University of L'Aquila

Department of Engineering and
Information Science and Mathematics

Report Homework #2

Water Distribution, Leakage and Quality Control System

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Github Project Repository:

https://github.com/GaetanoFichera/Water-Quality-Control-System

Academic Year 2017-2018

Index

Chapter 1

Our Homework

The task in this second homework is to create a Performance Model based on the system that we have modeled in the first homework. Using the Sequence Diagrams, we built the Execution Graph, and, through the Deployment Diagram we have built a Queueing Network. From the analysis of the Execution Graph we obtained the Demand Vectors that we used to parameterize the Queueing network. After that, the network has been resolved through a tool in order to obtain the output parameters that would allow to evaluate the system performance. In the final phase through the Architectural Description Language Aemilia we had the possibility to have a further evaluation of the system's performance.

Chapter 2

Work Planning

the workflow was:

- Light rework on our UML Model;
- Study of theoretical concepts of Queuing Networks and how to create the Execution Graph from Sequence Diagram;
- Connection between Deployment and Component Diagram;
- Drafting of the Executiong Graph;
- To simplify the amount of calculations to be done to obtain consumption of physical resources we used an Excel file;
- Drafting of the Queueing Network;
- Performance Analysis and evaluation, and Refactoring of the Queueing Network Model;
- Study of Aemilia;
- Drafting of the State Diagrams for the implementation in Aemilia;
- Drafting of the Flow Graph;
- Performance analysis in Aemilia;

Chapter 3

Light Rework On Our UML Model

After serious consideration of our last homework, we noticed that there were failures. Below is a list of rework:

- We have applied the stereotypes to the Communication Paths within the Deployment Diagram;
- in order to improve system performance and to better stratify the deployment, we decided to add 3 new nodes:
  - "SeaweedPickingInlandControlUnit";
  - "Seaweed Picking Outgoing Control Unit";
  - "MagikarpControlUnit".

  and , for this purpose we have also inserted a new profile called "Control Unit" from the server stereotype, these 3 new nodes are connected to the server with a wired connection and to sensors with a wireless connection;
- For the connections between the Control Center Server and the two Inland and Outgoing Seaweed Picking Control Units we have inserted a new communication path stereotype that does not consume resources because when we started the modeling work for the Queueing Network we considered the two Control Units located in the same physical space as the Control Center Server, then we use a "Internal Connection" stereotype with zero consumption of resources;
- We have added the operations to the components subsequently reused in the Sequence Diagram;
- we realized the lack of an internal server to the Control Center Pomezia that managed the requests coming from the App inside it;
- we realized that in the sequence diagram "check quality" the call from the component "check quality parameters inland / outgoing" was missing to the component "parameters Quality archieve" to retrieve the desired water parameters;
- we have established the types of connections between one node and the other of the deployment diagram, obtaining:
  - between the Control Center Server and the two Apps a Wired Connection;
  - between Control Center Server and Seaweed Picking a Wireless Connection;
  - between the Control Center Server and the Water Company Server and the Purification System Center an Internet Connection.
- we have agreed that there is a single database that is connected to the water company server or water archives;

- we realized that in the water sampling phase, the sensors will send the data of the water samples to the Control Center Server which, in turn, using the sample archieve component will send the data to the water company server, the problem is that in the SD after the component sample archive is not invoked any component that refers to the water company server. Solution:
  - We have decided to add a component called "Sample Archive" to the water company server which is responsible for saving data on the DB. In going to add this correction we realized that in fact we have failed to use sample sender. Then we have made a small change:
    * sample sender is inside the control center server;
    * sample archive is located inside the water company server and manages the data on the db.
- We modified the sequence diagram of "SturtUpSamplingWater" as we realized that the component sample data on the SeadweedPIckingInland / Outgoing node communicated with the "SampleSender" component on the ControlCenterServer node but from our component + deployment diagram it was not.

Below you can find the description of the new profiles popping out.

