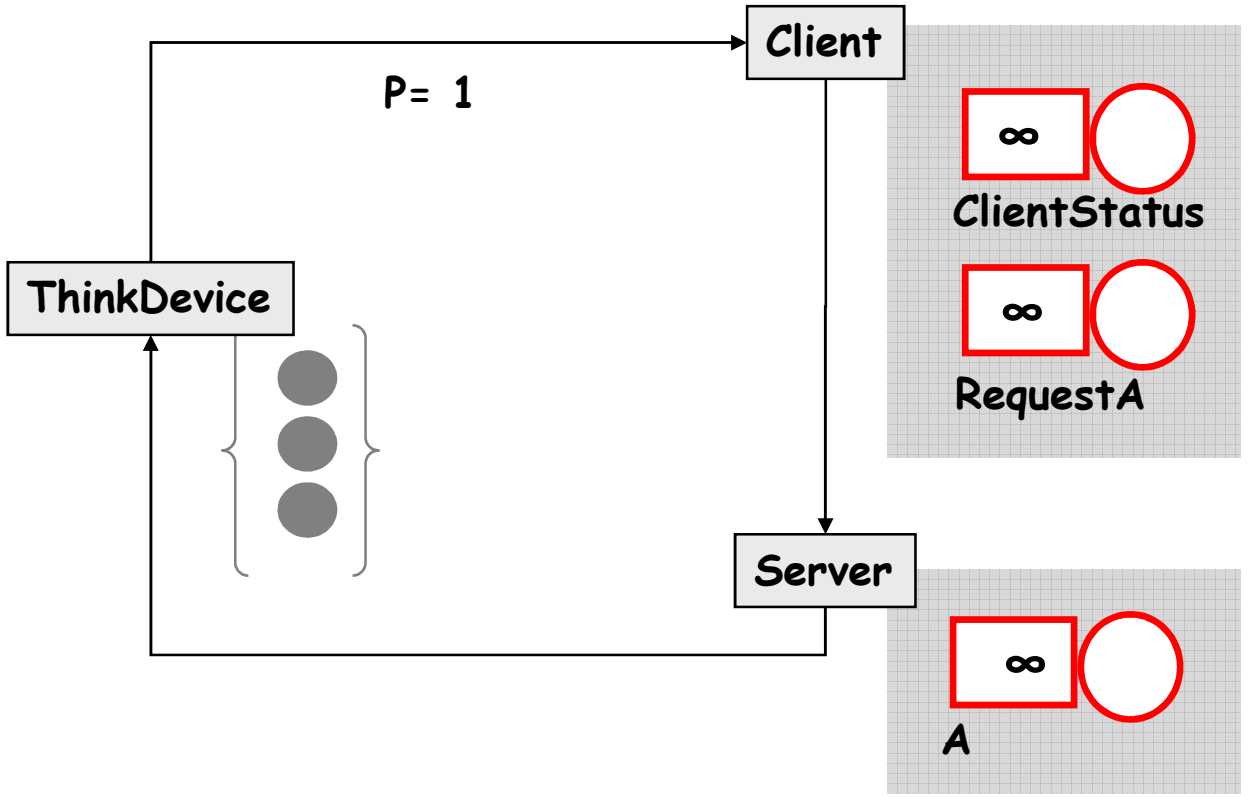



param_eqnm.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<QueueingNetworkModel xmlns:xsi="http://www.w3.org/2001/XMLSch
  <Node>
    <WorkUnitServer Name="ClientHost_CPU_0" Quantity="1" Sched
    <Server Name="ClientHost_DISK_0" Quantity="1" SchedulingPo
    <Server Name="ClientHost_TERMINAL" Quantity="100" Scheduli
