**Interactive Visualization of Dynamic Network Data**

**1. Description**

As our world is constantly changing, so do many real networks. For example, our friendship networks are evolving as we find new jobs, move to new places, and meet new people. The structure of the Internet changes every second due to failures of routers and incorporations of new ones. Proteins and genes in our cells interact in different ways as they move through different phases of life. Visualization is an important first step to examine the dynamics in those systems. And sometimes it is the key step to identify meaningful patterns in those complex networks. Although it seems to be a common task to visualize dynamic networks, it is not trivial and there is NO available tool to handle streaming network data and visualize it in an interactive fashion.

This project aims to fill this gap. The big picture of the product is as the following. A user will write a script (probably in Python, R, or plain text) describing how his/her network is changing, and send the script to our software. The software will read the changes and render the network dynamically. The user can interact with the visualization in multiple way, for example, pause or resume, zoom in or out, and so on.

First, we need to design a protocol to describe the change of a network in a concise and coherent way. Then the evolution of a network can be modeled as a series of events, for example, adding/removing a node, adding/removing a link, changing node properties, etc.

The second part is the actual visualization engine. Modern browsers such as Chrome, Safari, Firefox, etc. are best places for interactive visualizations. And there are good visualization engines in javascript such as d3.js, vis.js, and sigma.js, designed for visualization in browsers. Building on the existing visualization packages, we will implement an engine to render networks and changes of the networks as defined by our protocols.

The last part is to build a pipeline to connect these moving parts together. Specifically, we need a server that takes user input and transfer them to a client browser. Once the client receives a message it will render corresponding visualizations in the browser.

This visualization package will find applications in all kinds of domains that deal with relational data such as information systems, financial market, social networks, just to name a few. It will also revolutionize how we handle and visualize dynamic networks.

**2. Expected Deliverables**

* A pipeline that visualize dynamic network data interactively in modern browsers.
* Research article describing the method and tools.

**3. Related Work**

* “Networks: An Introduction” by Mark Newman or any other textbooks on complex networks
* Gephi (gephi.org)

**4. Prerequisites**

* Proficiency in programming language such as python, R, or similar ones.
* Proficiency in javascript.
* Analytic skills (algorithm analysis, mathematical notation, etc.)
* Any previous experience with network analysis is a plus.