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## IEEE P802.11 Wireless LANs

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**Title: Minutes to IEEE P802.11 WLAN High Data Rate FH-PHY Group  
Ad-Hoc Group Meeting**

**Dates: Buckhead, Atlanta  
September 20 and 22**

**Minutes by: Jerry Loraine  
Symbionics Ltd**

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### SESSION 1

17.15 to 21.45 September 20, 1993

#### 1. INTRODUCTION

WM: Goals establish any and all new issues for the full PHY committee consideration.

Motion, Feher, 2nd Jan Boer, WM and NS stay as co-chairs,  
No others were proposed, Question was called, vote as follows  
Yes= 12, No= 0, Abstentions=8.

**Motion Passed**

We are now an official Ad-hoc body.

A near complete attendance list is appended to this document in the form of a photocopy of business cards.

#### 2. SECRETARY

JL, Symbionics, was awarded the position of temporary secretary.

#### 3. CHANGES TO AGENDA AND GENERAL DISCUSSION

We should set a minimum for the higher data rates, e.g. >1.5Mb/sec, we should consider how to implement the gear shift. The aim should be to generate a proposal for consideration by the PHY committee.

Le Maut: We want something much higher than 1.5Mb/sec to give a real benefit to the users.

WM: We are trying to have interoperability with the same network using the same MAC. We are not trying to create a new standard, but extend it within the existing FCC rule.

Feher: Proposed a charter for the new committee:

'The initial issue of this group is to recommend specifications for a significantly higher data rate of 1.5Mb/sec minimum which is interoperable with the 802.11 FH PHY standard in the next 6-12 months. The output of this committee will be the completion of the framework requirements given in 93/83R1 for submission to the full PHY group.'

WM: Accepted friendly amendment to change specification not design, and to remain within the guidelines 93/83r1: This was accepted.

NS: Accepted friendly amendment, establish a minimum higher data rate, use significantly higher/1.5Mb/sec: accepted.

Dean Kawaguchi: remove 'throughput': accepted.

LVDJ: Motion: We (this ad-hoc group) can raise our own issues, then submit as input to the main PHY group.

Vote: Yes= 22, No= 0, Abstentions= 4.

**Motion Passed**

WM: Like to deal with issues to bring us to a focus. We need volunteers to generate issues for consideration.

NS: Questioned if MAC shift up and down

WinD: The understanding was that MAC will allow multiple bit rate.

LVDJ: Pointed out that this was a personal opinion, not a consensus within the MAC group. This should be discussed on Wednesday morning.

The agenda was agreed.

#### 4. APPROVE/REVIEW DRAFT MINUTES

WM: Minutes are brief, but does anybody propose a change. Shall we accept minutes? Vote restricted to those present at the meeting in Apple, Cupertino.

Yes=6, No= 0, Abstentions=0

**Minutes Formally accepted**

#### 5. ACTIONS

No discussion.

#### 6. NS, REVIEW AND UPDATE OF ESSENTIAL CRITERIA DOCUMENT (DOC NO. 93/164).

NS: Reviews document 17 September. Considers list as too long and it needs distillation into key points.

Le Maut: Pointed out that the work was in competition with RES 10 in Europe?

Feher: Stated this group is looking at 2.4GHz band.

WM: We could consider higher frequency bands at a later date.

WM: Document will be numbered, then distributed for further discussion on Wednesday.

## 7. HIGHER DATA RATE PRESENTATIONS

### 7.1 Feher's paper 93/183, section on FQPSK

Suggesting that 500kb/sec GMSK would give a better robustness than 1Mb/sec, on the grounds of a better Eb/No. The advantages of FQPSK and its variations were reviewed, it was pointed out that patents were held on the technology. For faster synchronisation with variants of FQPSK, Dr Kato's (NTT) patents could be used. These were offered (verbally earlier in the day) free of charge if the specification were accepted. Feher requested inputs from industry to help him develop a strategy for exploiting his technology. Results presented on FQPSK-KF were simulated, not practical results.

NS: It would fair to consider coherent demodulator performance for all figures.

Feher: We cannot do this as some parties, e.g. Proxim, are not making information public on their system. As a result I have estimated their performance.

L Zukermam: What is the effect of diversity on the figures regarding the non coherent systems, does it close the gap between GFSK and coherent systems?

Feher: Not sure of improvements, but adaptive equalisation is messy and he thought that it would not work with the non coherent systems.

Feher: Apologised for non availability of "Create" software, it is not currently in a fit state to distribute.

WM: Thanked Feher for his presentation. Time pressure means we need to close meeting soon, we should reconvene on Wednesday night, who will not be available.

General: Discussion as to time agenda. Unanimous decision for a Bio break, then to have Kato's and NC's paper.