    <WorkUnitServer Name="ServerHost_CPU_0" Quantity="1" Sched
    <Server Name="ServerHost_DISK_0" Quantity="1" SchedulingPo
    <WorkUnitServer Name="Network_DELAY_0" Quantity="1" Schedu
    <SourceNode Name="Init"/>
    <SinkNode Name="Fini"/>
  </Node>
  <Arc FromNode="ClientHost_CPU_0" ToNode="Network_DELAY_0"/>
  <Arc FromNode="ClientHost_CPU_0" ToNode="ClientHost_DISK_0"/
  <Arc FromNode="ClientHost_DISK_0" ToNode="ClientHost_CPU_0"/
  <Arc FromNode="ClientHost_CPU_0" ToNode="ClientHost_TERMINAL
  <Arc FromNode="ClientHost_TERMINAL" ToNode="ClientHost_CPU_0
  <Arc FromNode="Init" ToNode="ClientHost_TERMINAL"/>
  <Arc FromNode="ClientHost_TERMINAL" ToNode="Fini"/>
```

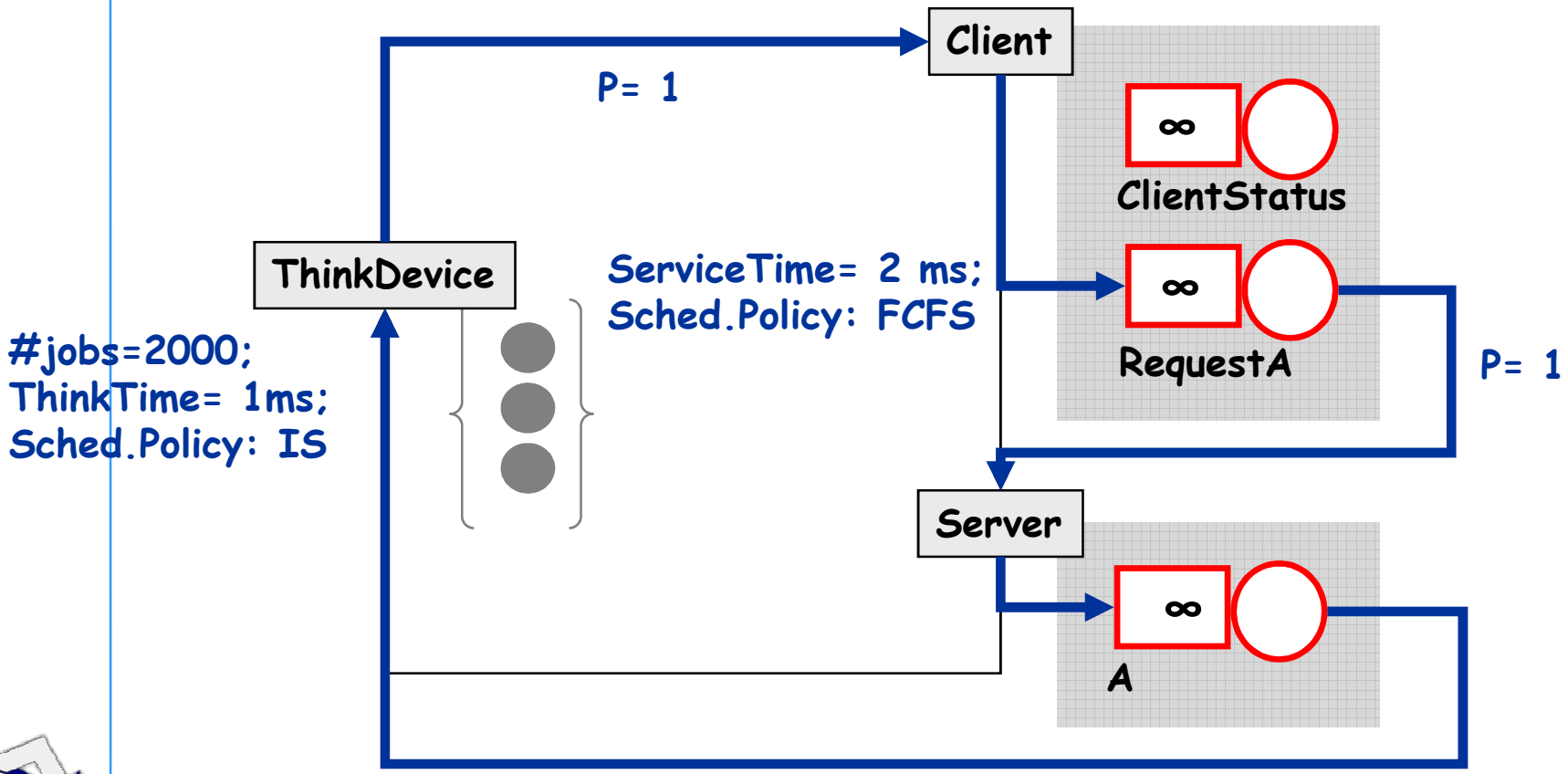
# Example 1: resulting Analysis Model

- SAPONE: QNM (pmif' format)



# Example 1: resulting Analysis Model

- SAPONE: QNM (pmif' format)

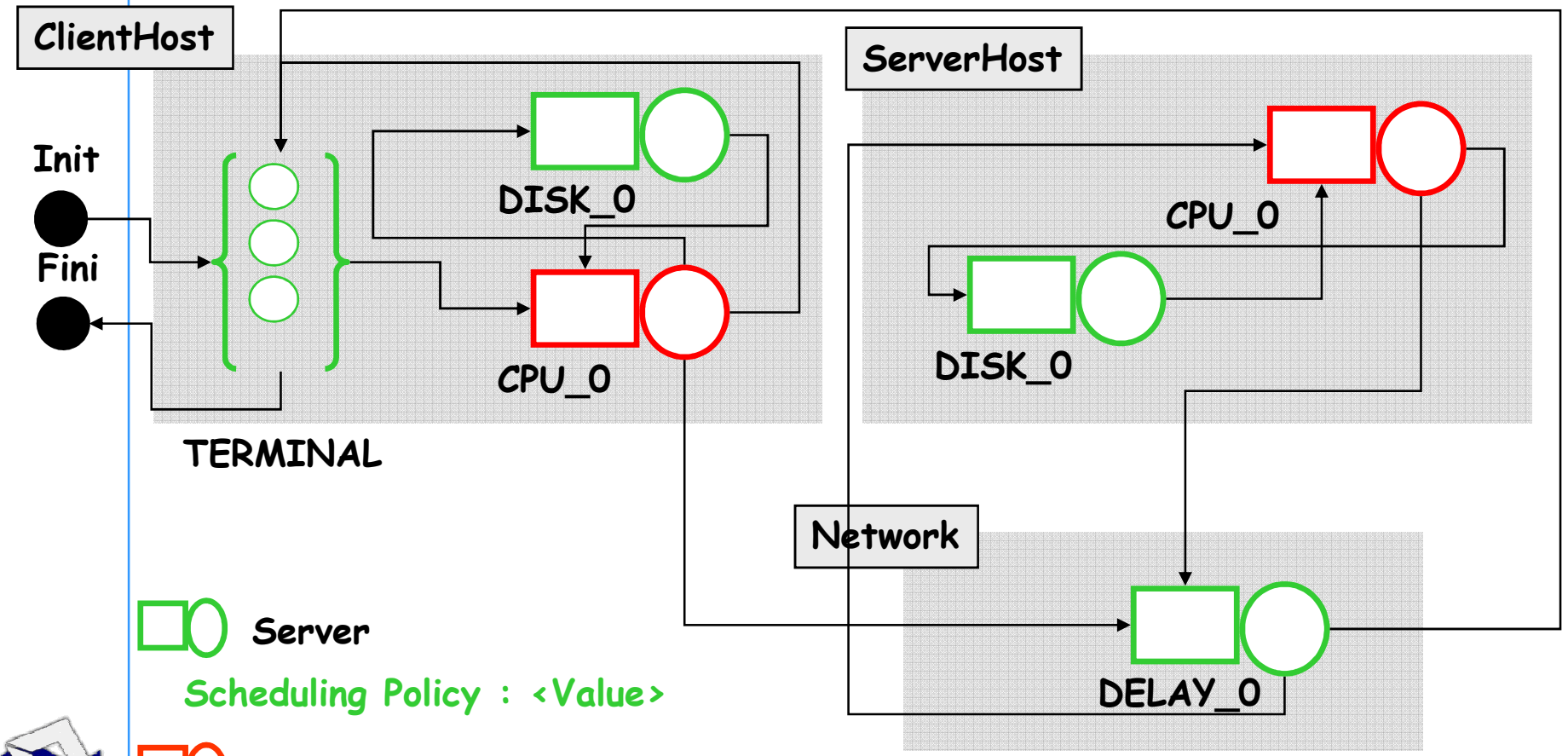



- Workload: FunctionalityA

ServiceTime= 20 ms;
Sched.Policy: FCFS

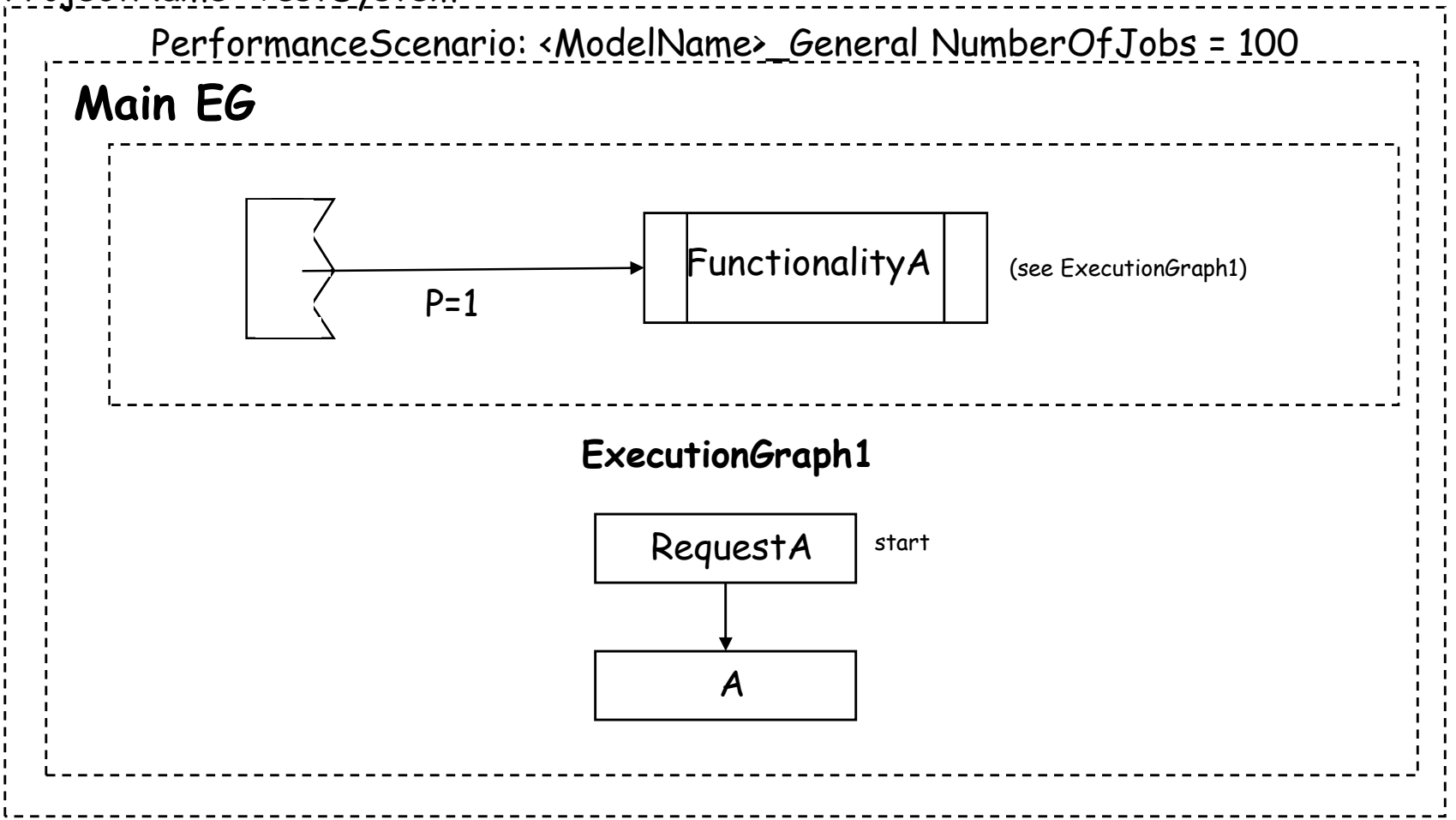
