# SMART REACH
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# Achieving Maximum Throughput in Random Access Protocols with Multipacket Reception

## Abstract:

This paper considers random access protocols with multipacket reception (MPR), which include both slotted-Aloha and slotted $\tau$-persistent CSMA protocols. For both protocols, each node makes a transmission attempt in a slot with a given probability. The goals of this paper are to derive the optimal transmission probability maximizing a system throughput for both protocols and to develop a simple random access protocol with MPR, which achieves a system throughput close to the maximum value. To this end, we first obtain the optimal transmission probability of a node in the slotted-Aloha protocol. The result provides a useful guideline to help us develop a simple distributed algorithm for estimating the number of active nodes. We then obtain the optimal transmission probability in the $\tau$-persistent CSMA protocol. An in-depth study on the relation between the optimal transmission probabilities in both protocols shows that under certain conditions the optimal transmission probability in the slotted-Aloha protocol is a good approximation for the $\tau$-persistent CSMA protocol. Based on this result, we propose a simple $\tau$-persistent CSMA protocol with MPR which dynamically adjusts the transmission probability $\tau$ depending on the estimated number of active nodes, and thus can achieve a system throughput close to the maximum value.