IEEE 802.11
Wireless Access Method and Physical Layer Specifications

Title: **Functional MAC / PHY interface Requirements**

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Issue's addressed:

Requirements for the MAC/PHY interface.	(12-2)
Is MAC/PHY exchange needed for Management	(13-5)

Abstract: This document provides inputs on the functional requirements of the MAC/PHY interface, and discusses possible interface signal arrangements.
It is intended to serve as input to the MAC/PHY interface discussions, which is one of the subjects for discussion in the July meeting.

Introduction:

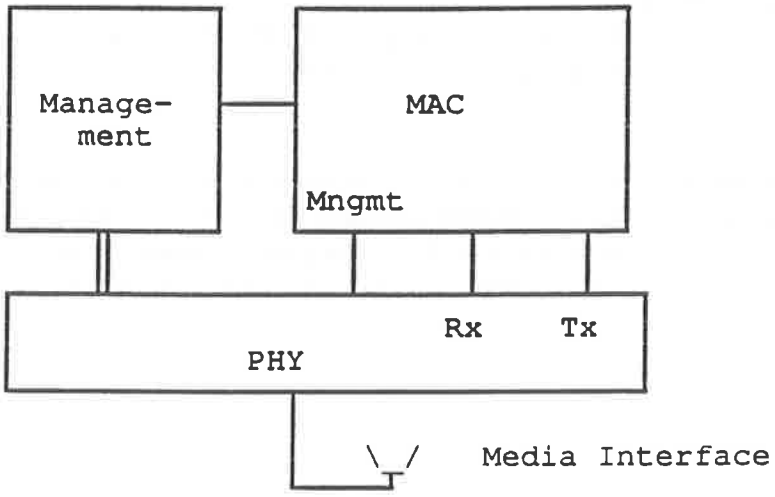
This paper is intended to provide inputs on the functional that need to be supported via the MAC/PHY interface, and will also address management interface aspects when appropriate. It is not intended to be a complete list of functions needed. The Management to PHY interface functionality items are mentioned but not further discussed.

Functional interface requirements:

The following functional subdivisions are relevant for the MAC/PHY interface:

- Transmit interface Function
- Receiver interface Function
- MAC/PHY management interface Function

In addition to that there will be a Management/PHY interface function.



The objective is to develop one MAC for a range of different PHY's. Although the MAC may contain PHY specific provisions, it is intended to provide for a generic functional MAC/PHY interface.

The functional characteristics that need to be supported are:

- Support variable PHY preamble length.
- Support for Ack protocol
- Support for dynamic Tx-Power control, and associated Defer threshold control
- Support for dynamic bitrate selection
- Support for Power Management / Sleep mode
- Frequency selection (Issue: Is Hop frequency selection PHY or MAC function)
- Tx/Rx Control
- Collect Quality Of Service information (QOS) per packet received:
  - Receive level
  - Signal Quality
  - "Silence/Interference" Level
  - Bitrate received
  - Antenna diversity information

Management to PHY functional interface characteristics:

- PHY initialization
- Channel selection
- PHY Identification
- PHY service specification
- PHY security control (Issue: do we need PHY level security)
- PHY specific tally collection
- Jabber Control

The following is a brief discussion of the functional characteristics listed above.

- Variable PHY pre-amble length

There may be large differences in the channel acquisition or training time needed in the PHY as a function of the modulation rate of the PHY. High speed systems will probably need channel equalization in the receiver to achieve acceptable performance. The training time for an equalizer may be a significant number of bit times. A 1 Mbps system on the other hand may do without it, so a considerable shorter training time would be sufficient.

- Support for Ack protocol

To return an Ack in the protocol, directly after a short Rx-Tx turnaround time, could require some unique PHY functionality. For instance it could be advantageous when the PHY use the same antenna to return the Ack packet, that it used during the reception of the Data packet. Therefore a signal may be needed between the MAC and PHY to indicate that a Ack packet is to

be transmitted.