# Example 1: resulting Analysis Model

- PRIMAUML: EQNM topology (pmif format)



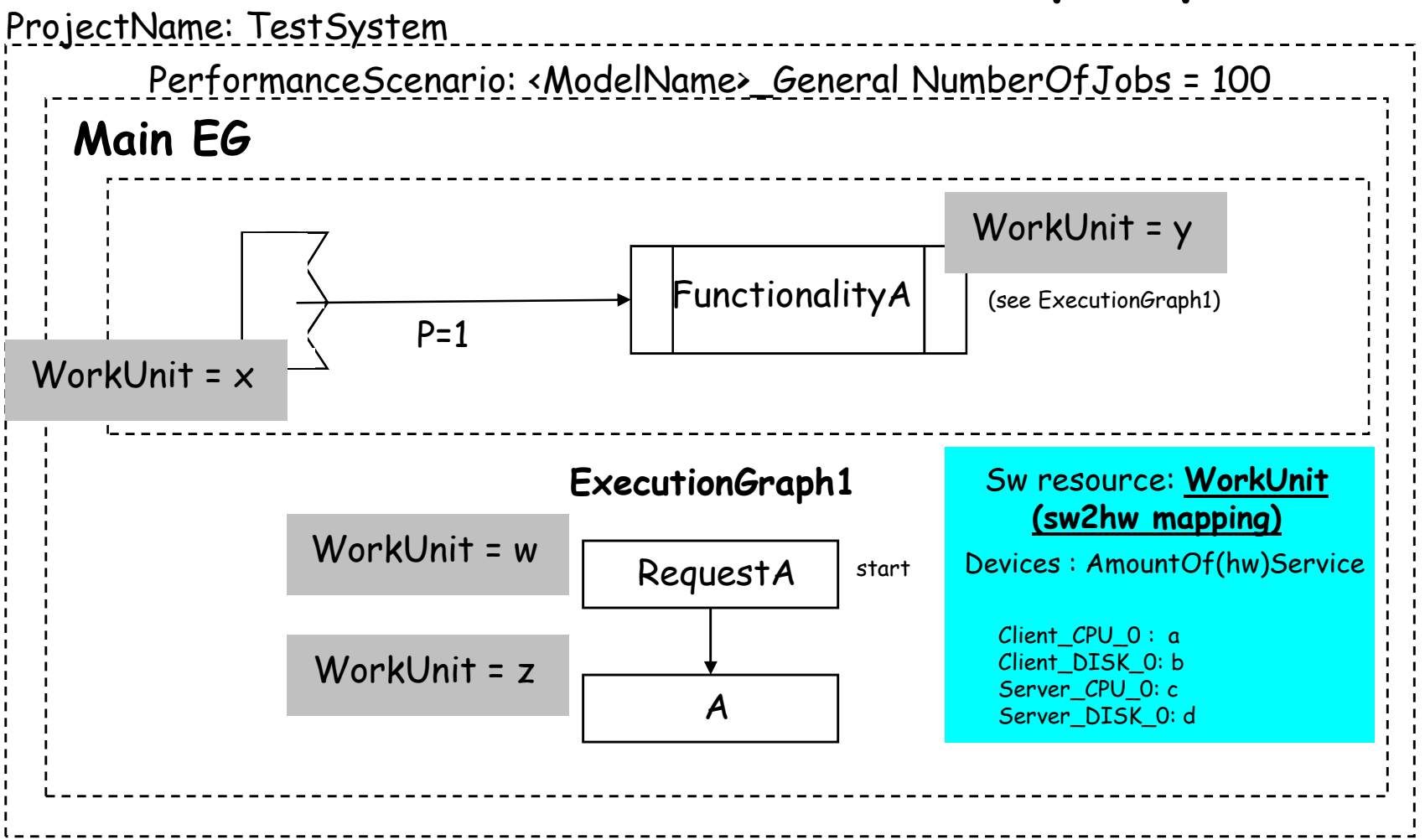
# Example 1: resulting Analysis Model

- **PRIMAUML: meta Execution Graph (EG) (spmif)**



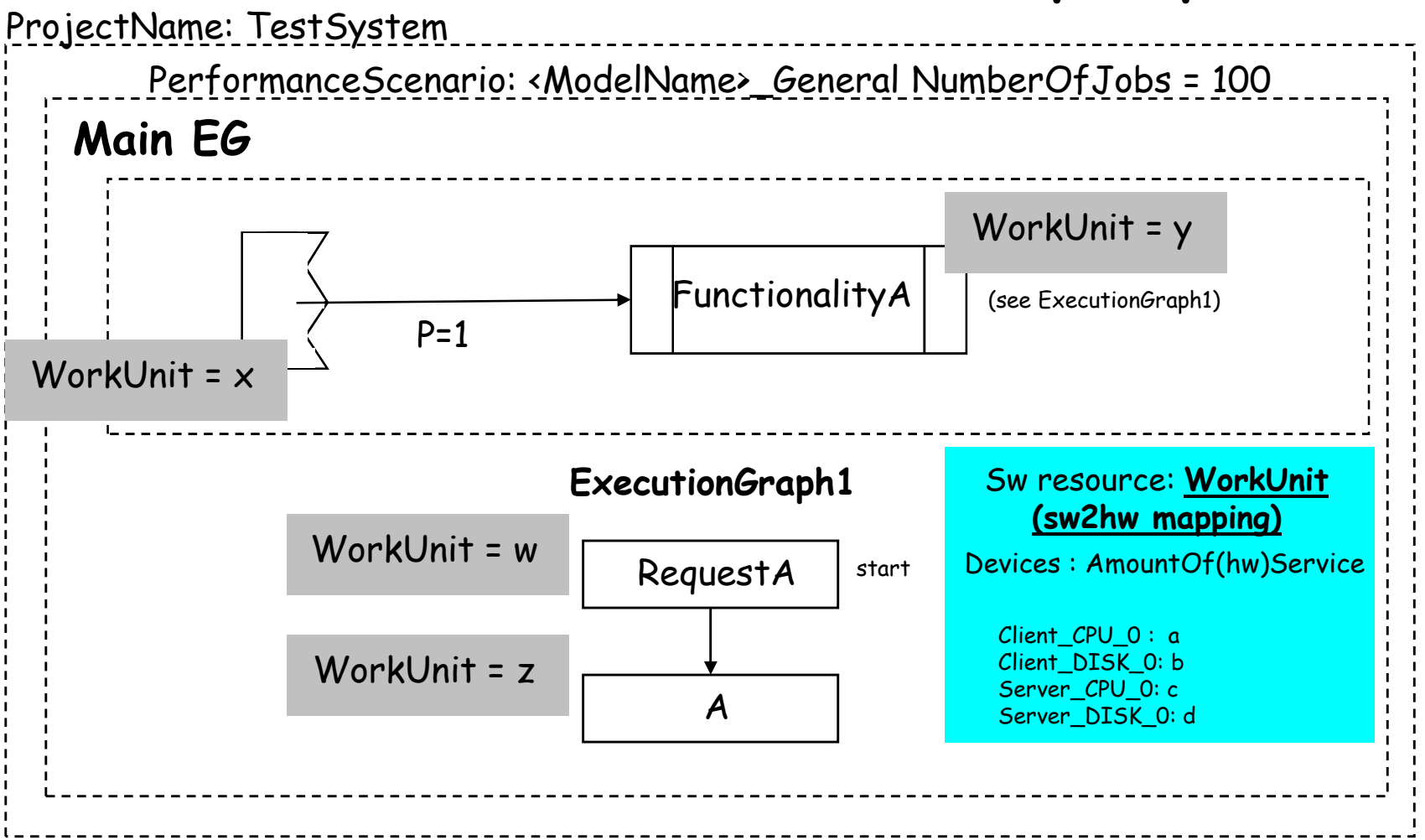
# Example 1: resulting Analysis Model

- **PRIMAUML: instance Execution Graph (spmif)**



