RAPPORTS DE RECHERCHE

L.R.I.

PERFORMANCE ANALYSIS OF VARIOUS CARRIER-SENSE PROCEDURES AND THEIR COMPARISON WITH A RING MULTIPLEXING ALGORITHM FOR A SINGLE CHANNEL

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Juin 1979 *Rapport de Recherche n° 44*

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RESUME :

Le développement de centres de calcul distribués rend nécessaire l'étude et la réalisation de réseaux de communication à haut rendement.

Deux politiques présidant à l'élaboration de ce que nous appelons RESEAUX LOCAUX sont ici envisagées. La première est une méthode d'accès aléatoire avec algorithme de contrôle, la seconde est une technique de multiplexage.

Nous montrons que la première méthode permet d'atteindre des rendements de l'ordre de 93%, alors que la seconde ne permet que 90%.

L'étude est menée aussi bien sur l'aspect débit de ce genre de réseaux que sur l'aspect temps de réponse.

Des simulations sont venus confirmer dans une large mesure les résultats théoriques obtenus.

ABSTRACT :

The development of distributed computing facilities and of remote terminals imply that it is necessary to study and work out highly efficient means of data communication. It is this motivation which leads us here to study some access protocols at a single channel in order to form what we will call a LOCAL NETWORK.

Two different policies are studied here : the first consists in random access to a channel with a control algorithm in order to optimize the performance of the system (we would like to optimize it in terms of throughput and response or waiting time).

The second consists in a ring technique trying this time to obtain a stable throughput under very high traffic.

Our study will use two different analyses in order to compare these two possibilities ; the first will be a throughput analysis and the second will derive response and service times.

I - INTRODUCTION

Our purpose is to compare two methods of access to a single channel and to search for possible adaptive means of control which can give a maximum throughput.

I-1 - The random access method

The first method is an extension of the CSMA protocol (Carrier Sense Multiple Access Scheme) as suggested by Kleinrock and Tobagi [1] ; we will call it Constant CSMA (CCSMA).

The basic idea of this protocol is that a terminal which has a message ready to transmit, will listen to the channel, before transmitting, and keep on listening for a certain time after the beginning of the transmission.

A terminal wishing to have access to the channel will sense its state. If it is sensed free, the terminal will begin the transmission while keeping on listening for a time δ depending only on the geographical dispersion of the other users of the network.

If it happens that during this δ period a collision occurs, the terminal will stop the transmission after a certain delay and reschedule it for a later date.

Supposing that, at the first try, the channel is sensed busy, the transmission will be automatically rescheduled.

Consequently, it seems that this protocol avoids collisions as much as possible without necessarily requiring the synchronization of the terminals.

However, it is to be noticed that all or at least a great deal of the protocol is hidden in the scheduling or rescheduling of transmissions.

An adaptive algorithm which aims at giving a good means for calculating the retransmission times will be proposed below.

I-2 - The ring technique

The second method consists in a protocol in which every user of the network can transmit in turn. We thus avoid any kind of collision at the price of a certain constraint put on the synchronization between stations. However, the constraint comes from the channel itself in a way that we are going to define below.

This protocol will be called the ring multiplexing protocol (RMP)

Two kinds of messages can circulate in the channel : the so-called information messages and one "special message" which is to be distinguished from the others. The principal operating rule of this protocol is as follows :

> A terminal which is not given the special message must remain silent

Consequently, when a terminal receives the special message two things can happen :

1 - the terminal has no message ready to be transmitted, it only sends the special message to the next terminal on the ring.

2 - the terminal has a message ready to transmit ; it does so and then sends the special message to the next terminal on the ring.

The notion of "next terminal on the ring" can be defined as follows :

Each terminal sharing the network is given a number (chosen between 0 and N-1 if there are N users) ; the terminal following the i^{th} terminal will be the one whose number is j where

$$j = i + 1 \pmod{N}$$

Naturally, other ways of defining the next terminal could be considered. For example :

- the special message could be sent to the terminal which receives the ordinary message.
- the special message could be sent at random to any user of the network.