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Title: An Updated Version of GRAP

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Abstract

An new verison of GRAP with reservation and fixed maximum frame length is proposed to better support time bounded services. GRAP with excellent performance in multi-cell environments is thus attractive as a MAC of wireless LANs.

Introduction

One of the critical issues to design the MAC protocol is to support time bounded services and reduce network management overhead. A popular solution such as that proposed by researchers from IBM [1] and other similar proposals is the reservation technique. A novel MAC protocol with flexible frame length [2], GRAP, has been proposed to the committee. To further improve the proposal, a modification combining GRAP with reservation is therefore proposed in the following.

GRAP with Reservation

We basically divide a superframe into three parts:

(1) down-link traffic
(2) reserved transmission for up-link
(3) contention for up-link

The frame structure is arranged as follows.

<-------> down-link broadcast
|------| reserved up-link, at most M frames in a super-frame
[------] contention up-link, p frames in a super-frame

The purpose of reservation is two-fold: to save the polling overhead for time bounded services and to save the polling overhead for continuous time services. The down-link is still achieved by broadcasting. The up-link contention remains the same as GRAP. The only difference lies on the reservation part. The initiation of reserved traffic is through the contention. If necessary, the base station will assign a slot I.D. to the mobile node which needs time bounded or continuous services. Then, the traffic is handed over to the reservation part.

The reservation has to be limited by a maximum number of time bounded traffic and let this number be M. These numbers range from 1 to M. Each reserved traffic can be supported for a maximum duration (e.g. number of packets), after this duration, this traffic has to go through another contention cycle to request bandwidth to continue services. A counter built in the base station will handle this function.

The complete operation can be summarized as follows. Any uplink message may result in two kinds of situation - a continuous packet transmission or a time bounded service transmission for a while; only one uplink packet. In latter case, the MAC to handle uplink packet is straightforward as GRAP. Otherwise, the uplink packet will contain a reservation bit information to inform the base station to reserve a slot for future uplink traffic.

If the number of reserved traffic is less than the maximum limit M of the responsible base station, the base station simply assigns an I.D. of reservation which is simply a number between 1 and M, and the base station notify the mobile node to continue communication via the reservation period. If there are already M traffic in the reservation period, the base station has to turn down the reservation service request and the mobile node retains communication through normal up-link frame.

If the traffic in the reservation period is not a time bounded service, the base station will assign the maximal service time (the number of packets in the reservation period) at the begining of reservation. A counter associated with each traffic in this case will take care it. Please note that this maximal service time is smaller than that for time bounded services.

The base station simply polls based on the I.D. (1 to M) of reservation in the reservation period. Disconnection of reservation traffic is achieved simply via the cancellation initiated by the base station. What is the optimal M has to be determined by further analysis. To

constraint the maximal length of super frame, GRAP in the contention period has to terminate after certain time if possible collision(s) can not be resolved. All unsolved nodes have to be regrouped.

Finally, to maintain the "seamless" time bounded services, soft handoff with two reception levels must be used. Traffic in the reservation period will try to get a slot from next base station in the monitoring mode. This can be done in the contention period for next base station.

Conclusions

The operation of the GRAP with reservation has been proposed. The superframe length is upper bounded as a tradeoff between efficiency and time bounded consideration. GRAP has shown remarkable performance [3], especially in multi-cell environments with stability in traffic congestion while protocols in the ALOHA family (including CSMA and its variations) can not achieve.

References:

[1] K.S. Natarajan, C.C. Huang, D.F. Bantz, "Medium Access Control Protocols for Radio LANs", *IEEE P802.11/91-74.*

[2] K.C. Chen, "GRAP - A Proposed Medium Access Control Protocol for Wireless LANs", *IEEE P802.11/92-131.*

[3] K.C. Chen, M.C. Li, "Performance of GRAP in Multi-Cell Wireless LANs", *IEEE P802.11/93-xxx.*