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Military Technical College
CAIRO - EGYPT

A NEW PRIORITY MESSAGE BASED PROTOCOL FOR ALOHA AND ITS ANALYSIS

M.A.Abou Seif* F.Shaaban** E.Garras**

Abstract

In this paper we describe a new prioritized protocol for ALOHA in a satellite channel which divides the messages on the channel to two classes : Priority messages (class-A) and non-priority messages (class-B). The scheme is based upon the principle that exclusive access right to the channel is given to class-A messages after each successful transmission from any class of messages [2]. This is accomplished by reserving the channel for a certain period of time during which only class-A messages can contend for the channel.

The equilibrium throughput and delay for both classes of messages are obtained and also the effect of reservation period of the channel on class-B messages by using a new language in the network analysis field (QNAP 2).

1. INTRODUCTION :

In multiaccess systems, all users share a common transmission medium over which they interchange their messages. It is well understood that, instead of furnishing individual low speed channels to users, it is more efficient to provide the available communication bandwidth as a single high-speed channel to be shared by the contending users. One efficient way for accessing the common channel in the satellite environments is the ALOHA technique which become popular in long-haul networks [4].

The contention-based protocols have a common problem :

The conditions assumptions under which the performance evaluation can be computed. The reason of this is that the exact performance analysis of these protocols are generally difficult, and therefore some assumptions and approximation are made so that the analysis can be tractable. In the analysis of these protocols, Poisson input sources and statistical equilibrium usually assumed, this mean that the stability problem which is present in all contention-based protocols was not considered in performance evaluation . On the

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* Signal Corps of Air Force.
** Military Technical College

other hand, the system under a protocol without random access channels is always stable [6].

It is required that a multiple access scheme be responsive to the requirements of each message on the channel. The introduction of priority for messages of the users in this multiaccess environments offer a possibility of being responsible to several classes simultaneously.

The new scheme introduced in this paper is prioritized ALOHA at which the name implies from reserving the channel for a fixed period of time. The start of this period is specified to be after each successful transmission from any class of messages. The priority messages contend, among themselves, for accessing the channel during the reservation period on an equal right basis in ALOHA mode. As we can see in this new scheme, there is no extra overhead needed for implementation nor any control information need to be exchanged among the users.

In section 2 of this paper, we give a precise description of the prioritized ALOHA protocols. In section 3, we present the traffic model, system assumptions and provide the intuitive analysis for the proposed protocol. In section 4, the simulation results will be present. In section 5, a brief conclusion is provided.

2. THE PRIORITIZED ALOHA PROTOCOLS :

The new version of ALOHA (prioritized pure ALOHA), divides the messages to two classes :
Priority (class-A messages) and Non-priority class (class-B messages). All classes of messages of users contend among themselves. After each successful transmission from any class of messages we reserve the channel RP period of time (seconds), see Fig.1, for the sole use of class-A messages. After this reservation period the channel becomes free for contention among the other class once again.

As we can see here, although class-A messages are prioritized over class-B messages, they are not seize the channel any time they have packets to transmit, this is because they are granted the right to use the channel during the reservation period. Not only that,but the beginning of this reservation period is controlled by any successful transmission. There is no overhead or controlled information needed to be exchanged among the users to reserve the channel because of the positive acknowledgment (ACK) sent back by the recipient. Our objectives in this protocol are to provide class-A messages with a communication channel which does not decrease the average throughput of class-B messages substantially. On the other hand, the delay of class-A messages should be kept minimal.

3. ANALYSIS OF THE PRIORITIZED ALOHA :

We point out that the usual assumption that no packets collect at individual class of messages is relaxed for both classes,this means that there is a buffer for holding the new generated packets from class-A messages until there exists a successful packet transmission from the other class. We also assume that any arrivals from class-B messages during the reserving period for class-A messages will be hold until the reserved period is elapsed.

INTUITIVE ANALYSIS

The analysis depends upon interdeparture time [3]. The inter departure time (IT),can be defined as the time between any two consecutive successful transmission from any class of messages normalized to the packet length, T.

So, IT, can be obtained by defining two interacting embedded Markov chains at the following instants of time, see Fig 2.

_ Inner embdded Markov chain defined at the end of each transmission (successful or not) from any class of messages.

_ Outer embedded Markov chain defined at the end of each successful transmission from any class of messages. Clearly, these two chains are dependent on each other. Since we assume infinite population model, then, we should introduce a model for calculating the average value of IT, for the protocol under consideration. We will use this model to find, by intuitive analysis, the performance of each class on the channel, no closed form expression is mentioned due to complexity of the behaviour of users on the channel.

4. THE MODEL :

Let N_d = # of transmission periods (TPs) in IT.

Since TPs are independent from TP to another, then, N_d is geometrically distributed with parameter p, p = Pr. [the given TP is successful]

Let IT_K = length of IT/N_d = K , K ... integer

i,e. # of TPs in IT is K (see Fig. 3).