- Support for dynamic Power Control

As explained in Doc P802.11-92/76 using dynamic Power Control have good potential for improving the medium re-use efficiency, especially in a single channel system.
A management interface is needed between the MAC and PHY under control of the MAC, that allows for downloading of Tx Power Level and Rx Defer threshold settings. In addition the MAC should have access to the received signal level and "silence" level information collected in the PHY on a per packet basis.

- Support for dynamic bitrate selection

Especially in a harsh environment it can be advantageous to use a variable bitrate per connection, so that far away stations can still be serviced, which would otherwise suffer from high loss rates. Control should be on a per packet basis, also in a connection oriented implementation, because the Access Point should switch instantaneously between connections.

- Support for Power Management / Sleep mode

The MAC must be able to put the PHY in a sleep or low power mode to conserve power consumption of the unit when no communication is in progress.

- Frequency selection

In a Frequency Hopping system it could be advantageous when a number of dedicated Hopping tasks are still located in a PHY dependent part of the MAC. Frequency band selection could be one such function which need tight control by the MAC to assure proper synchronization.
Issue: Is Hop frequency selection PHY or MAC function

- Tx/Rx Control

Tx/Rx switching is a medium access function which needs to be under control of the MAC.

- Collect Quality Of Service information (QOS) per packet received:

To support "Roaming" and "Handoff", the MAC will need Quality of Service information from the PHY to make certain decisions.
Since all kind of parallel activity can be going on the medium, it is crucial that only the information relevant for the received packet is collected. Possible QOS information are listed below.

. Receive level
. Signal Quality
. "Silence/Interference" Level

- Bitrate received
- Antenna diversity information

Note that Receive level and "silence/Interference" Level type of information is also needed to support (an optional) Power Control facility.

Intelligence distribution:

In general the MAC would be more intelligent than the PHY. This is because by nature the MAC can correlate things like Destination address, with packet success rate and things like number of retries needed and other tallies that can be maintained per connection. It will also have the task to monitor these different tallies to allow "handoff". The MAC is much more suited for this because it already contains the MAC frame interpretation logic generally needed.
The intelligence level of the PHY should therefore be low. It should be a datapump, which provides the necessary services to allow the MAC sufficient control.
To support all different type of PHY's it may be needed to have a PHY dependent layer in the MAC. Ideally this should be as generic as possible, with possible different parameterization per PHY.
An example would be a frequency Hopping PHY. Who should control the frequency selection and associated timing for that? There may be good grounds to do this in the MAC. On the other hands it would require unique PHY dependent logic in the MAC, which could burden the non hopping implementation significantly.

MAC / PHY Interface requirements:

Figure 3 shows a functional block diagram, indicating the additional functionality needed in the interface between the MAC and the PHY. Figure 4 shows a hardware implementation level blockdiagram in which the extra functions needed for the support of Power Control are shown. The additional algorithmic requirements needed are not shown, but these will likely be software functions needed in the Driver Software.

The MAC will need to manage the PHY on a per packet basis, and will either need a dedicated management interface for this, or will need control over any existing management interface. Before the medium is accessed, the Tx-PowerL and Rx-THRhold values need to be downloaded in the PHY, after which the MBUSY interface signal is being sensed as part of the "Listen Before Talk" class of distributed access protocol. At the end of a received packet, the Rx-level and Silence-Lvl need to be retrieved from the PHY, to attach it to the received packet in its receive frame buffer. The "Rx-Level" can be measured anywhere within the received packet. The "Silence-Lvl" should be measured in a defined silence period such as the Inter Frame Space (IFS).
It is likely that at this moment also other PHY status is collected that also need to be attached to the received packet. Examples will be any Quality Of Service (QOS) related status like "signal Quality".
Perhaps the TxD and RxD data lines can be multiplexed for this, to serve as a management datapath.