Ad-Hoc Group MAC/PHY Interface Meeting Notes

Date: 8 March 1994 (Tuesday Evening)

Notes taken by Simon Black

Chair: Jim Schuessler

List of questions - firstly should go back to 802.11 model (page 2-5 of 93/20) and talk about where to draw the MAC/PHY line. Also state machine diagram - page 5-3 . Couple of questions from FH PHY - and would like to spend some time discussing some of services PHY would provide to MAC at service boundary. Also one useful exercise - in tutorial session on Monday a list of implications for MAC/PHY interface was raised - might be useful to review in this forum. Jan Boer also has document on MAC/PHY interface for DS.

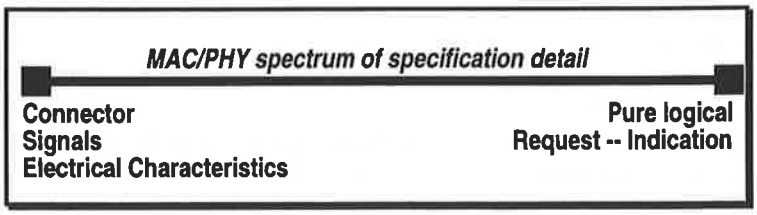
TOPICS FOR DISCUSSION

Agree on the 802.11 Model

1. **Is draft correct?**
2. **Is the state machine high level diagram better?**
3. **Where do we draw the MAC/PHY line?**

The Exposed Interface

1. **PAR seems to require it since: MAC must support multiple PHYs. Only way this can be proven is if some interface is defined between the two.**
2. **Where on the spectrum of physical to logical should the interface be defined?**



Define information that must traverse the MAC/PHY boundary

1. **Data**
2. **CCA**
3. **Signal Quality**
4. **Others?**

Questions to help definition of MAC/PHY Interface

1. **Is CCA binary or multi-value?**
2. **Is signal quality binary or multi-value?**
3. **Is the path dual simplex or half duplex?**
4. **Are the control and data paths the same or different?**

Ask direction from various PHY groups as to maximum length frame they would support at some common error rate. (10E-5)

Some discussion on max frame length - tentative proposal is 800 octets.

Do people think that page 2-5 is correct. DB:Where to put the dotted line is probably unimportant, want to get it so that it functions correctly.

Kerry Lynn (KL) : work of this group is sublayer above and below (medium independent layer and convergence layer).

Ed Geiger (EG): Presents unapproved PHY draft document - "Physical Layer Draft Specification for 2.4GHz Frequency Hopping Spread Spectrum Media", document 94/68. View of convergence layer - how you would map into given PHY. Try and make the interface as generic as possible - MAC might be able to view all PHYs in the same light without having to know the details about how they all worked. Assumes protocol reference model (on page 2). Service specifications in terms of primitives on page 4. Peer-peer primitive: PHY_DATA and sub-layer to sub-layer service primitives: PHY-TXBUSY, RXBUSY, RXERROR , CS, FREQHOP. Also list of parameters for each primitive. ANTSEL - antenna diversity - selection for next transmission. Primitives are just abstract way of defining service interface - does not define an implementation. ANTSEL is a controversial parameter - some people believe that this should not appear. Idea is that you, for example, select the antenna you received on for an ACK. Some people in PHY group believe that by using same antenna like this channel is reciprocal in tx/rx directions therefore want to be able to control this.

Dave Bagby (DB): life might be simpler if data and control were separate. Belief is that to make the MAC medium independent - medium dependent functions need to be in convergence sub-layer, this includes tx/rx state machines, clock recovery and clear channel assessment - data interface is whole octets.

EG: LENGTH field on RX : Proposal is to have length field at beginning of packet (in PLCP header), protected by CRC. Then can tell the end of the packet. If CRC does not check there is no indication. If there is a valid length field - PHY will issue RXBUSY indicating rx state machine is handling incoming packet. PHY-DATA indicate issued when last bit indicated by length is received. Remember this is abstract. What if length checks but the rest crashed? RX state machine will continue to recover data in line with length field - would then pass data up (and CRC would fail). There is a management primitive to allow reset rx state machine - but not sure when this would be used.

This is an abstract interface and the authors have avoided creating an exposed interface. This precludes real PHY independent MAC proposals, i.e. precludes 'just MAC products'.

Going back to the timing of the indicate primitive: in BEACONs there needs to be timing reference - defined as time that start of frame delimiter is generated. Reference is arbitrary. Are some time dependent primitives. Receive timing is on page 18 shows timing of RXSTART. If length field fails - get RX-ERROR indication, else get PHY_DATA indication at end of data field.

OK with abstract description of primitive. But taken out all timing. Core of problem is that MAC can't be time independent of PHY - and this is in danger of being lost in the abstraction. e.g. MAC has to do time measurement - and this would be related to primitives.

Stuffing - several proposals that imply that bits will be added to data stream in deterministic manner - for radio. Fixed rate stuffing. Discussion as to whether octets cross boundary - MAC people would see this more naturally if there was an octet stream. Control information could go via separate interface - but how do you tie everything together ?

Also primitives between PLCP and PMD in this document - at this level bits are being transferred.

Also some layer management primitives - power management (sleep modes) and indication that synth is locked. May be other management primitives.

Back to length. In rx diagram; is there are a requirement that the indication occurs when the length says. May have energy there. PMD_DATA last (and thus DATA ind) occurs at end of length (by definition) energy after this is just busy channel.

There is an RXERROR primitive that is indicated to the MAC if the length CRC fails.

Why have two CRCs - have to positively identify where CRC is (else power of CRC is diminished) - this is the reason for the length field - tells you where the CRC is.

To MAC - in this diagram - is the PHY_RX START enough.

