

# Performance Analysis of Random Multiple Access Protocols used in Wireless Communication

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**Abstract**—A Multiple Access Protocol is an access mechanism and a set of rules for successful transmission of information using a common medium. In this paper, the multiple access protocols studied are those used in communication systems in which the resource to be shared is the communication channel. For wireless communication efficient resource utilization relies upon effective sharing of the available medium. Contention based random multiple access protocols, specifically the repeated contention based random multiple access protocols such as pure-ALOHA, slotted-ALOHA, Carrier Sense Multiple Access and Inhibit Sense Multiple Access protocols, are studied and the results presented. The protocols have been evaluated based on the quality of service parameters such as offered traffic, throughput, delay and capture effect. The simulations were carried out using MATLAB v7.6.

**Keywords**—Multiple Access Protocol; Pure-Aloha; Slotted-Aloha; non-persistent CSMA; ISMA; MATLAB.

## I. INTRODUCTION

For wireless communications the multiple access protocols should be more robust with respect to changing conditions such as the hidden terminal problem, the near-far effect, and the effects of multipath fading, shadowing and the effect of co-channel interference. In this paper several typical wireless communication protocols are introduced and evaluated for various conditions. It is assumed that the mobile terminals communicate with a centrally located base station using packet radio. The best known method for contention based random multiple access packet communication is ALOHA [3]. As traffic increases in an ALOHA system collisions among packets leads to a performance drop. The Carrier Sense Multiple Access (CSMA) protocol [4,5] offers higher capacity, but its performance is affected by the hidden terminals problem. A third variation known as Inhibit Sense Multiple Access (ISMA) [6-11], in which the central base station controls the flow of packets from the mobile terminals, reduces the two problems: (1) collisions among data packets; and (2) hidden terminals. The inhibit delay fraction [6-11] is a decisive parameter in designing a packet communication system using ISMA, and is defined as a fraction of the packet duration necessary to inhibit other mobile packet transmissions by a broadcast outbound-signaling channel (base to terminal) in the event that the inbound multiple access channel (terminal to

base) is already busy. The ISMA protocols can be divided into two subclasses: (1) the non-persistent ISMA and (2) the p-persistent ISMA protocols.

In the non-persistent ISMA protocols, if the inbound channel is idle, a user can transmit a packet; otherwise, the user will wait a random time and then try again. At first sight it seems that it totally avoids collision, however due to propagation delay between two users, it is possible that a user considers the inbound channel idle and starts transmission while another transmission is already in progress. A user is informed of a collision by the absence of an acknowledgment packet from the receiving station. Upon detecting a collision, the packet is rescheduled for transmission at a randomly selected time later.

The remainder of the paper is organized as follows: Section II is the related background including a discussion of the basic performance parameters; Section III provides a list of the simulation parameters used; Section IV provides simulation results for Pure-Aloha, Slotted-Aloha, non-persistent CSMA and ISMA; and Section V provides a summary, conclusion and discussion of future work.

## II. BACKGROUND

Each user terminal connects to an access point by using an access protocol. Performance parameters affected by the access protocol utilized may be analyzed to identify overall system performance. The performance parameters offered traffic, throughput and average transmission delay have been identified as key parameters and analyzed in this study.

**Offered Traffic.** The total quantity of packets that include newly generated packets and retransmission packets at the access point in a time interval is called offered traffic and the normalized offered traffic by transmission data rate is shown in (1).

$$G = T/R \quad (1)$$

If no packets are generated,  $G=0$ .  $R$  is the transmission data rate and  $T$ , (bit) is the total traffic to be transmitted.

**Throughput.** The total quantity of packets that is successfully transmitted to the access point is called throughput and the normalized throughput by transmission data rate is shown in (2). The transmission data rate is  $R$  (bps), the quantity of information in a packet is  $T$  (bit) and  $n$  packets are successfully transmitted.

# Performance Analysis Of Multiple Access Protocols

**JE Gale**



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