3.1 Wired Connection Profile

Wired Connection	
Metamodel Class	Communication Path
Description	It is a representation of the physical meaning of Wired Connection
Tagged Values	
Constraints	

3.2 Internet Connection Profile

Internet Connection	
Metamodel Class	Communication Path
Description	It is a representation of the physical meaning of Internet Connection
Tagged Values	
Constraints	

3.3 Wireless Connection Profile

Wireless Connection	
Metamodel Class	Communication Path
Description	It is a representation of the physical meaning of Wireless Connection
Tagged Values	
Constraints	

3.4 Internal Connection Profile

Internal Connection	
Metamodel Class	Communication Path
Description	It is a representation of the physical meaning of Internal Connection
Tagged Values	
Constraints	

3.5 Control Unit Profile

Internal Connection	
Metamodel Class	Node
Description	It is a representation of the physical meaning of Control Unit
Tagged Values	
Constraints	

Chapter 4

Use Cases Decision

Chapter 5

Identification Of Performance Requirements

The following consideration has been made:
1 Km of the route with respect to the connection point with the system is taken into account for an Entry Water Channel or Exit of 5 meters radius, and every 10 meters must be 10 Seaweed Picking, with a total of 1000 Seaweed Picking.
Non-functional requirements are:

- Each sensor must take 500 ms to carry out a sampling;
- The time tat passes between a sampling and the other is 60 s;
- The time that each node must use to send the data to the archive is 200 ms;
- The time of use of each node must be less than 90
- The response time of the Archive after a call by an actor must not exceed 300 ms.

Chapter 6

Development Of Component Diagram Into Deployment Diagram

Chapter 7

Model WCS With Execution Graphs

The Use Cases we have considered are:

- UC1 StartUp Sampling Water activated by Sample Supervisor;
- UC3 Check Water Quality activated by Quality Control Supervisor.

In reference to the Use Cases taken into consideration, to better understand our architecture, we have combined the Deployment Diagram with Component Diagram. In the figure below this is represented.

Figure 7.1: Deployment Diagram + Component Diagram

7.1 Demand Vector

Il Demand Vector scelto in base alle risorse virtuali che risaltano dal deployment diagram sono:

Wired Connection Request	
Wireless Connection Request	
Internet Connection Request	
Database Request	
Control Center Server CPU	
Water Company Server CPU	
Purification System Pomezia CPU	
Seaweed Picking Inland Control Unit CPU	
Seaweed Picking Outgoing Control Unit CPU	
Seaweed Picking Outgoings Sample Request	
Seaweed Picking Inlands Sample Request	

Spiegare cosa sono queste risorse virtuali

The Execution Graphs obtained are:

- UC1 Sampling Water activated by Sample Supervisor:

