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AN ANALYSIS OF INFORMATION THROUGHPUT IN UNSLOTTED ALOHA WITH PARTIAL ACK OF RANDOM LENGTH PACKETS

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ABSTRACT

In the paper an unslotted ALOHA protocol with partial positive acknowledgment of packets and geometrically distributed packet lengths is discussed. The analysis is carried out with respect to the information throughput as a measure of performance quality. The results are compared with the pure ALOHA protocol.

1. GENERAL ASSUMPTIONS

Users of the ALOHA system transmit packets at random and hence the packets sent from different terminals may mutualy interfer and result in transmission errors. In the pure ALOHA protocol [1] all overlapped packets have to be wholly retransmitted. Most analysis is carried out basing on the assumption that the packet lengths are fixed. This assumption is due to the fact that in such a case the channel throughput reaches its maximum [2]. In this paper we are mainly interested in the improvement of the channel utilization for the case when packet lengths are geometrically distributed [3,4] and we allow a partial positive acknowledgment of the first of the interfering packets.

We consider three cases:

A) There is a possibility of partial ACK; we assume a geometrical distribution of information parts in packets.

B) The pure ALOHA protocol is used; information parts in packets are geometrically distributed.

C) The pure ALOHA protocol is used; packets have fixed lengths.

According to the principle of packet (message) switching each message I generated by a user is transmitted with an appropriate header H forming together a packet of length L=H+I. In cases A and B the lengths of I are geometrically distributed

$$P\left(I=kL_1\right) = q^{k-1}\left(1-q\right)\ ;\ k=1,2,\ldots;q \in \langle 0,1)$$

where L_1 denotes the length of one segmment (we assume $L_1=1$). In case C the length I is equal to the average length $\overline{I}$ obtain for case A or B. In all cases we make the assumption that message arrivals are governed by a Poisson process with arrival rate λ.

2. RESULTS

From Figures 1 and 2 one can see that the information throughput depends very strongly on the operational scheme as well as on the distribution of the packet lengths. Protocol A results in an

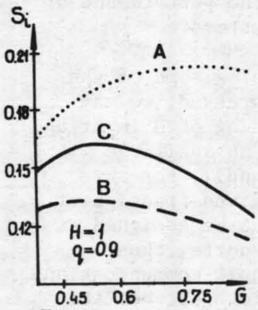

Fig. 1

The information throughput vs. the offered traffic

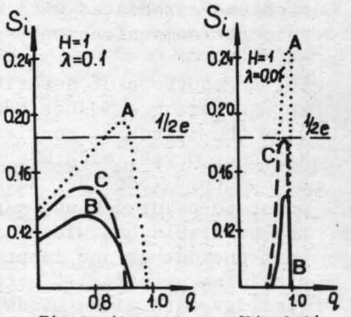

Fig. 2 a) Fig. 2 b)

The information throughput vs. q; where q the parameter of the geometrical distribution

increased value of the information throughput (or equivalently the channel throughput) in about 30% (for $q \to 1$). This means that such a modified protocol is preferable in the case of very long; at the mean, random length packets.

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