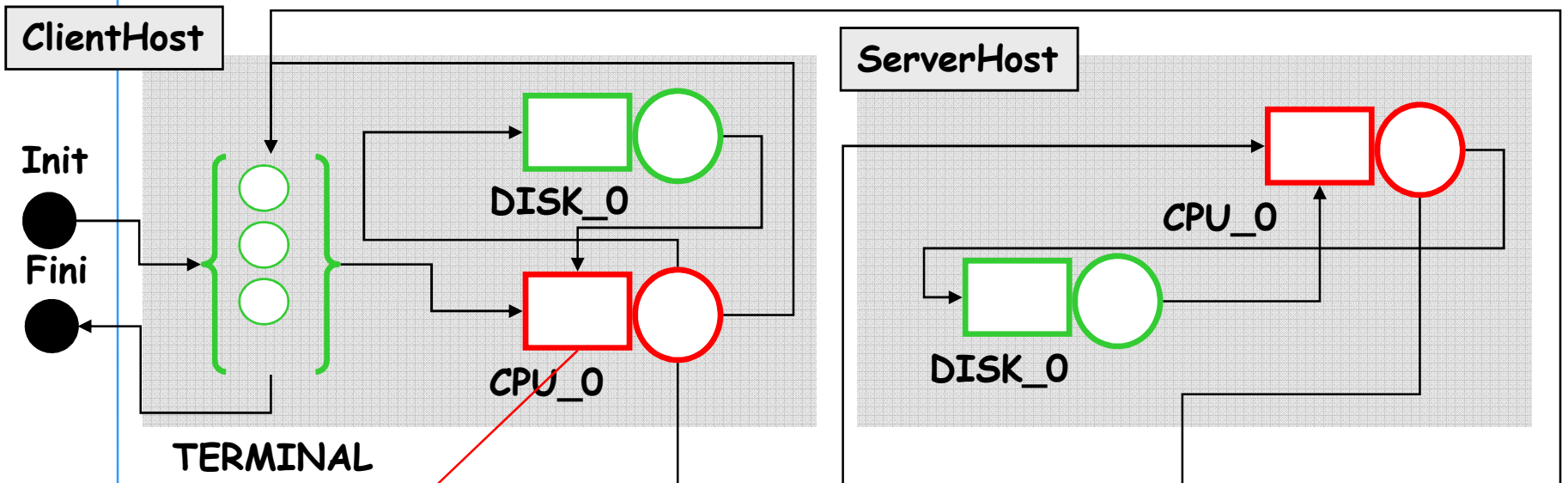
# Example 1: resulting Analysis Model

- **PRIMAUML: instance Execution Graph (spmif)**



# Example 1: resulting Analysis Model

- PRIMAUML: Parameterized EQNM (pmif format)

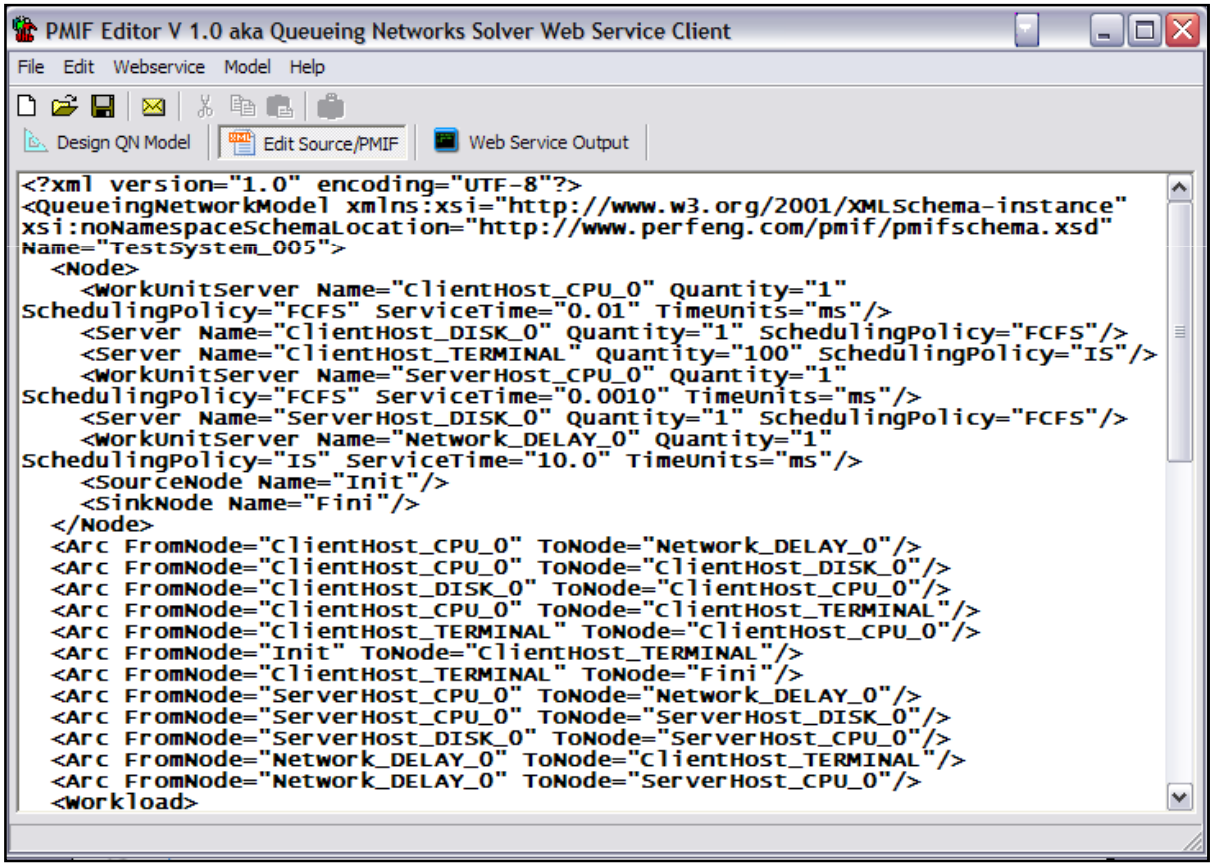



**WorkUnitServiceRequest**

ServiceDemand: 0.36
WorkloadName: FunctionalityA