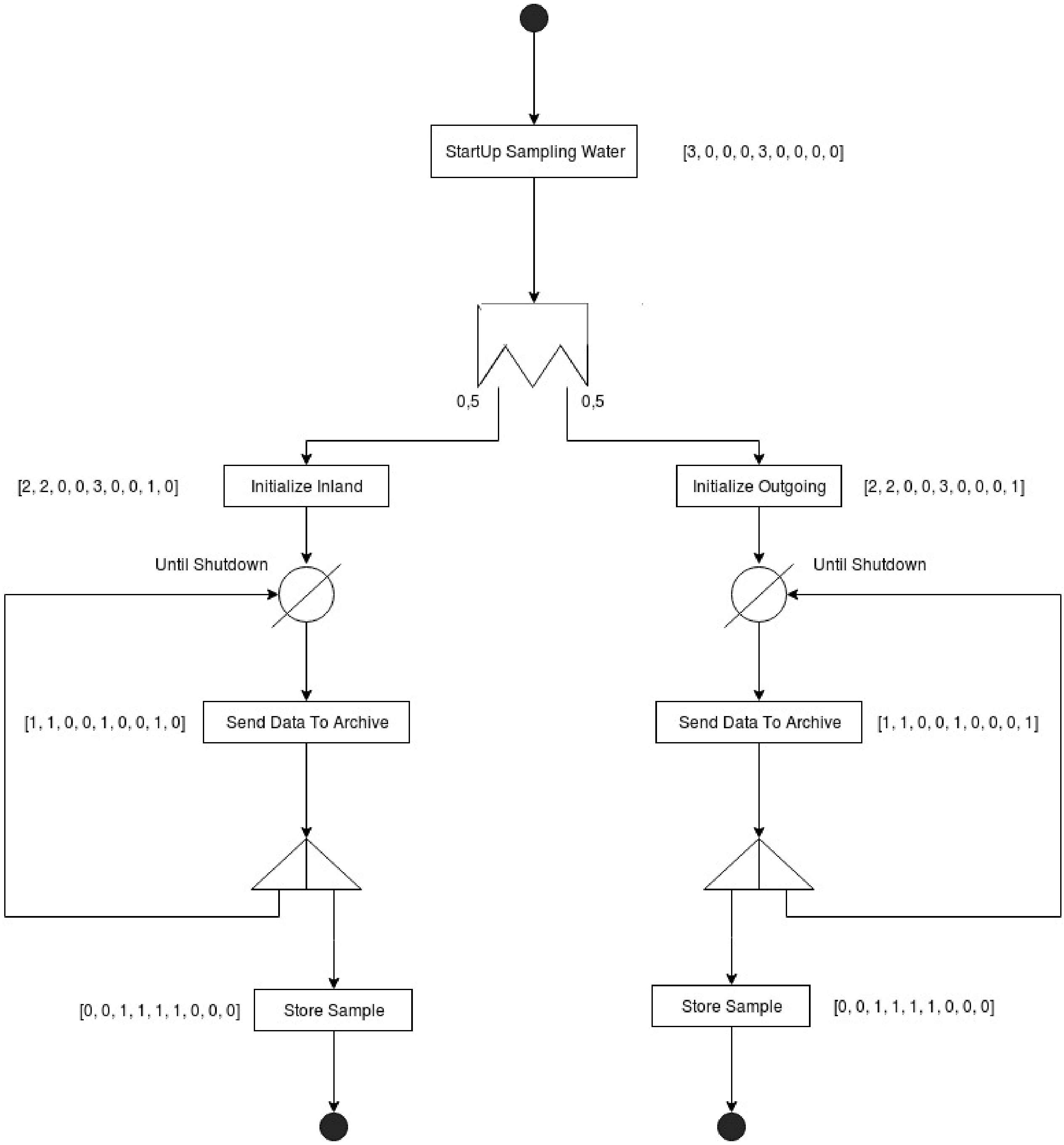

Figure 7.2: EG UC1 StartUp Sampling Water

- UC3 Check Water Quality activated by Quality Control Supervisor:

