1 Functional Summary

This project aims to design a tool for stochastic network analysis. These analyses include implementing some of the graph algorithms under uncertainty conditions and capacity reliabilities of the network. For the uncertainty analysis we use a simulation method.

This tool uses the following inputs:

1- Network Topology
2- Capacity distributions of links in the networks.
3- Desired demand levels.
4- Links weights

The results of reliability evaluation will be used as a metric in a mathematical programming model which aims to optimize the investment decisions in an integrated infrastructure model with various components.

2 Requirements Specification

To categorize the functional requirements, classes for the actors of the system have been defined and various use cases have been assigned to each class.

2.1 Use cases of the system

To organize better I categorized the functional requirements in to 5 packages.

1- Network functionalities including:
   - Bi-connectivity Inspector (between node pairs)
   - Connectivity Inspector (all nodes)
   - Deterministic and Stochastic Shortest Path Finder
   - Minimum Weight Path Finder
   - Maximum Flow of the Network
   - Capacity Reliability Evaluation

2- Network Creating functionalities including:
   - Read a network with a specific format
   - Translating a map into a network / Generate a Network (Nodes, Arcs, Lengths,...)
   - Visualization Capabilities
   - Specifying classes of nodes and arcs of the network
   - Add Node, Add Arc
   - Drawing the generated network
   - Adding attributes to Arcs such as weight, lengths, capacities by random sampling
3- Simulation related functionalities including:
   o Choosing type of distribution for link capacities and demand
   o Choosing parameters for distributions
   o Choosing numbers of trials

4- Administrative functionalities including:
   o Select the desired map (set network)
   o Select Origin (set origin)
   o Select Destination (set destination)

5- General User Functionalities including:
   o Login to the system
   o Generate various reports

3 Non functional Requirements

The non functional requirements of the software are mostly determined in the planning phase. Some of non functional requirements of our software are as follows:

3.1 Hardware Requirements

   • X64 pc with any of these platforms: Windows/Linux/Mac-OS
   • 4GB of Ram
   • Minimum of one 10GB of hard disk

3.2 Software Requirements

   • Development Platform
     o JAVA (JDK 6 update 18)
   • Interactive Development Environment
     o IntelliJ IDEA 9.1
     o NetBeans 6.8
   • Network/Graph Libraries:
     o JGraph
• Math Libraries
  o Apache Math Commons
• XML Parse
  o Xalan 2.7
  o Xerces 2.9

4 Alternative and Rationale

I expect some of the methods introduced as system use cases in section 2.2 to be available through some libraries or commercial and non commercial packages and I am planning to use them whenever it is needed. But the main part of the project is done for a very specific reason and needs special algorithm implementations as well as sampling. I don’t think there is an alternative to development of these parts.

5 Feasibility and Scheduling

Most of the functional requirements discussed in 2.2 are the minimum requirements which I expect to complete by the end of the semester (By Mid-May).

A tentative schedule of the project deliverables and their order is as follows:

<table>
<thead>
<tr>
<th>Deliverable</th>
<th>Expected to be ready to deliver by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functionality Package 2, 3, 4</td>
<td>March 31</td>
</tr>
<tr>
<td>Functionality Package 1, 5</td>
<td>May 15</td>
</tr>
</tbody>
</table>

There are is one functional requirement “Making a database of the applicable maps”, that I am not sure how much could be accomplished by the end of the semester.