### 7.2 Kato's presentation

Implementation Architectures.

Coherent vs. non-coherent, non coherent is easier, but offers poorer performance. VLSI is required to reduce size and power consumption of the coherent demodulator.

Proposing that the QPSK system requires 16 symbols for carrier and bit timing recovery for a burst demodulator (that is it has no knowledge of the data's time of arrival). This technology is the same as that used in Japanese PHP, where the bit rate is 384kb/sec.

Summary of other points:

Estimate the power consumption for FQPSK modulator is 150mW;

Reviewed carrier recovery circuits including reverse modulation, x4 configuration and Costas Loop. Reverse modulation requires very much lower SNR, and is used in satellite and PHP systems.

WLAN demod, would require 30k gates and use 20mW for 1.5Mb/sec, this excludes the ADC and any radio circuits. If based on 60Mb/sec circuit. It was estimated that a

demodulator, if based on PHP, would use 10k gates and use of the order 10mW, again excluding the radio and the ADC.

Improving Eb/No improves Frame error rate more than the long term aggregate BER.

NC: What is channel bandwidth?

Kato: 300kHz.

NC: Is there a problem with the change in ratio of channel spacing and bit rate, (384/300 for PHP versus 1.5/1).

Kato: Not thought to be a problem.

Feher: What about equalisation?

Kato: Yes it is possible with the coherent demodulator, but we have nothing to report on progress at NTT.

WM: Thank you very much, we appreciate your presentation.

### 7.3 NC's Presentation, Simulation Results For Several WLANs... doc. no.

Summarised comparison table. Again estimations made for Motorola and Proxim's demodulator performance. It is estimated that Proxim's performance is less than that possible with other four level schemes, but achieves the highest bit rate to date with the exclusion of Lannair's proposed 8-FSK.

A review of the FLOQAM patented by Lannair was given. It has 3 level I and Q signals, which are staggered by 1/2 a symbol. Square root raised cosine filtering is applied. This enables a saturate amplifier to be used. The demodulator is a limiter, quadrature 3 level slicer.

FLOQAM was compared to FQPSK. The FLOQAM enables a higher symbol rate, of the order of 1.8Mb/sec compared to 1.2Mb/sec. This however was at the expense of a reduced Eb/No.

Dean W: Is this similar to the 9 state QPR modulations?

General discussion, 9 QPR is well acknowledge scheme used successfully by Northern Telecom.

NC FLOQAM can use a non linear PA and a limiter in receive, 9 QPR cannot.

Feher: Suggests Lannair use up to date figures for FQPSK, then do a patent search on the techniques they use. It was pointed out some of the techniques were patented. Finally the FLOQAM should be considered in terms of its immunity to delay spread, Feher stated that he believed the modulation scheme would be useless in a multipath environment. Feher also questioned if the FLOQAM was patented by Lannair.

NC: He was not aware of the patent situation.

Followed a NC/Feher 'discussion'. Outcome was, it was agreed that the multilevel modulation schemes required increased complexity in the demodulator and high carrier accuracy and good phase noise performance.

JL: Suggest analyse modulation schemes with 2 ray model, with delay, amplitude and phase variation.

Feher: Use Cellular model?

NC: Agreed to provide performance simulation results in the presence of multipath at the next 802.11 meeting. **ACTION**

General discussion as to how to compare modulation schemes. Suggestion was to use same model and presentation scheme as in Kato's paper.

Feher Proposes: Multipath sensitivity information should be presented, with the assumed criteria, then the comparison method will be agreed.

WM: This was how we agreed in Cupertino to present the results.

General discussion, we need to set tolerances later for the spectrum mask. It was agreed that each proposed should evaluate the effect of tolerances and susceptibility to multipath with time delays in the range of 10nsec to 300nsec. **GENERAL ACTION**

Presentation continues. NC is proposing a family of modulations to improve performance of the system. NC presented the following:

Proposed 2,4&8 FSK,  $hM=2/3$  with pre emphasised sqrt-rolloff filter. Plots show  $<-20\text{dBc}$  in 1MHz channels for 700kSymbols/sec.

AFC is required to track frequency errors, with a differential phase demodulator.

Simulated results presented.

Propose use of trellis coding to reduce errors.

Feher: What DC accuracy is required or what ADC is required?

NC: 4-Level needs 6-7 bits, 8 level needs of the order 1-2 more.

JL: Questioned complexity of implementing system, notably modulating the VCO, transmit modulation filters and the receive filter.

NC: This replied that this was being quantified.

JL: Suggested evaluating the transmitter accuracy requirements and the effect of Tx and Rx phase noise.

Feher: Have you evaluated effect of adjacent channel interference.