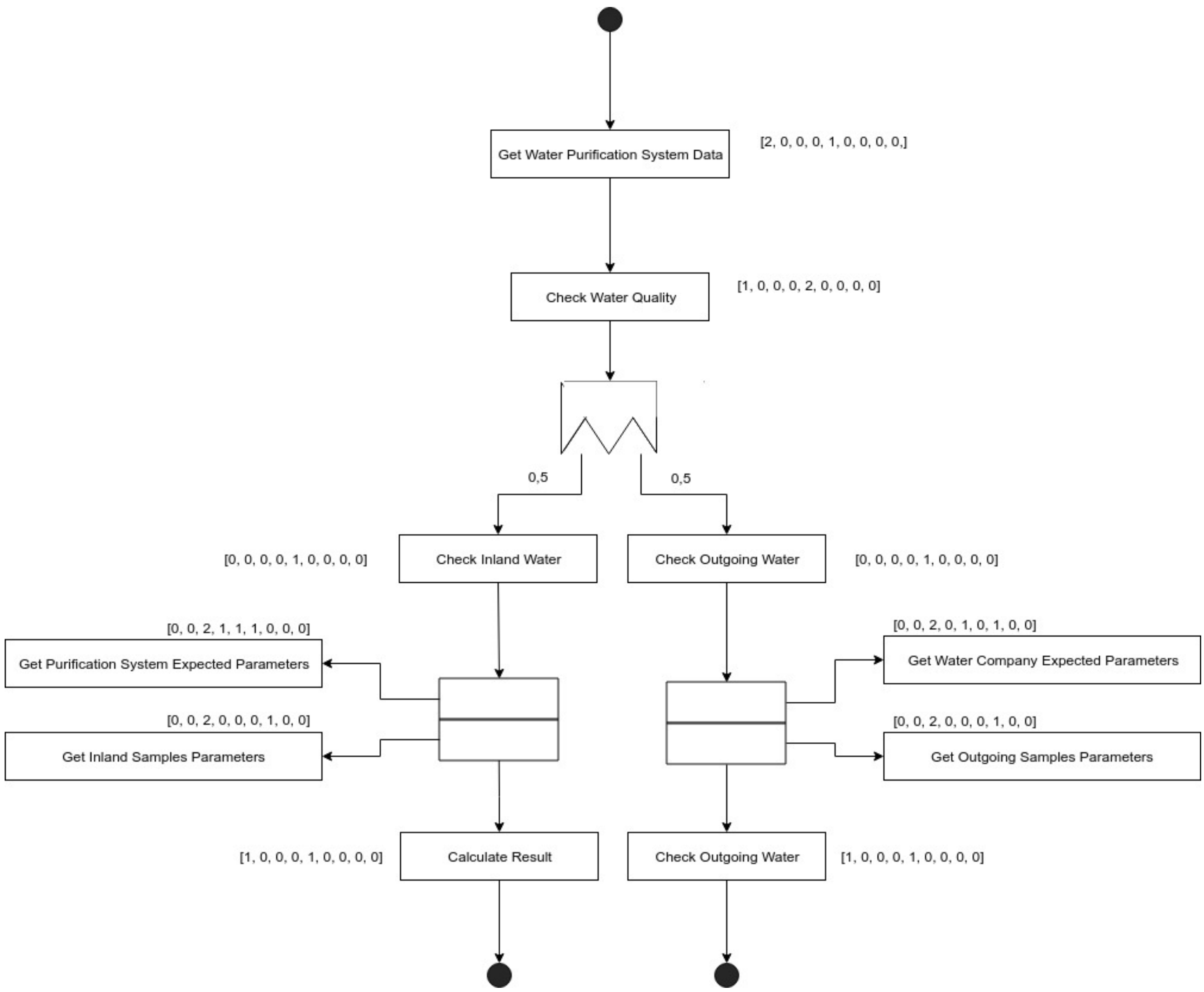

Figure 7.3: EG UC3 Check Water Quality

Chapter 8

Queueing Network Model

Then we have identified the physical nodes of our system going to introduce how the Execution Graphs are connected to them:

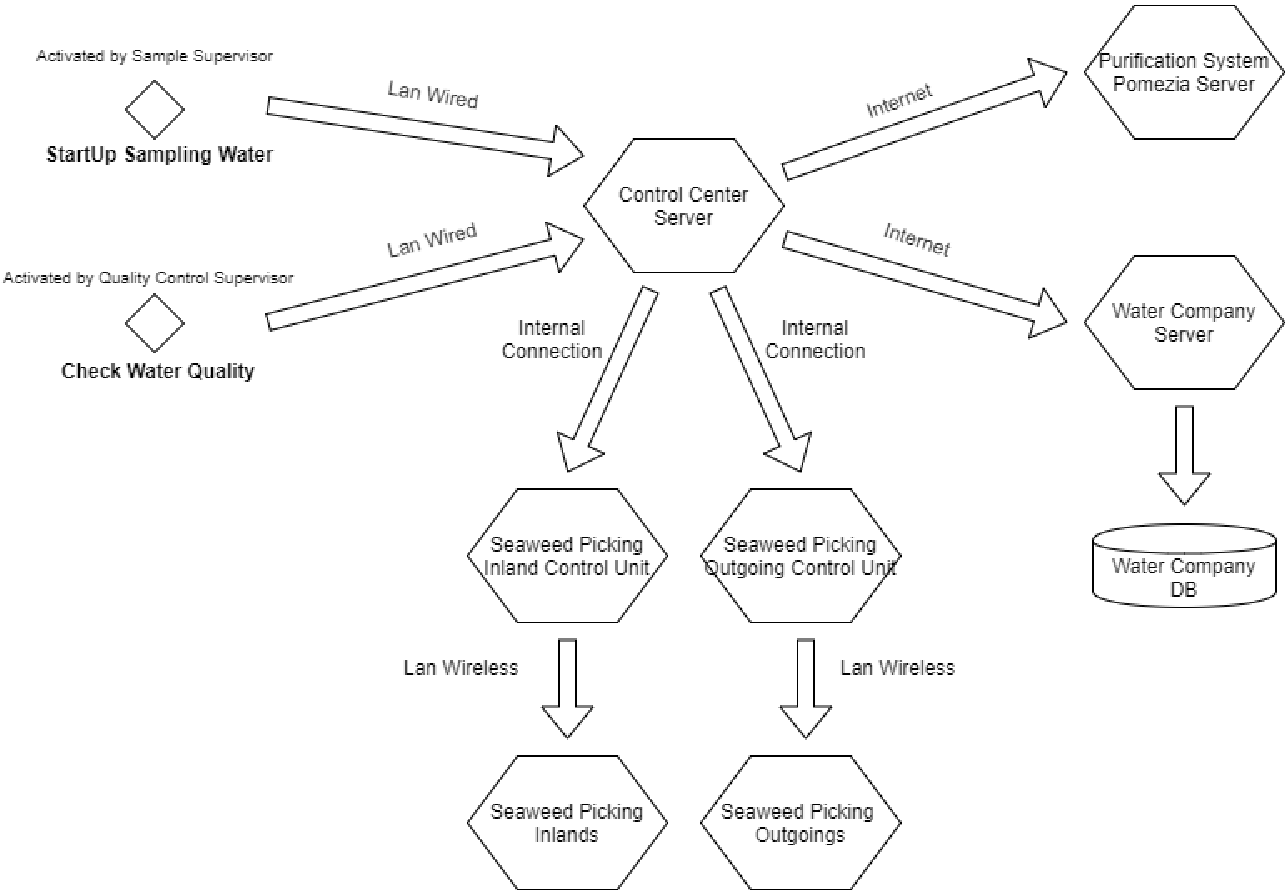

Figure 8.1: Physical Nodes

This is the Queueing Network so obtained:

