

A Distributed Optimal Time Slot Assignment Algorithm for CRMA High-speed Networks

Jae-In Kim* · Sehun Kim*

* Department of Industrial Engineering, KAIST

Abstract

Cyclic Reservation Multiple Access (CRMA) is an access scheme for high-speed local and metropolitan area networks based on a dual bus configuration. CRMA provides high throughput efficiency and fairness independent of the network speed and distance. In CRMA, the headend generates the reserve commands periodically. Each station reserves a number of slots in each command if necessary. The headend will generate a sequence of cycles each of which is used to serve the reservations on the corresponding reserve command. Generally, a longer cycle length will conduct a longer access delay and a lower slots utilization. It is desirable to have a scheme to make the cycle length as short as possible. In this paper, we study the problem of reducing the total number of empty slots generated within every cycle as much as possible.

The phenomena of traffic locality usually happens in present networks, including metropolitan networks. By exploiting the property of traffic locality, several methods based on the concept of slot reuse have been proposed to improve the performance of the original CRMA. In these slot reuse methods, downstream stations may have chance to reuse those slots which have already been used by upstream stations and whose packets have already been received by their destinations.

It has been shown that the problem is NP-complete under the constraint that the slots used by a station in a cycle are required to be consecutive and can be optimally solved in polynomial time by relaxing the constraint. Several efficient polynomial time distributed algorithms were proposed under the constraint and recently a centralized polynomial time optimal algorithm was proposed without the constraint. For the considerations of implementation, the critical points are that since the centralized optimal algorithms have to be executed in the bus headends, the headends have to collect all traffic reservation requests of each node via reserve command and equip extra hardwares, such as VLSI chips to find optimal solution fast.

We therefore propose a distributed optimal time slot assignment algorithm for CRMA high-speed networks. The scheme is quite simple and the number of empty slots reserved in each cycle is optimal. As compared with the most efficient distributed scheme, the new scheme makes the cycle length much shorter.