

A discrete-time analysis of the cyclic reservation multiple access protocol *

Phuoc Tran-Gia and Rainer Dittmann

Institute of Computer Science, University of Würzburg, Am Hubland, D-8700 Würzburg, Germany

Received 31 July 1991

Revised 14 February 1992

Abstract

Tran-Gia, P. and R. Dittman/A discrete time analysis of the cyclic reservation multiple access protocol, Performance Evaluation 16 (1992) 185–200.

In this paper a performance analysis of the CRMA (Cyclic Reservation Multiple Access) medium access protocol, which is proposed as an access mechanism for high-speed LANs and MANs is presented. An approximate computational method is derived to obtain the distribution functions of performance measures of interest like the medium access delay and the packet transfer time. The analysis is done in discrete-time domain using a decomposition approach for the access delay in conjunction with a G/G/1 queue with control-feedback and a M/G/1 queue with server vacation. In the model the reservation–cancellation backpressure mechanism is also taken into account. Numerical results are obtained to investigate the efficiency of the backpressure scheme and the scaling issues of the interreserve interval under various load conditions and system configurations. Furthermore, results addressing performance aspects like the fairness issues, the jitter of maximum access delay and the system behavior under station-wise saturated conditions are also discussed.

Keywords: protocol performance analysis; HSLAN and MAN; CRMA; G/G/1 queue with control-feedback; M/G/1 queue with server vacation.

1. The CRMA protocol

The Cyclic-Reservation Multiple-Access (CRMA) protocol has been proposed recently as access scheme for high-speed LANs and MANs, especially in the network capacity region beyond 1 Gbit/s. The proposed protocol can be used in unidirectional folded-bus or dual-bus topologies. Detail descriptions of the CRMA access scheme with various bus structures can be found in [7] and [8].

From a performance analysis point of view, there are a few studies dealing with modelling

aspects of the CRMA protocol. In [2] analytic results for the mean values of the access delay are discussed, comparing different reservation mechanisms without backpressure in continuous-time domain. A simulation study of the CRMA protocol with backpressure is given in [5]. Simulation results also obtained in [6] to compare the end-to-end delay performance of CRMA with a modified version of the DQDB access scheme (DQDB: distributed queue dual bus) called DQMA (DQMA: distributed queue multiple-access).

To consider the efficiency of overload control mechanisms like the backpressure scheme in CRMA, it is necessary to know the entire state distributions as well as delay and transfer time distribution functions, rather than only the mean values and some higher moments. Thus, the major aim of this paper is to derive an approximate computational method to obtain distribution functions of performance measures of interest.

Correspondence to: Professor P. Tran-Gia, Institute of Computer Science, University of Würzburg, Am Hubland, D-8700 Würzburg, Germany. Tel. +49-931-8885-509, Fax +49-931-8884-601, Email trangia@informatik.uni-wuerzburg.dbp.de.

* This article is a revised and detailed version of our paper presented at the Conference on the Performance of Distributed Systems and Integrated Communication Networks, Kyoto, Japan, September 1991 [12].