Coding Schemes for Multislot Messages in Multichannel ALOHA with Deadlines

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ABSTRACT

Slotted multichannel ALOHA is the access scheme of choice for short messages and to reserve channels for longer ones in mnay statellite-based networks. This paper proposes schemes for increasing capacity of multichannel Slotted ALOHA subject to a user-specified deadline and a (small) permissible probability of exceeding it, thereby jointly capturing the user requirements and the system owner's desires. The focus is on short yet multislot messages. A key idea is to achieve a low probability of missing the deadline by permitting a large maximum resource expenditure per message, while holding the mean expenditure low in order to minimize "pollution". For a K-slot message, redundant single-slot fragments are constructed using block erasure-correcting codes, such that any K fragments suffice for message reception. With Multiround Coding, an optimized number of fragments are transmitted in each round until K are received or the deadline is reached. Even with very strict constraints, capacities that approach the $1/e$ limit are attained. The Coding-Reservation scheme raises capacity above $1/e$ by allowing the hub, upon receipt of a message fragment, to grant contention-free slots for the remaining required fragments. Both schemes are adapted for use with single-transmitter stations at a small performance penalty in most cases. Finally, because capacity is maximized by minimizing the mean per-message transmission resources, the transmission scheme is also power efficient.