High-level design document

1. Executive summary

1.1 Focus of the game

The game is a real-time strategy (similar to SimCity), where the player is a network designer and administrator of a large telecommunications firm. The player's goal is to provide efficient digital communication service to customers in terms of customer satisfaction and profit by building a cost effective and reliable network.

1.2 Educational purpose

The game aims to teach fundamental techniques involved in the design of digital communication networks. It does so by introducing elements normally found in those networks (such as cables, and routers), allowing player to experiment with them. By analyzing customer's needs, and designing the network to meet them, player can develop the critical thinking skills necessary to succeed in network design and support tasks. The game is not meant to replace a computer networking course, but it is meant to provide an interactive learning experience that allows students to apply their knowledge in a secure, challenging, and fun environment .

2. Game mechanic (Gameplay)

The game is a real-time strategy (RTS). Game starts with a screen of an empty terrain. As time progresses, player will see customers (represented by small houses or businesses) appearing randomly on the terrain. Each customer specifies three requirements that needs to be met: targets (a set of customers that this particular customer would like to communicate with), the minimum bandwidth, the monthly fee the customer is willing to pay.

2.1 Game elements

The player's job is to lay digital cables on the map and place routers that interconnect them by choose from a set of available tools. The player's primary interaction method is drag-n-drop, where player selects one of available tools, and uses the mouse to place a cable or router on the terrain, similar to SimCity. The available tools are divided into two

categories: *cables* and *routers*. There are few types of available cables that differ in their maximum bandwidth and cost per mile, possible choices might include:

1. 2 Mbps
2. 4 Mbps
3. 16 Mbps
4. 64 Mbps
5. 128 Mbps

Similarly, there are several types of available routers that differ in the number of interfaces, maximum bandwidth the router can handle, and cost per unit. Possible choices might include:

1. 2 Interfaces, 4 Mbps
2. 4 Interfaces, 16 Mbps
3. 6 Interfaces, 64 Mbps
4. 6 Interfaces, 265 Mbps

2.2 Rules (please consult the *initial rules* document for more details)

Player starts with a balance of a certain initial capital. The player has to design his/her network so that to ensure the existence of a connection (possibly passing through intermediate routers) between each customer and his set of target customers. At that time, the player may negotiate the monthly fee with the customer. If the negotiation succeeds, the customer becomes subscribed (contracted) to the service and will start paying the fee.

Once a customer is contracted, traffic will start flowing from his cable, and through the network to his targets (traffic will be represented by tiny, SimCity cars like, animated elements). Every element of the network (both cables and routers) will have a *utilization indicator*, that indicates the current bandwidth consumption on that element. The utilization indicator of an element will be shown as a bar that appears above the selected element. If the utilization exceeds the maximum bandwidth of the element, packets will be dropped, causing customers to suffer. Additionally, over utilization of routers might cause them to eventually fail which would require them to be replaced.

Each customer has an associated satisfaction rate that changes with time. This rate is calculated as a percentage. The calculation involves the following parameters:

1. Bandwidth: how much bandwidth the player is supplying to customer vs. his minimum required bandwidth.
2. Downtimes: downtimes contribute negatively to customer satisfaction. Additionally, the longer downtimes, the more the drop in customer satisfaction rate.
3. Connection to targets: with which of his targets can a customer communicate with, and what is the quality of the connection.

If the customer satisfaction drops below a certain level (for example %30), the customer will eventually cancel his contract. The individual customer satisfaction rate contributes to the overall customer satisfaction. The lower the overall customer satisfaction, the higher the probability of existing customers canceling their contract, and the lower fees new customers will be willing to pay.

2.4 Goal

The goal of the game is to make profit. There is no certain balance that the player has to reach, the player can play as long as he/she wants. However, the balance can not go below a certain negative amount. If this happens, the player loses.

2.5 Challenges

As more and more customers are added, the network gets more congested more, and the player needs to add more cable, and possibly replace old routers with new ones of higher maximum bandwidth and/or interfaces. As player replaces old cables/routers, he/she has to be careful not to interrupt the customer's service. Player should also consider building redundant links, especially for backbone routers, so as link/router failure affect as few customers as possible.

Disasters

There are three types of disasters:

1. Link failure: a link my randomly fail at any time. If this happens, the link has to be replaced, and the player will incur the whole cost of the new link.
2. Router failure: also a router can fail. Routers incurring high loads are more susceptible to failure. If this happens, the router has to be replaced, and the player will incur the cost of the new unit.
3. Denial-of-Service (DoS) attacks: can happen randomly. These attacks target one customer, and causes the network segments leading to that customer to be overloaded, possibly affecting the whole network, and causing customer satisfaction rate to drop.