NC: Not yet.

Discussion summarised that further work is required.

WM: Thanked very much for presentation and asked for copy of foils to be given to audience. Hoped that two submissions could be made to 802, one of them to

help FCC(USA) to offer the same quality of service as ETSI RES10, by trading spectral power density with occupied bandwidth (e.g. 4MHz channel spacing, with 100mW EIRP). We should concentrate on raising real issues to ensure that the gear shifting is included. Ideally the 'gear shift' higher data rate specification would be available when the 1Mb/sec is completed.

## SESSION 2

17.00 to 19.15 Wednesday 22 Sept., 1993.

### ATTENDANCE LIST, SESSION 1

NS, WM, K.Feher, F Le Maut, H Kato, Dean K, J Socci, K Morita, J Rackowitz, Alexander Belfer, JL.

### INTRODUCTION TO SESSION 2

- WM Purpose is to set future meeting plans. A review was given of progress to date. Naftali has given copies of his presentations to WM, these can be distributed when the appropriate headers have been added.  
Distribute Naftali's OHPs Action WM
- Feher We need support from larger companies in the form of contributions to prevent the group dying.
- NS MAC must be capable of gear shift, we should ensure it remains an issue.
- JL 802.11 is the 1Mb/sec system, are we proposing that higher rates are in the standard?
- NS No we want to have the hooks added to the MAC. We need to make issue of the gear shift is essential.
- Feher Motion, 2nd NS, That one of the chairmen open the issue that 'it is essential that the gear shift is included in the MAC' as an issue in tomorrow's PHY meeting.
- Yes =7, No =0, Abstentions =2. Action one Chairman
- NS Asked for technical inputs to enable the generation of a first cut higher data rate PHY. NS volunteered to help generate this document.
- 8.**
- WM Item 8 complete.
- 9.**
- WM Item 9 covered in the joint session, is it closed?
- NS What higher data rate should we go for?

WM We should understand what impact we have on the MAC. Item 9 complete.

**10**

Feher We should write to FCC to get a clarification on 99% power bandwidth, then take the aggressive interpretation.

WM John Reed's answer is read the law! We should write an amendment to part 15 to allow wider channels in our next meeting. **Action Group**

Feher Volunteered to draft the modification. It was accepted. **Action Feher**

**11**

WM Item 10 now closed. Item 11, actions deferred to next meeting. Item 12 closed. Future meetings should be scheduled when more people are available. How can we achieve this.

General discussion. Monday morning, Sunday evenings before the reception were suggested.

The suggested time agreed for the next meeting was unanimously agreed as 08.30 Monday morning in West Palm Beach.

**AOB:**

Kato Do we have a channel model?

NS No.

**Future Meetings**

- 1) West Palm Beach Plenary, time TBD.

**Key to Names**

- JL Jerry Loraine
- LDVJ Larry van der Jagdt
- NC Naftali Chayat
- NS Nathan Silberman
- WM Wayne Moyers

September 1993

DOC: IEEE P802.11-93/xxx

IEEE P802.11  
Wireless LAN

Title: High Data Rate FH-PHY Study Group  
Atlanta, GA, Holiday Inn, Buckhead  
Date: 6:00 PM, Monday, September 20, 1993  
Room to be announced

## TENTATIVE AGENDA

1. Introductions and Purpose (by co-chairs: W. Moyers and N. Silberman)
2. Appointment of a Secretary
3. Approval/Suggested changes/additions to Tentative Agenda
4. Review/Approval of Draft Minutes: Meeting and attendance at Apple Computer on 8/23/93
5. Actions based on 8/23/93 Cupertino meeting - Discussion
6. N. Silberman: Review and update of essential criteria document
7. Higher bit rate WLAN proposals/Presentations/Discussion
  - a) M. Kothenberg, Lannair, Israel
  - b) K. Feher, UC Davis, USA\*
  - c) S. Kato, NTT, Japan\*
  - d) Others as offered
8. MAC control interface and "gear-shifting" method for interoperability - Discussion (Concepts are requested for means to implement vote of PHY committee and set up liaison with MAC group)
9. Discussion of minimum bit rate decision taken and "message delay/throughput" relation to BER and C/I robustness tradeoffs
10. FCC issues: ref. to 99% power spectrum or integrated vs. -20db rule and proposal potential for possible wider instantaneous FHSS Bandwidth, ie.  $\geq 2$  MHz new assignment/rules
11. Further recommended actions of study group
12. Generation of Issues for 92/64 Document - Discussion
13. Future meeting plans

\* Presentations (a) - (d) could be during the day on Monday to the full complete PHY committee (Highly recommend this if time and interest allows) so as to allow time for further discussion in the evening of specific "high" data rate concerns.



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