IEEE 802.11
Wireless Access Method and Physical Specifications

Title: A Compromise MAC Protocol Concept

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Abstract
An effective compromise is offered using major elements of both the Reservation Based protocol proposed by IBM (doc 91/74, 92/39 and others) and the Hybrid CSMA/CA Based protocol proposed by Xircom (doc. 92/14, 93/13, 93/40 and others). Three major changes are made to bring both protocols together:

1. CSMA/CA using RTS/CTS messages is used in the 'C' or contention area of the Reservation Based protocol.
2. HDLC-like framing structure is used for all data transmission
3. A mapping of functions to the 802.11 reference model is suggested that pushes low level framing into the Media Convergence Layer. The choices admittedly do not follow convention for the purpose of facilitating progress toward publishing a standard.

Issues Addressed
Due to the broad scope of this submission the number of issues effected in the Issues Log (doc. 92/64) is quite large. Especially relevant are sections 9 (Performance), 10 (Coordination Function), 12 (Interfaces), 14 (Connection Type), 15 (Services), and 17 (Addressing).

Introduction
For quite some time now two of the prominent protocols proposed to our plenary have been viewed as having "irreconcilable differences". The protocols need not be viewed that way. It is in the entire committee's interest to facilitate progress toward one MAC protocol providing interoperability with the first PHY Medium Dependent Layer (FHSS, 2.4GHz ISM).

This document is intended more as a "concept" document as opposed to having all the details and end cases nailed down. Admittedly there are numerous details yet to be resolved, but this document should provide the guidelines with which to make those decisions.

The description of this blend can be approached from a number of different angles. I have chosen to describe the differences to the Hybrid Asynchronous / Time-bounded Protocol first.

Hybrid Protocol Operation in the Absence of Reservation Protocol Cycles
This is the easiest starting point since there are no differences to the Coordination Function (CF); only differences to the frame structure. In this mode, a node would power up and attempt to acquire a potential existing FHSS hop sequence. If found, the Station (STA) must listen for Reservation Protocol cycles. Finding none, the STA has the option of initiating the cycles itself, or attempting communication using the Hybrid CSMA/CA CF as presently described in 93/40 - leaving the CF unchanged.

The major difference to the Hybrid Protocol exists in the frame structure. In all cases, the Hybrid Protocol uses the HDLC-like frame structure described in "Wireless LAN Medium Access Control Protocol: Description of the Air Interface, doc. 93/__". It is repeated here for clarity.

Table 1. HDLC packet frame structure

FIELD	BYTE LENGTH	VALUE	MEANING
F	1	0x7E	Start Frame Delimiter
DA	1	variable	Destination Address
SA	1	variable	Source Address
C	4	variable	Control Field
L	1	variable	Data Field Length
Data	variable	variable	Information Data
FCS	2	variable	Frame Check Sequence
F	1	0x7E	End Frame Delimiter

In addition to the frame structure, the definition of the control fields, the addressing and other elements of this document will be conformed to. Since the Hybrid Protocol uses additional CTS/RTS messages to avoid collisions, the format of these messages will also conform to the above general structure. The specific control field codes for CTS and RTS are TBD..

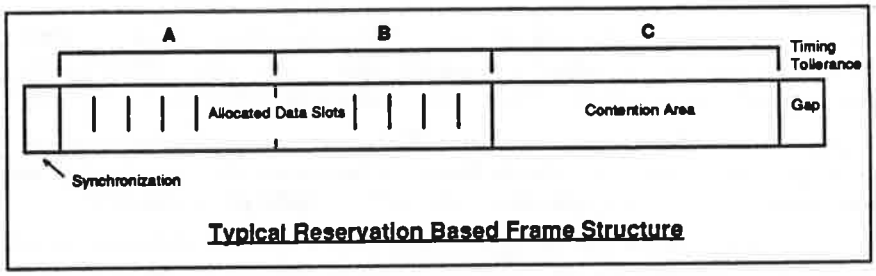
In summary, all transmission will utilize the same general frame structure. If no Reservation cycles are present or desired, the CF may operate according to the CSMA/CA (RTS/CTS) method for asynchronous (non-Time-bounded) data. Time-bounded data transmission is required to utilize the Reservation Based cycles.

