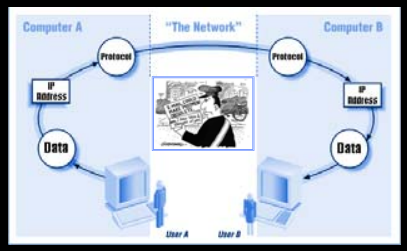
Multi Protocol Label Switching & Auto Bandwidth Allocation Mechanism

Dr. Jaudelice Cavalcante de Oliveria and Sukrit Dasgupta ~ Department of Electrical and Computer Engineering, Drexel University
Barbara B. Algieri ~ Drexel RET

RET Support from NSF-0227700 Dr. Mary Poats (Program Manager)

Computer Networks

Computer Networks are an electronic form of the national postal service. We all have experience with writing a letter, enclosing it in an envelope, addressing it and finally mailing the letter. The Post office implements a system to process and deliver the letter to the correct address. A computer network works much the same way. The letter is the DATA that is being transferred. The computer places that data in an envelope called a PACKET with an IP (Internet Protocol) address. The computer is programmed with a set of rules called PROTOCOL that delivers the packet to the correct address.



The Problem

Everyone has experienced a slow connection. This occurs because everyone is trying to send data at the same time and through the same path. The PROTOCOL implements 'Dijkstra's Algorithm' which selects the shortest path for every packet. This is where the problem begins, if everyone is using the shortest path congestion starts while other paths are unutilized. It's just like traffic during rush hour.

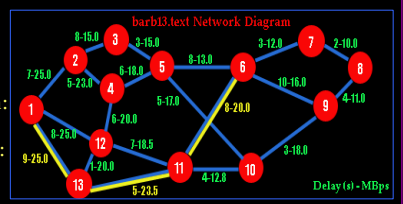
MPLS and Auto-Bandwidth

Multi Protocol Label Switching (MPLS) is geared to control the flow of traffic. Time sensitive data would be sent along a Label Switched Path (LSP) corresponding to the shortest path, while less sensitive data would receive a different LSP. Label switching also allows the setting up of dedicated paths for source destination pairs. Companies can reserve a specific amount of Bandwidth for their traffic alone. Bandwidth samples are taken every five minutes to measure traffic and then the Reserved Bandwidth for the LSP is resized automatically every hour. This allows for efficient use of Bandwidth on all links, optimizing the overall traffic flow. This research deals with creating the optimal and most efficient resizing criteria. The unused Bandwidth on any link can then be reallocated to another LSP, Auto-Bandwidth Allocation.

Simulator

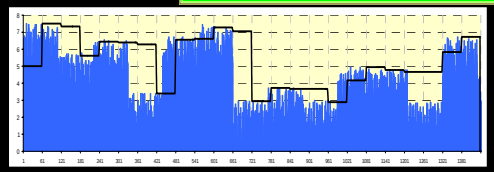
The Simulator Program used for this research was written in Java so that it could be run on any platform. The Simulator needs a Network Topology to run its tests on. Below is the diagram of the network that I wrote to simulate my own test results. The network also contains the Delays and the Bandwidths for each link. Once the network is entered in the system one or more LSPs (Source, Destination and Bandwidth) are chosen to test.

LSP
Source: Node 1
Destination: Node 6
Bandwidth: 5 MBps



The Simulator runs the CSPF (Constrained Shortest Path First) Algorithm and finds the best route depending on the constraints on the LSP and the available bandwidths on the links. (highlighted in yellow on the diagram)

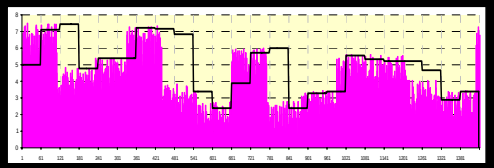
Simulation Results



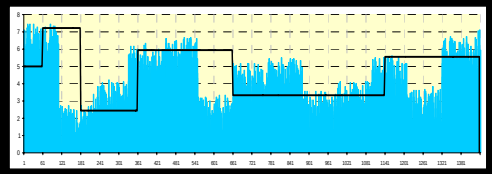
Resizing According to Maximum Sample

The present Auto Bandwidth Allocation uses the maximum sample every hour to resize the reserved bandwidth. This causes a resize every hour which creates a signaling overhead.

One variation is to resize according to the average of the samples from each hour. This still causes a resize every hour but leads to more efficient bandwidth reservations.

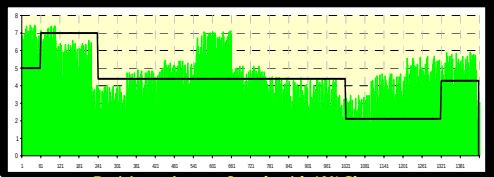


Resizing According to Average Sample



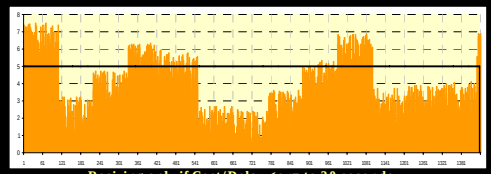
Resizing to Maximum Sample with 40% Change

Resizing takes place only if the maximum sample is more or less than the initial size by 40 percent. This results in much less signaling and more efficient bandwidth reservation.



Resizing to Average Sample with 40% Change

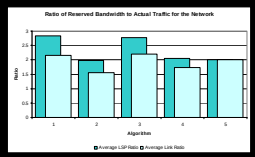
Resizing takes place only if the average sample is more or less than the initial size by 40 percent. This results in even less signaling and more efficient bandwidth reservation.

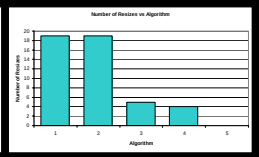


Resizing only if Cost/Delay <or= to 20 seconds

This simulation resized only if the total delay of the new path was less than 20 seconds. However, since the shortest delay in my network was 22 seconds for my LSP, it never resized.

The number of resizes and the ratio of reserved bandwidth to actual traffic for each LSP and link are compared. The most favorable mechanism has the smallest ratios and the least number of resizes. For these results, Method 4, Resizing to the average when there is a 40% change yields the best results. However Method 5 was eliminated because of the LSP chosen.





My RET Experience