Title: **Minutes to IEEE P802.11 IR PHY Sub-Group Ad Hoc Meting San Jose, CA**

Date: **January 11, 1993**
7:30 p.m. to 9:45 p.m.

Chairman **Roger N. Samdahl, Photonics Corporation**

Secretary **Barry A. Dobyns, Photonics Corporation**

The minutes to the meeting are presented in a 'dialogue' style. This is not an exact transcript, and many comments may not have been captured accurately, or have been edited, thereby improving or destroying the grammar. Comments of the secretary are presented inside <angle brackets>.

Attending Members:
Rommel Atienza, UC Davis
James G. Bertonis
Peter Blomeyer, Andromeda Gmbh
Dr. Kwang-Cheng Chen, National Tsing Hua University
Barry A. Dobyns, Photonics
Richard Ely, Unisys
Mel Farrer, Diablo Research
Dr. Dr. Kamilo Feher Feher, UC Davis
Wei Gao, UC Davis
Francisco Jose Lopez-Hernandez, Univ. Polytechnica de Madrid
Roger N. Samdahl, Photonics
Michael Serrone, Diablo Research
Michael A. Soderstrand, UC Davis
Rui T. Valadas, Universidade de Averio
Jeanine Valadez, Advanced Micro Devices
Hirohisa Wakai, Sharp
Hongying Yan, UC Davis

<Meeting was called to order by Roger Samdahl at 7:30 PM>

Roger Samdahl: Tom Baumgartner is no longer available to chair this meeting, and may not continue to participate in the 802. Because Larry Van der Jag is sick and not in attendance, I have been asked to temporarily chair this meeting.

<A paper was presented by Peter Blomeyer, IEEE 802.11 94/24>

Peter Blomeyer

<These are highlights of Peter Blomeyer's presentation, refer to the actual paper, IEEE P802.11-94/24 for details>

This scheme is compatible with 802.11, but many other groups, especially the IRDA group are coming to market fast.

We must develop a standard which allows different applications in one environment.

Many manufacturers are rushing to transmit data in a single IR medium, but they all use different techniques.

Adoption of IR is being driven by concerns about regulation, data rates, health and safety. There will be too many vendors to share a single channel medium successfully.

Different services must share a single room, for example in a single conference room, there may be projector and AV remote controls, interpreter systems, printers, and an IR LAN.

These cannot go in the same protocol, and we must separate them. Peter Blomeyer proposes a separation scheme based on channels, as in Radio.

- Only one channel limits market to one application at a time.
- No standards for baseband communications have ever been accepted by an international standards organization.
- A standard must be compatible with the existing installed base and cannot obsolete it.
- Eight channels solve adjacent interference problems.
- Peter Blomeyer presented at the last meeting a paper 93/217 which describes this scheme in outline.
- Market projections indicate that there will be between 2 and 17M mobile data communications units by 1995, probably 30% will be IR.

Peter Blomeyer proposes that we develop his proposal in 93/217 to the point that it can be adopted <by 802 as well as other international standards bodies> by partnering with other companies, especially chip makers. Andromeda is building feasibility prototypes for this scheme now, and is talking with chip makers about modifying their designs for IR use.

Peter Blomeyer wants help from:

- System Implementors
- Chip Makers
- Communications Companies

< Peter Blomeyer presented a Recap of 93/217 >

Peter Blomeyer — Modulated transmissions in IR are under consideration for regulation by two international standards committees.

- IEC-BBB-6
- IEC-84 BAND V

Francisco Jose Lopez Hernandez — What wavelengths of IR are they regulating, specifically? What about the 1,300 nm band?

Peter Blomeyer — I believe that they are considering regulating from 0 to 30 MHz modulation in the 800 to 920 nm band.

In any event, it is not possible to channelize based on the wavelengths. If that were possible, then the problem I am trying to solve would just go away.

Dr. K.C. Chen — Not so, you can easily channelize in at least two channels, a 800 nm to 900 nm band and another at about 1,400 nm.

Francisco Jose Lopez Hernandez — This is because the silicon for those bands are blind to IR in the others.

Dr. K.C. Chen — How are you going to modulate for your channelization?

Peter Blomeyer — We're going to do QPSK

<Unparameterized debate about the relative merits of various modulation scheme>

Peter Blomeyer — Let's defer the details of Andromeda's QPSK modulation to a later discussion.

Dr. Kamilo Feher — IR Medium is band limited, want to maximize the capacity and must be robust against noise. Do you have linear or nonlinear amplifiers?

<Some conversation lost here>

James G. Bertonis — Are there better LED's that you guys are getting? I can't get better than a couple of MHz out of the LED's I have.

Peter Blomeyer — There is a quantum leap at about 30 MHz in price, and after that it goes up exponentially.

James G. Bertonis — There's a big jump at a few MHz too.

Peter Blomeyer — Yes, that's true. There are very cheap ones which can do a few MHz, suitable for use in consumer products, but for "professional" use, the products cost between $0.30 and $0.50 and can support rates up to about 30 MHz.