Jan Boer: AT&T GIS

Presents overview of 91/61: Terms and method of description are different but intent is same.

On tx side signal requesting PHY to tx frame -TX enable.

Energy detect and Carrier sense (modulation) signals on receive

No length indicator in DS

Functional description of MAC/PHY management variables

Static variables: : PHY type, no. of channels available, number of transmit power levels, number of RSS and SQ levels, number of antennas, modulation capabilities of PHY (may support multiple mod schemes)

Then dynamic variables : defines things for the packet to be transmitted - power, mod scheme, rate, antenna.

and some receive variables: channel on which to receive, received RSSI, SQ, ...

Q: couple of parameters that the MAC needs to know e.g.: tx/rx turnaround time

Look at list that came out of the tutorial (94/57): continuous clear channel assessment, PHY channel selection, wake/sleep, fast wake time, CCA activation in middle of frame, signal quality, deterministic PHY delay.

Continuous clear channel assessment - will be discrete - at least sampled, but need to look as if its continuous from MAC perspective.

Need to consider normalizing signal level/quality over PHYs. Issue in association or hand-off. Therefore need information in order to select transmission path - may also be a help in selecting transmit power level.

IR PHY group have done work on this also - IR list is v. similar to DS list. V. good convergence between these two PHYs.

Purpose of this group is to bring convergence.

Fragmentation Issue: Question from MAC to PHY - discussion in MAC group - should we do fragmentation in MAC. MAC service user expects to be able to use some minimum size DU. May be at odds with what is sensible from a radio perspective. Several possibilities - like see what you can do given the radio and let the MAC user sort the problem out, or do fragmentation to suit. Discussion came down to what order of magnitude PHY could deliver with reasonable error rate. PHY people say depends on channel error rate. 800bytes suggested. May be somewhat high - 500-600 may be closer. Sometimes channels are better than others - how much effort do you want to put in to compensate - e.g. doing fragmentation then making fragment sizes dynamic, or use FEC.

Is there likely to be a significant difference between 600 and 1500 bytes. Non-scientific straw poll indicates that somewhere in the 500byte range is reasonably comfortable.

One of the other critical issues is clear channel assessment response time. May need to do same type of negotiation. Talking about 100-200µs. Two numbers how long to tell MAC channel is active and then inactive.

Some of these issues are important for realistic simulations - need to get some representative figures.

Close until tomorrow.

Ad-Hoc Group MAC/PHY Interface Meeting Notes

Date: 9 March 1994 (Wednesday Evening)

Notes taken by Rick White

Chair: Jim Schuessler

Will not make any formal motions since several people are at the social.

Agenda

- Request for small group to work on Common PHY MIB
- Michael Fischer to present summary of list
- What time dependencies are we concerned with?
- Given a Service Primitive Structure: request, indicate, confirm: Goal: To agree on the set of MAC/PHY Service Primitives and Parameters they contain
- Clarify purpose/use of length in PHY header
- Not strictly an interface issue, but... Resolve location of frame check sequence (CRC) - how many, where are they and what do they do they protect?
- If there is time... Address Tx-Power control on a per station, per frame basis (Wim)
- Jim McDonald to present summary of CCA paper
- Michael Fisher presented a table of a possible PHY MIB
- Summary of Monday's foundation tutorial, FH PHY Spec, and DS PHY Spec

Michael went through the table hitting the high points.

Ed Gieger indicated that there may be some things that could be eliminated and some things that may need to be added.

Ed: Are there any critical timing issues that were missed in 94/68

Are there parameters in the PHY MIB that cover the time it takes to send the ack

The MAC will not care if the radio has not seen a rx idle when an Ack is to be sent. The radio will send the Ack

The radio will not determine whether to transmit or not based on CCA. It will be commanded by the MAC.

Will the transaction of a frame and an Ack happen all on one frequency? The answer was yes. If an ack is not received the packet will be transmitted.

May need an addition number that address the amount of time require to do diversity.

Need to set a maximum value for doing antenna diversity per PHY

One thing that has come appear, the MAC should examine values that have a max and mix value and determine which are important.

What if the MIB contained just the information that was require by the MAC. There seemed to be an agreement on this.

What about a vendor identification in the MIB so that he could do better on the specs. There was violate disagreement with this.

Need to identify parameters that are not interoperable dependent. This allows a vendor to do things better. An example is receiver turn-on that might allow a vendor to sleep longer before waking-up.

Do not want to allow vendors to provide deltas for parameters that it can it can do better.

Presentation of CCA summary by Jim McDonald

The transmitter should worry about will it be interfered with and will it interfere.

Four types of clear channel assessment considered

RF Power detection

Clock or symbol rate detect - could be very sensitive

A hybrid of power and rate detect

Packet detect

Would be blind to the idle pattern

Collision can false packet detect

Kerry Lynn: Could use the all the above in combination.

Greg Ennis: Packet detect can not give a clear channel assessment immediately when coming out of sleep

Jim Mcd: Only a problem when you need to transmit when coming out of sleep.

Peter Chadwick: Packet detect will try to transmit over microwave interference. CCA broken into three areas, don't care-just transmit, don't transmit if a like system, don't transmit if you hear anything.

Dave Roberts: MAC already has packet detect. MAC will not transmit if it is receiving a packet.

Five criteria used to compare expected performance

False Deferral

Could we determine the detection time for each of the possible CCA types?

Packet detect = 100 - 150 usec

Clock recover = 25 - 50 usec

Power Detect = 10 - 20 usec

Mark Demange: Slot time have to be at least as long as the preamble.

Michael F.: The MAC does not view packet detect as a clear channel assessment. CCA is very critical to operation to the MAC.

Consensus is that quicker CCA is better than a perfect CCA.

MAC group should take a look at doc 94/70

Both groups need to get together to discuss speed shifting.