-----> $IT_K = (K - 1)(UTP + I) + STP + I.$

-----> $IT_K = IT .Pr.[N_d = K]$

$= [(K - 1)(UTP + I)+ STP + I$

-----> $IT = (1/p-1)(UTP + I) + STP + I$

====> $\overline{IT} = (1/p-1)(\overline{UTP} + \overline{I}) + \overline{STP} + \overline{I}$

where $\overline{STP} = 1 + R + RP$

$\overline{UTP} = 1 + R + \overline{Y}$

Y... is defined as the time of last arrival between (0,t). Since the aggregate input traffic is Piosson distributed, then,

I = 1/G , G...normalized offered traffic from both classes,

=========> $p = \exp.(-2G)$

$$----> \overline{IT} = [exp.(2G)-1][1+R+\overline{Y}+1/G] + [1+R+RP+1/G] .$$

It's clear that IT depends upon system parameters R, G, RP and Y which is in complex way function in G , for fixed values of R,G the dependance on the parameter RP is linear one. We can obtain the limiting values of IT as G --> infinity or zero.

$$\lim_{G \to \infty} \overline{IT} = \text{infinity (channel saturated)}$$

$$\& \lim_{G \to \text{zero}} \overline{IT} = \text{infinity (no ready users)}$$

this also should be intuitively clear, since for both cases the average throughput goes to zero.

5- SIMULATION RESULTS :

The model of the proposed protocol is carried out by a new language (QNAP 2) which is specified in the network analysis and performance evaluation. The throughput_delay characteristic of each class is obtained against the total average traffic G. Notice that, in the case of RP = 0, the obtained result is the same as pure ALOHA (see figures 3-6). The effect of reservation parameter on the channel capacity seen in Fig.7.

6- CONCLUSION :

An important conclusion can be drawn here , namely, for small values of RP the decrease in the channel throughput for class_B message can be neglected. A new version of pure ALOHA multiaccess protocol has been introduced. The effect of reserving the channel for priority messages has a minimal effect on the performance of the non_priority messages.

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Fig. 1

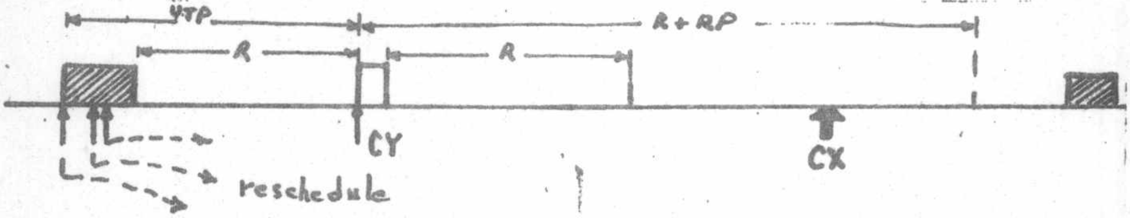
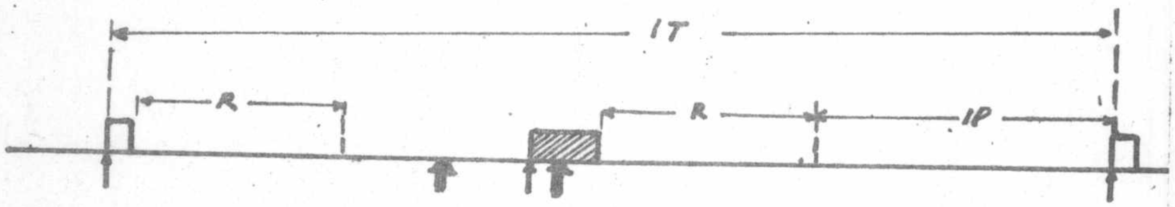


Fig.2



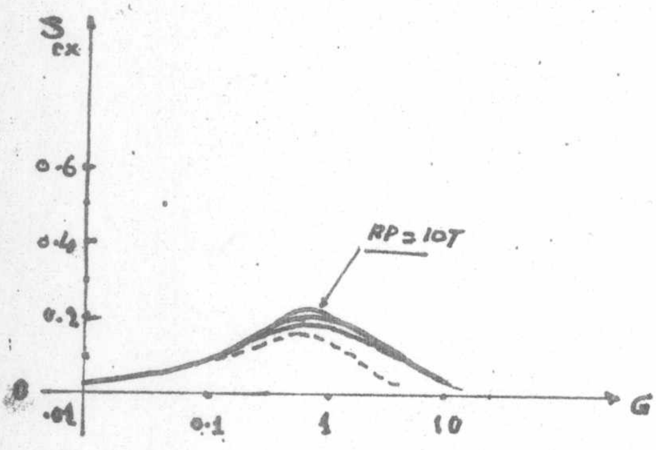


Fig.3

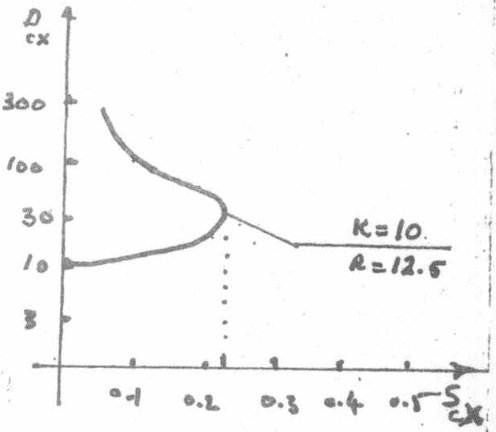


Fig.4