Hybrid Protocol Operation in the Presence of Reservation Protocol Cycles

Similarly, a STA would awaken or power up and attempt to acquire an existing hop sequence. Assuming it is found, Reservation cycles are listened for and (in this case) found or initiated. Asynchronous data is now conveyed according to the bandwidth allocation of the CF, or within the contention area of the cycle.

If data is conveyed within the contention area (Area 'C'), it does so using the Hybrid CSMA/CA protocol. This is a major departure from the Slotted ALOHA protocol previously proposed for this area.

Data occupying any slot in the A or B intervals, or the C area, will use the HDLC frame structure described above.



Typical Reservation Based Frame Structure

The boundaries A/B and B/C are dynamic and a system could be designed with all data conveyed in the 'C' interval, however to conform to the proposed standard, the same system (STA) must operate with as little as 20% of the frame reserved for the 'C' interval.

Data conveyed in the 'A' and 'B' intervals and the allocation of bandwidth between all intervals does not change from the current Reservation Based proposal (doc. 92/39, etc.).

Functional Partitioning in the Reference Model

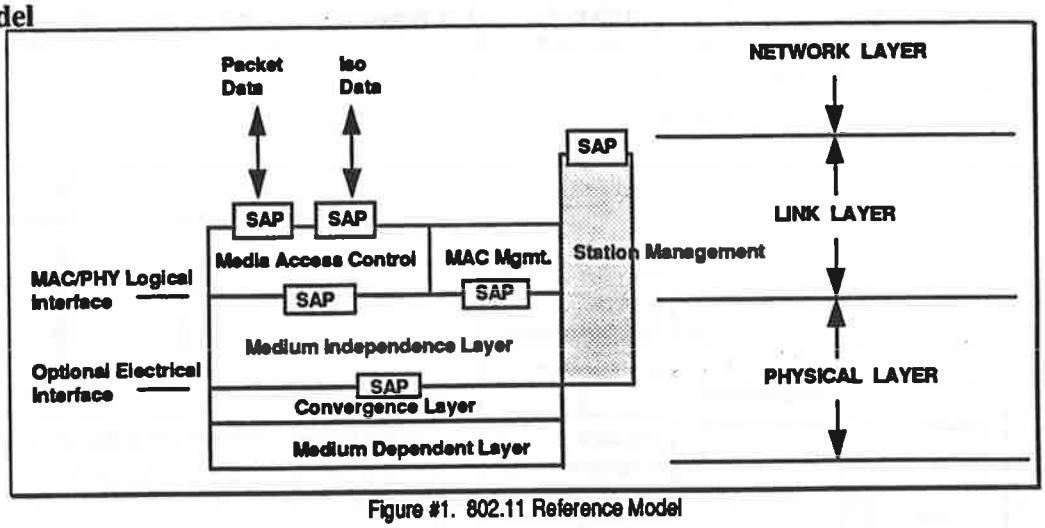


Figure #1. 802.11 Reference Model

The most unconventional aspect of our proposal is to locate the HDLC-like sub frame structure in the PHY Convergence Layer. Although perhaps not architecturally pure by a strict OSI interpretation, it is a practical and expedient approach to couple the FHSS PHY (which is closest to standardization) to certain elements of the blended protocol. We believe that if the proposed framing remains solely in the MAC layer, further delays will be incurred while additional development of the protocol was done for many other possible PHY MDL.

By coupling the framing and low-level timing to a particular MDL, design trade-offs such as performance, simplicity and cost are allowed to be naturally optimized.

