IEEE P802.11

Wireless Access Method and Physical Layer Specifications

Title: Some Ideas on How to Overcome the Tx-Rx Switching Time Overhead

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Abstract:

A previous submission (IEEE P802.11-93/xx) described how the tx-rx switching time affects MAC protocol performance. This submission shows some ideas on how the overhead introduced by this parameter can be significantly reduced.

Related Documents:

IEEE P802.11-92/39	Medium Access Control Protocol for Wireless LANs
IEEE P802.11-93/40	The WHAT MAC Protocol
IEEE P802.11-93/83	Draft Proposal for FH and DS SS PHY Standard
IEEE P802.11-93/70	A Distributed Access Protocol proposal supporting Time Bounded Services
IEEE P802.11-93/xx	The Importance of the tx-rx switching time on the MAC protocol performance

Introduction

This submission describes some ideas on how the tx-rx switching time [BRE93] overhead may be reduced on the different MAC protocols currently under discussion on the MAC Working Group. The general ideas are presented first, and specific implementations on three MAC Protocols (IBM's [NAT92], Xircom's [BIB93], and NCR's[DIE93]) are discussed in the following sections.

The general concept

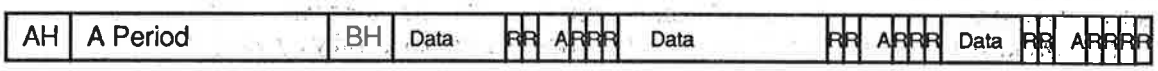
All the MAC protocols proposed till now, contain at least a two way transaction (DATA-ACK) for every data packet to be transmitted, this implies that a new data transfer cannot start before twice the tx-rx switching time (once before transmitting the ACK, otherwise it will not be received by the other station, and the second time after the ACK, because this last station will not be ready for reception).

The idea presented in this paper is to allow other stations to make use of this channel time to start a new transaction (a reservation request in IBM's proposal, an RTS/CTS transaction in Xircom's, or a new packet transmission on NCR's). This will be valid in the case that the new addressed station is not any one of the stations participating in the previous transaction.

The overall result is that we provide a way for interleaving of data transfers, reducing drastically the overhead introduced by the tx-rx switching time. It should be noted, that the overhead remains the same for a single data transfer.

IBM's Proposal Application

In the IBM's proposal, the above specified concept may be used for interleaving Reservation Requests with Data Transfers, by distributing the "C" Period Aloha Minislots interleaved inside the "B" periods, immediately after the Data and ACK Minislots, as shown in the following picture:

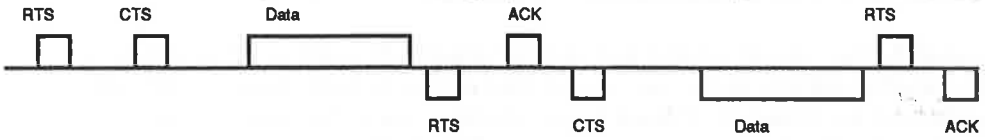


In order to assure a minimum number of reservation slots, the CF may append some additional reservation slots at the end of the SuperFrame.

It should be noted that if the data packet on the B period was addressed to the CF, then the surrounding reservation slots will not be available, the stations can learn which reservation slots are available and which aren't from the AH header where the reserved slots are assigned.

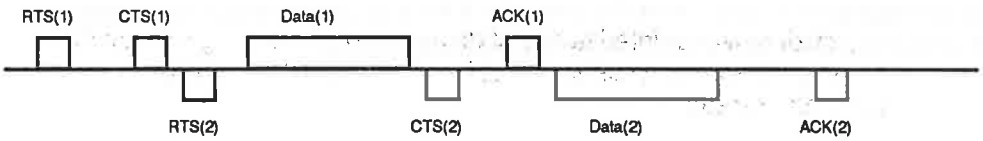
XIRCOM's Proposal Application

In XIRCOM's proposal the concept can be easily applied by allowing new RTS/CTS transactions to occur in the timeframe between the Data packet and it's respective acknowledge, instead of waiting for the whole transaction to end. This is illustrated in the following diagram:



The diagram shows two data transactions, where the second starts immediately after the Data Packet of the first transaction finishes. This enables data to be transmitted with a gap of twice tx_rx_switching_time instead of four times (which would be the case if the new RTS was sent tx_rx_switching time after the ACK).

The concept could be developed further by defining some kind of "advanced RTS", which could be issued immediately after the previous CTS was received, and its CTS would come immediately after the Data transfer, allowing the new Data transfer to start immediately after the previous acknowledge, the new timing is shown in the next diagram:

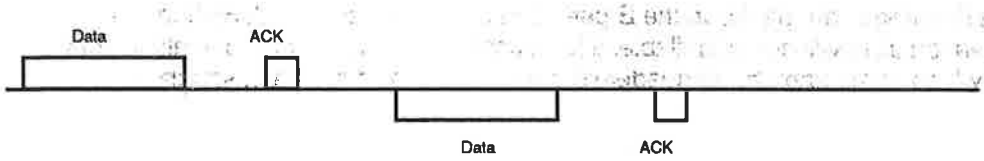


In this case the Data to Data gap is reduced to one single tx-rx-switching time.

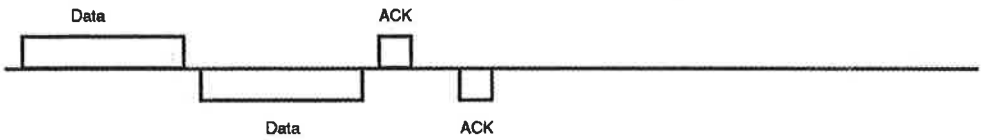
NCR's Proposal Application

For NCR's proposal, the concept usage would be similar to Xircom's, a new data transfer (with or without backoff) from a different station could start immediately after the Data packet transmission (without waiting for the ACK packet), and the ACK package will be transmitted only when the new data packet finishes (the ACK will still have a higher priority by using a shorter IFG).
An example is shown in the following diagram:

Instead of waiting for the ACK to start a new transaction, as shown below



the data transfer could start "immediately" after the previous data transfer:



Problems to be solved

These interleaving techniques affect the protocols' fairness, instead of being fair to the transmitters (as usual in LAN protocols, where each station has the same probability to transmit), the fairness is now given to the receivers (if station A wants to transmit to station B, it cannot do that if B was transmitting or receiving on the previous transaction).

This shouldn't (but needs further studying) be a problem for unicast messages, but it may be for multicast messages, a station wishing to transmit a Multicast (or Broadcast) message, should wait until no messages are transmitted for at least tx-rx-switching-time (otherwise the last transmitting station will not receive the message), and under high traffic conditions there will never be such silence period.

One possible approach to solve this problem may be issuing a "Broadcast RTS" message (which will have the same probability to be transmitted as any other message), and only after the tx-rx-switching-time elapses the data packet would be transmitted.

Conclusion

An interleaving technique that would reduce the overhead caused by the tx-rx-switching time was presented, while this concept does not increase the throughput for a single transaction, it allows for better bandwidth utilization when two or more parallel connections exist.

References

[BRE93] P. Brenner, The Importance of the tx-rx switching time on the MAC Protocol Performance, IEEE P802.11-93/

[NAT92] K.S. Natarajan, Medium Access Control Protocol for Wireless LANs, IEEE P802.11-92/39

[BIB93] K. Biba, P. Belanger, The WHAT MAC Protocol, IEEE P802.11-93/40

[DIE93] W. Diepstraten, A Distributed Access Protocol proposal supporting Time Bounded Services, IEEE P802.11-93/70