Tunneling the Internet

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INTRODUCTION

Despite a considerable increase in the capacity of the Internet, regional congestion is still an issue at certain times of day. Dimensioning the system to provide minimal delay under these transient conditions would be uneconomical, particularly as various forms of application data are more or less sensitive to these delays, as are different end-users. We therefore investigate a scheme that allows end-users to selectively exploit a sequence of mini tunnels along a path from their origin to a chosen destination. We assume the availability of such tunnels is advertised centrally through a broker, with the cooperation of the Autonomous System (AS) domain operators, allowing end-users to use them if so desired. The closest analogy this scheme is that of a driver choosing to use one or more toll roads along a route to avoid potential congestion or less desirable geographic locations. It thus takes the form of a type of loose source routing. Furthermore, the approach avoids the need for inter-operator cooperation, although such cooperation would provide a means of extending tunnels across AS peers. In this paper, we explore the benefit in terms of delay reduction for a given concentration of tunnel presence within a portion of the Internet. We show that a relatively small number of tunnels may be sufficient to provide worthwhile improvements in performance for some users at least.

KEYWORDS

Internet, Autonomous System, loose source routing, tunneling, broker.

RESULT AND EVALUATION

A framework is built to investigate the benefits of using different percentages of tunnels present in a part of the Internet for sending data from one AS to another. The topology generator tool PFP (Positive Feedback Preference) developed by Mondragon and Zhou in 2004 [1] has been used to generate regional Internet topologies which are then fed into the bespoke tool we have developed. Dijksta's Algorithm calculates the least cost path from every AS to all the remaining ASes. Then the presence of tunnels are consequently added to the topology and least cost paths are again calculated for every percentage. The benefit of the tunnels present is calculated as follows:

Benefit from AS "A" to AS "B" for x% tunnels = [cost from A to B using no tunnels minus the cost from A to B when x% tunnels are present] ms

The amount of delay experienced via tunnels versus no-tunnel intra-AS paths and the corresponding cost ratio (1:3) have been chosen carefully after doing some research on Internet delay measurements [2, 3]. This tunnel-placement process is repeated 10 times for a given overall AS topology and the average and standard deviation of the benefit are calculated.. Figure 1 presents a graph of the results,

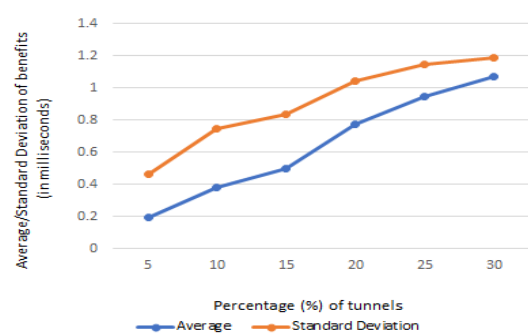

Figure 1: Average and Standard Deviation of Cost Benefit ()

It is clear from the graph that the benefit increases, as there is an increase in the percentage of tunnels present in the Internet. The average improvement is relatively small. This is not surprising, as many paths would incur a costly diversion to reach tunnel(s), particularly when they are few in number. However, the increasing standard deviation shows that between a smaller numbers of source-destination pairs, the cost benefit can be substantial.

However, if the standard path experiences delays brought about by "hot-spot" congestion then tunnel alternatives become much more attractive. Even so, in this paper we have omitted these "extraordinary" congestion scenarios as it is self-evident that access to low delay tunnels would be attractive.

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