NumberOfVisits: 36
--
TransitProbability = 0.0416667
To: Network_Delay_0
--

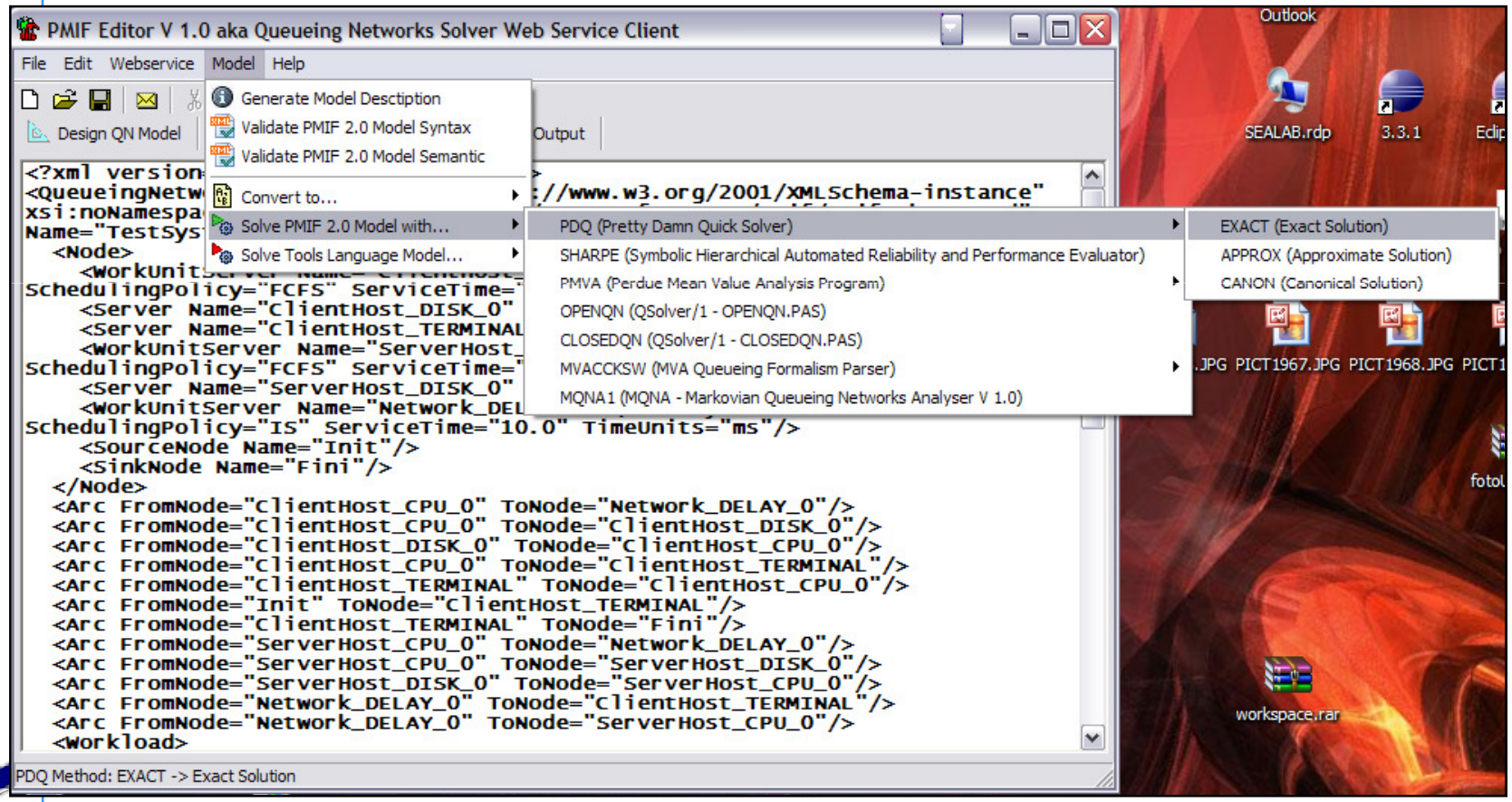
# Example 1: MOSQUITO- WEASEL (working)

- **Step 8**: Open PMIF Editor and load the obtained Analysis Model (PRIMAUML)



# Example 1: MOSQUITO- WEASEL (working)

- **Step 9**: Invoke remote pmif-based QN Solver.