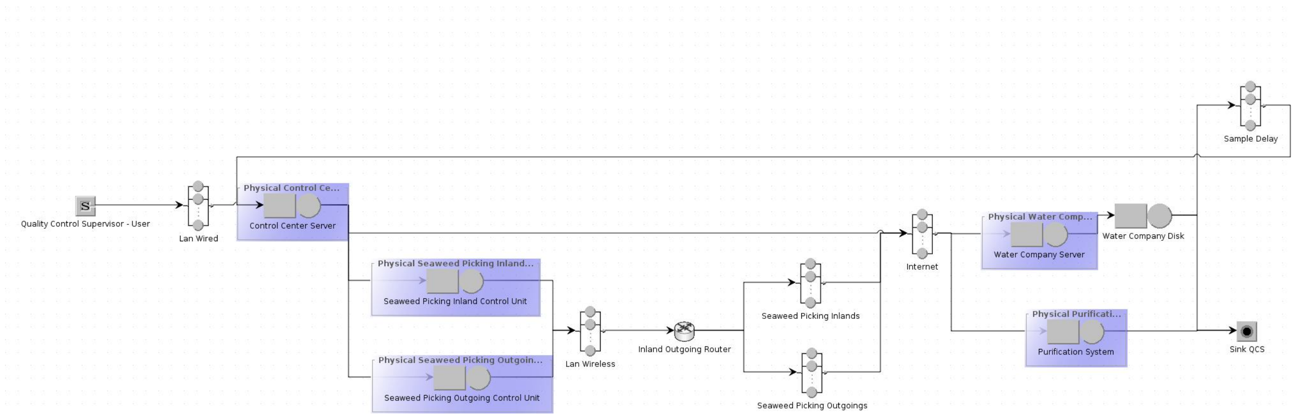

Figure 8.2: Queueing Network

After several tests, we agreed to reduce the sampling time to 500 seconds to refine the performance analysis. On JMT for the same reason we have only one SeaweedPicking Control Unit and no two for In / Out.
We have also decided to eliminate the finite capacity regions as useless for the purposes of our project. So our final Queueing Network has become this:

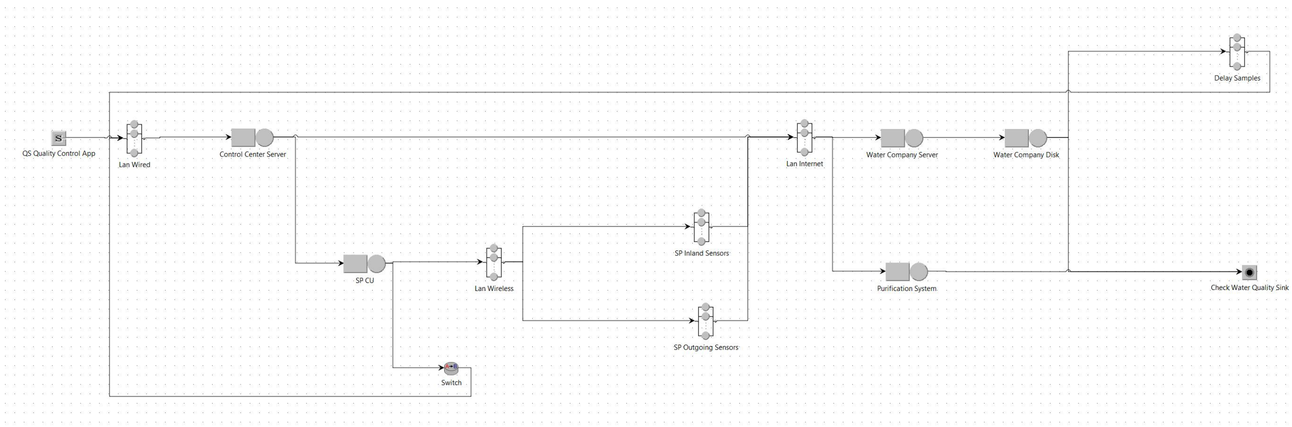

Figure 8.3: Final Queueing Network

Chapter 9

AEmilia Model