Specifically we propose the following split of functions:

Layer	*Function*
Medium Access Control	• Association / Disassociation / Reassociation • Authentication • Security Interface • Interface to Distribution System
Medium Independent Layer	• Hybrid Mux: Time-bounded / Asynchronous selection • Bandwidth allocation • Segmentation and Reassembly • Low-level packet retransmission
Convergence Layer	• Assemble bits into low-level frames • Access Method: hybrid TDMA / CSMA • Low-level packet framing: Preamble, address, check field • Hop Timing: Acquisition and tracking
Medium Dependent Layer	• Bit Transmission / Reception • Activity Monitoring (Carrier Sense) • Signal Strength (RSSI) • Clock Recovery • Signal Acquisition and Antenna Selection

These functions are, of course, under the control of the Station Management entity. We agreed that document 92/98 formed the basis of our SMT implementation and further work on defining the function of the blocks was done and voted on at the January, 1993 meeting. A diagram or

mapping of how SMT fit into the approved Reference Model has never been done, and seems to point up an error.

Our current model shows SMT descending only to the Medium Independence Layer, when Steve Chen's doc. 92/98 more correctly shows connections all the way down to the Medium Dependent Layer (a.k.a. Physical Medium Dependent or PMD)

Should we alter the Reference Model?

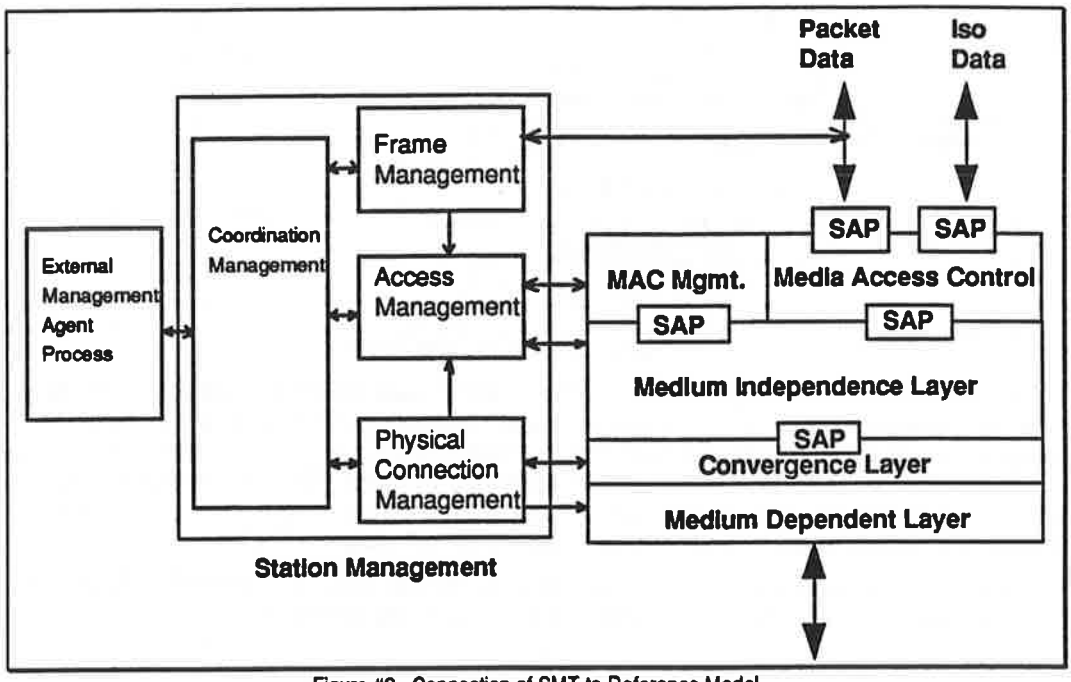


Figure #2. Connection of SMT to Reference Model

Furthermore, a number of committee members desires for more intelligence being located in the PHY layer can be accommodated, making an exposed DTE/DCE interface easier to implement. A Command / Status / Data protocol over this interface is easily imagined working within the proposed functional partitioning. For those of us interested in a "lowest cost" approach; the option of not exposing this interface does not increase complexity (cost).

Summary

A possible compromise position has been presented between two of the proposed MAC protocols. My intention of this paper is to lobby for a convergence of the protocols and further progress toward an approved standard. Three techniques have been described which ease this convergence.