# Example 1: MOSQUITO- WEASEL (working)

- **Step 10**: Performance Indices

****** PDQ Model OUTPUTS *******

Solution Method: EXACT

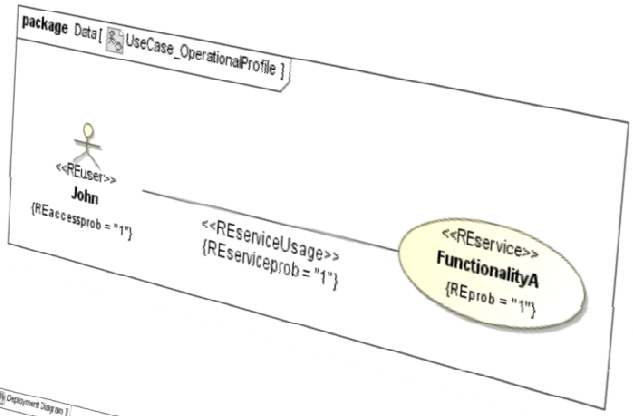
****** SYSTEM Performance *******

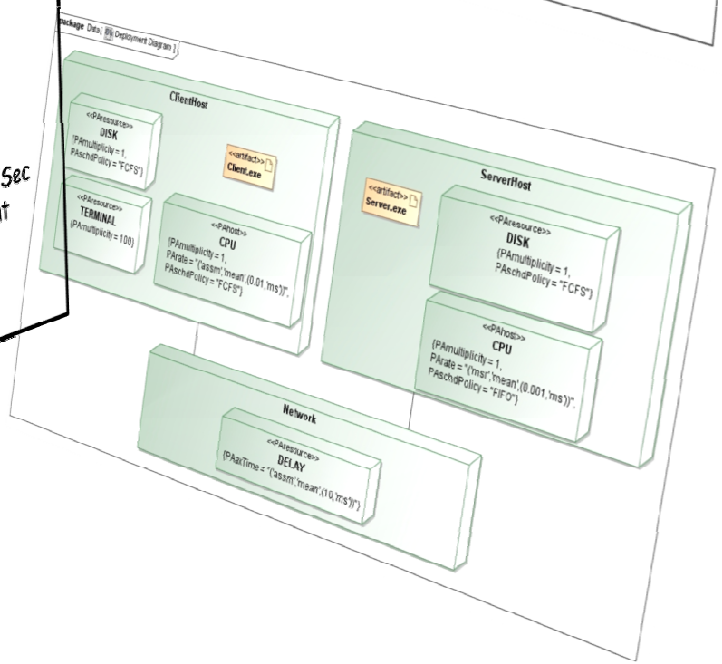
| **Metric** | **Value** | **Unit** |
|---|---|---|
| Workload: **"FUNCTIONALITYA"** | | |
| Mean **Bounds Analysis:** | | |
| Throughput | 0.0333 | Job/Sec |
| Response Time | 3000.0000 | Sec |
| Mean Concurrency | 100.0000 | Job |
| Stretch Factor | 98.7980 | |
| | | |
| Max Throughput | 2.7778 | Job/Sec |
| Min Response | 30.3650 | Sec |
| Max Demand | 0.3600 | Sec |
| Tot Demand | 30.3650 | Sec |
| Optimal Jobs | 84.3472 | Jobs |

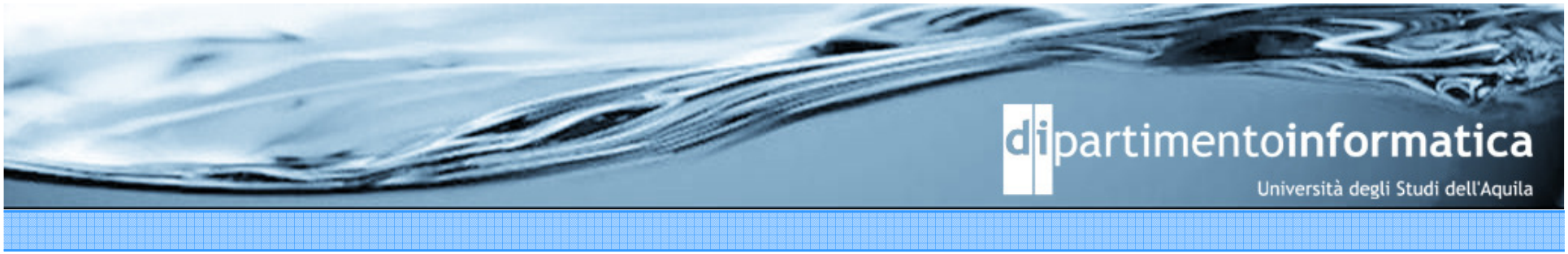
# Example 1: MOSQUITO- WEASEL (working)

****** RESOURCE Performance ******

| Metric | Resource | Work | Value | Unit |
|---|---|---|---|---|
| Throughput | CLIENTHOST_CPU_0 | FUNCTIONALITYA | 1.2000 | Visits/Sec |
| Utilization | CLIENTHOST_CPU_0 | FUNCTIONALITYA | 1.2000 | Percent |
| Queue Length | CLIENTHOST_CPU_0 | FUNCTIONALITYA | 0.0121 | Job |
| Residence Time | CLIENTHOST_CPU_0 | FUNCTIONALITYA | 0.3644 | Sec |
| Waiting Time | CLIENTHOST_CPU_0 | FUNCTIONALITYA | 0.0044 | Sec |
| Throughput | SERVERHOST_CPU_0 | FUNCTIONALITYA | 0.1667 | Visits/Sec |
| Utilization | SERVERHOST_CPU_0 | FUNCTIONALITYA | 0.0167 | Percent |
| Queue Length | SERVERHOST_CPU_0 | FUNCTIONALITYA | 0.0002 | Job |
| Residence Time | SERVERHOST_CPU_0 | FUNCTIONALITYA | 0.0050 | Sec |
| Waiting Time | SERVERHOST_CPU_0 | FUNCTIONALITYA | 0.0000 | Sec |
| Throughput | NETWORK_DELAY_0 | FUNCTIONALITYA | 0.1000 | Visits/Sec |
| Utilization | NETWORK_DELAY_0 | FUNCTIONALITYA | 100.0000 | Percent |
| Queue Length | NETWORK_DELAY_0 | FUNCTIONALITYA | 0.0000 | Job |
| Residence Time | NETWORK_DELAY_0 | FUNCTIONALITYA | 30.0000 | Sec |
| Waiting Time | NETWORK_DELAY_0 | FUNCTIONALITYA | 30.0000 | Sec |



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