A Fuzzy Scheduler for Crossbar Switches

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INTRODUCTION

Crossbar switches have received significant attention over the past two decades. They consist of 2N buses to connect N input ports to N output ports in a matrix manner. Different arbitration rules can be applied to schedule the incoming packets in crossbar switches, such as Round Robin (RR), Earliest Deadline First (EDF), Longest Queue First (LQF), First-In First-Out (FIFO), and Random (RD). In these rules, only one criterion is considered to identify and serve the eligible packets. However, in this paper, we consider a combined variable to dynamically schedule the best effort flows. In our approach, queues are served based on the reconfigurable weights. The weight of each queue is a fuzzy combination of two parameters, length of the queue in the input buffer and the departure deadline of the packets.

THE STRUCTURE OF THE FUZZY SCHEDULER

As depicted in Figure 1, the scheduler consists of two inputs, buffer occupancy and departure deadline of the packets; and one output to determine the weight of the incoming traffic to make the scheduling decision.

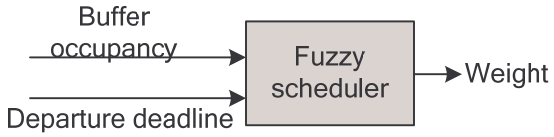

Figure 1: A Fuzzy Scheduler

There are three membership functions for each input and four linguistics terms for the output. The linguistic terms related to the input buffer occupancy are light, medium, and full corresponding to the queue length that has occupied the buffer capacity. The departure deadline is described by three expressions: short, medium, and long to represent the remaining time for the packet expiration. The four linguistic variables assigned to the output are low, medium, high, and too high to determine the weight of each queue for the packet scheduling. For instance, "too high" implies that particular packet has the highest priority for the scheduling process.

After applying the inputs to the fuzzy scheduler, the inference engine computes the output corresponding to each rule. A set of "If-Then" rule is used to derive a consequence similar to the human reasoning process. For example, "If the buffer occupancy is full and the departure deadline is short, then the weight is too high". Next, after organizing the fuzzy conditional rules, the inputs are combined based on the Mamdani model to produce the values for the output. The standard Centroid method is applied to calculate a crisp output value. Accordingly, a weight is allocated to each packet and then, arrival packets are dynamically scheduled through the crossbar switch based on their weights. The metrics used to evaluate the performance of the fuzzy scheduler are the throughput and the average delay.

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