AU J.T. 12(4): 217-226 (Apr. 2009)

Local Routing in Multihop Networks

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Abstract

The overlapping of multihop paths in decentralized networks may cause congestion at certain nodes and underutilization of other neighbor nodes. The choice of a given path for the delivery of packets from source to destination makes other connected nodes, located one hop away from the said path, prospective candidates for local rerouting in case of substantial increase of the traffic rates. Two-hop local rerouting is considered for general queuing with the use of the method of decomposition for non-product networks. Rate-delay equalization of packet flows among two concurrent local paths is used for splitting a packet flow for a given set of input parameters. The analytic model is solved numerically for both M/M/1 and GI/G/1 queues at the individual nodes. Each node has a single output channel having different service rates for packet delivery to different neighbor nodes .

Keywords: *Rate-delay equalization, local routing, two-hop path, general queuing.*

Introduction

The local routing in decentralized networks becomes an important factor in the establishment of reliable fault-tolerant paths for the delivery of packets over multiple hops. A reason for the occurrence of packet drop is the increased utilization of some nodes which handle more traffic while there are similar local paths along a chosen path, which can be used to share the traffic load. Such local paths exist in variety of topological configurations. In well connected network configurations, the optimal choices from a multitude of local paths are made by solving a combinatorial problem.

A typical case, especially in planar networks, is the rhombic configuration of four connected nodes where two opposite nodes represent local source and destination and the remaining two nodes could be used as intermediate nodes along two concurrent paths since each path consists of two hops as shown in Fig. 1. The said configuration of four nodes seems topologically trivial but there are challenging queuing issues associated with it.

The problem statement of local routing to be considered in this contribution is to find the optimal splitting ratio for a given packet rate so that the two paths could be utilized in the most efficient way for a given set of input traffic and service parameters. The realistic scenario of a single output channel, where the service rate of the channel changes dynamically when packets are sent to different neighbors, is used to interpret the packets from queuing perspective as different types of customers with their specific service rates. Also, each node can receive packets from several input channels simultaneously where the incoming packets are stored in a single first-come first-serve (FCFS) queue. This approach has been used by Batovski (2008) to implement the well known method of decomposition (Pujolle and Wu 1986) for the development of a custom network analyzer in multihop networks.

The said approach can be used to analyze the properties of local routing as well. Local rate-delay optimization model (Inthawadee and Batovski 2008) is to be defined for the chosen rhombic configuration of two paths and used together with the method of decomposition to obtain a suitable analytic model.