SENSIBLE ROUTING IN LARGE SCALE NETWORKS

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Abstract

Delivering QoS in large scale networks is an important issue. We introduce *sensible* routing networks. In these networks, the packets make self-routing decisions based only on local information. Hence, the amount of information is independent of the size of the network. Sensible routing allows QoS goals for large scale networks to be met with less transmission overhead than active routing algorithms. We present the experimental results for various degrees of sensitivity on the network from zero-sensitive to full-sensitive.

1 INTRODUCTION

The possibility of providing improved QoS is of great interest in communication networks, and QoS can include important aspects such as resilience and reliability. One approach to improving QoS is to construct self-adaptive behavior either in the individual network nodes, or in the packets, or both.

In this paper, we investigate self-adaptivity based on the use of Smart Packets, inspired by our previous work on “Cognitive Packet Networks” [1, 2]. More specifically, we consider Sensible Routing Networks (SRN) in which smart packets sense network status to make self-routing decisions at each node based on myopic and local information. Since smart packets rely only on local information, the amount of information used in SRN is independent of the size of the network. In addition, since the local information is sufficient to estimate the QoS metric for each direction, the sensible routing approach is relatively simple to implement.

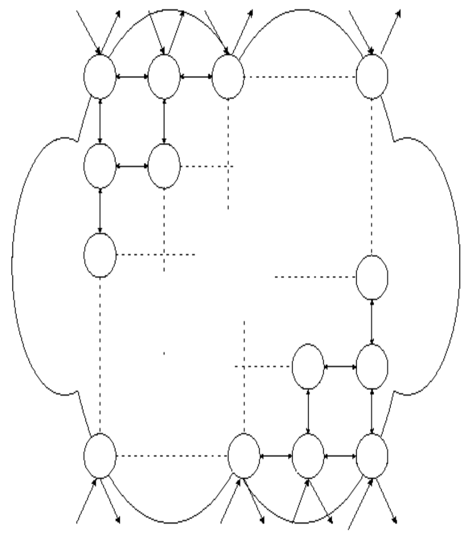

Figure 1: Topology of the simulated 100-node network.

2 SENSIBLE ROUTING

We introduce $k-sensible$ routing algorithms where each smart packet can sense the status of all links in a k-distance diameter (in number of hops) from its current location in the network, and obtain the QoS metric M (e.g. delay, or jitter) for each path in the corresponding tree. In k-sensible routing each smart packet will make a probabilistic choice of the *next hop among a set of allowable hops* so as to minimize the average value of M based on the sensed data up to k hops ahead. The set of allowable hops correspond to those neighboring nodes which can lead to the destination of the particular smart packet, excluding the node previously visited by the smart packet. QoS metrics of interest can include packet loss rates, delay, jitter, and their combinations. Note that delay and packet loss rates are good indicators of the reliability of a path. We prove that $(k+1)-sensible$ routing leads to a better average QoS metric than $k-sensible$ routing, so that obviously

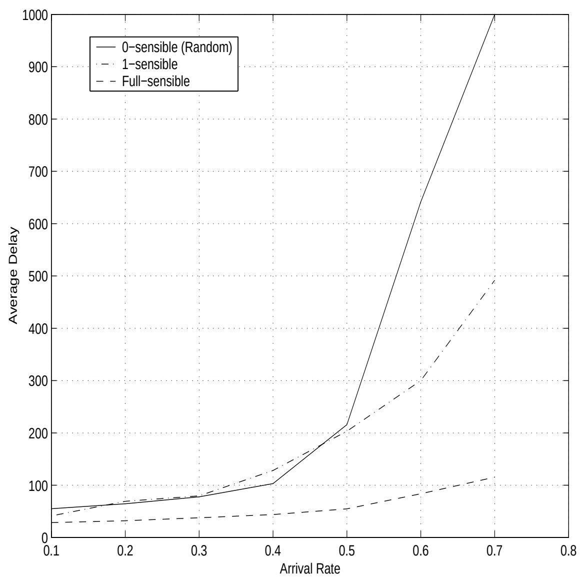

Figure 2: Comparison of 0-sensible (Random) routing, 1-sensible routing and routing with full information. The graph shows average end-to-end delay for the 100-node network of Figure 1 with external arrival rates between 0.1 and 0.7.

$1 - sensible$ routing is better than random $(0 - sensible)$ routing.

3 EXPERIMENTS

We present simulations of a 100 node network topology shown in Figure 1. In the simulation, smart packets self-route using sensible routing with delay as the QoS metric. The simulation results are summarized in Figure 2 and in Figure 3. Figure 2 shows the average end-to-end delay for 0-sensible (or random routing), 1-sensible and full-sensible networks with external arrival rates between 0.1 and 0.7. Figure 3 shows additionally the end-to-end delays for 2-sensible, 4-sensible and 7-sensible networks. These experimental results show how the increase in k impacts the packets' end-to-end delay values.

4 CONCLUSIONS

We observe that even a small value of k can provide significant improvement in QoS. Therefore, *k-sensible* routing with a good choice of k, seems to be a good and practical approach to achieve QoS goals with reasonable amount of overhead in large scale networks.

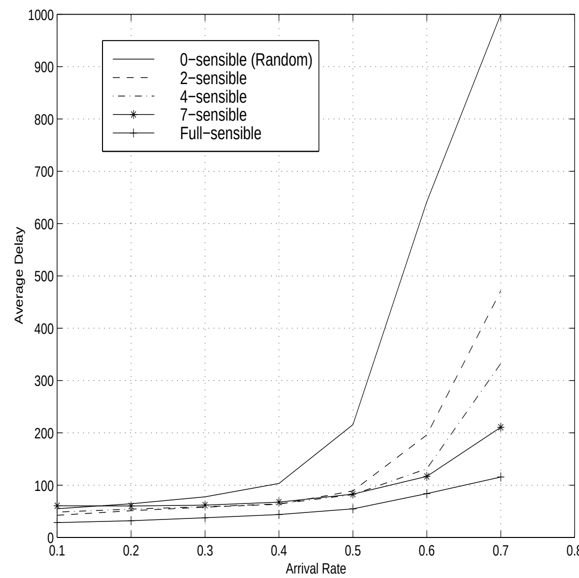

Figure 3: Comparison of 0-sensible (Random) routing, 2-sensible routing, 4-sensible routing, 7-sensible routing and routing with full information. The graph shows average end-to-end delay for the 100-node network of Figure 1 with external arrival rates between 0.1 and 0.7.

References

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[2] Erol Gelenbe, Ricardo Lent, and Z. Xu. Measurements and performance of cognitive packet networks. *Computer Networks*, 37:691–701, 2001.