Rui T. Valadas	Power is the problem. the proposed scheme is not so efficient in the use of power. I am not in favor of a multichannel scheme.
Peter Blomeyer	The market need for multichannel overrides the concern for power. But we must do both. This scheme allows for baseband below 5 MHz. We cannot judge today which strategy will succeed.
Dr. Kamilo Feher	<To Rui T. Valadas> My understanding is that QPSK, as proposed, will be as efficient as NRZ if you only transmit on channel.
Roger Samdahl	Does this scheme require linear modulation? Are the LED's fully on/off?
Dr. Kamilo Feher	GMSK has a constant envelope.
Dr. K.C. Chen	How do you modulate, specifically? Knowing the modulation makes it easier to visualize the solution.
Dr. Kamilo Feher	We should stick with constant envelope schemes.
Richard Ely	It looks to me like we will have a real problem with adjacent channel interference. You can't build optical filters, you know.
James G. Bertonis	GMSK solves this.
Dr. Kamilo Feher	In radio now, if you look at modern designs, there are no filters, it is all shaped in the baseband by your modulation technique.
	< Peter Blomeyer ended his presentation and yielded the floor>
Dr. Kamilo Feher	Will this committee build a PHY specification by November? Will that PHY interoperate with the MAC?
Roger Samdahl	Exactly. Several proposals for IR PHY standards have been made, but there are surprisingly few contradictions on details. There is good agreement on low frequency IR PHY, and there is less agreement on high frequency.
	If we are to publish by November, then we must resolve by July all the big issues.
	I am strongly adamant that there be an IR PHY this November, I do not want it to be an RF only specification in it's first ballot.
Dr. Kamilo Feher	That answers my first question, but leaves the question of interoperation with the MAC.
Barry A. Dobyns	Our PAR states that it must interoperate, I don't think we have any choice.
Dr. Kamilo Feher	The 1 MBPS and 2 MBPS rates are "firm" in the RF PHY groups, as well as the MAC. Should we also arbitrarily limit our considerations to the 1 and 2 MBPS rates? We must come to a decision very fast based on already presented material.

Peter Blomeyer	Should include the 1 MBPS solution. From many analog problems the 1 MBPS helps, and the 2 MBPS also. MAC people believe that IR does not have the same <level of complexity> of problems as RF.
Dr. K.C. Chen	FSK is better. PSK, QPSK give us fading problems of RF
Peter Blomeyer	Whatever MAC decides for interface will be fine for us, but we will have same issues as RF when we go to higher speeds.
Dr. Kamilo Feher	Dave Bagby <Chair of MAC subgroup> is limiting to only 1 MBPS now. It would be best for us to go for only one of 1 MBPS, 2 MBPS or 4 MBPS now.
Richard Ely	Didn't we decide this already? I thought we had adopted the 16-PPM for 1 MBPS.
Dr. Kamilo Feher	<To Peter Blomeyer> What is the lower bound on the number of subdivisions? Is there any reason for your choice of this number of subdivisions?
Peter Blomeyer	Five or Six is the lower bound. You can have as many as your hardware can resolve as an upper bound. Since you can keep moving to higher frequencies above 30 MHz as hardware permits, you can have unlimited subdivisions.
Dr. Kamilo Feher	Who is the chair here?
Roger Samdahl	I am the temporary chair. Larry Van der Jag must elect a new chair, but he is unfortunately sick this week.
Dr. Kamilo Feher	I believe that we need to find a permanent chair if this subgroup is going to produce anything by the November Letter Ballot.
Roger Samdahl	I feel that Larry Van der Jag, who is the chair of the PHY subgroup should participate in the selection of a new permanent chairman of this committee
Dr. Kamilo Feher	I think that appointment of a chair is inappropriate. The DS PHY has operated for some time with two co-chairs which were not appointed. Furthermore, who will be the contact point for the work which must be done between now and the next meeting? We should not wait in Larry Van der Jag and should elect a new chair now.
Roger Samdahl	I would like to defer the choice of a new permanent chair until the next meeting. However, I am willing to be the contact point between now March.
Roger Samdahl	IR is such a small part of the puzzle to the other sub-groups, especially the MAC, and to the plenary, that we "don't exist." I would like to propose a strategy is that we "emulate" one of the other radio PHY interfaces so that we do not have to be dealt with separately by the MAC group.
Dr. Kamilo Feher	What? <more verbose>

Roger Samdahl	We would emulate the interface to the MAC, not the modulation scheme. There is excellent work that has been don on modulation by other groups. We would simply present to the MAC one of the common interfaces that another PHY presents.
Peter Blomeyer	I don't understand your issue, this is a trivial matter.
Richard Ely	Tom <Baumgartner> has gone over some of this stuff already. Is there anything unique about us?
Peter Blomeyer	No.
Barry A. Dobyns	It is very dangerous to emulate either DS or FH, or any multichannel MAC. If the only interfaces the MAC has presented to it are radio, especially multichannel radio, then there will be a strong temptation by the MAC group, to use special features of DS or FH to solve technical problems in the MAC, like interference. This temptation will be even stronger for implementors of the MAC. This would be very bad for us.
Dr. K.C. Chen	Trying to figure out FSK, one problem is LED not coherent and PIN diode not linear, you have lots of face noise. Probably face noise dominant over signal. Talking about 200 KBPS using FSK.
Dr. Kamilo Feher	Based on my experience on phase noise in satellite communications, for non-coherent receivers, phase noise screws up higher speeds. For coherent receivers, you can <??> out the phase noise.
Dr. K.C. Chen	This is very different from satellite communications.
Dr. Kamilo Feher	My experience in fiber digital communications is the same. More problems with phase noise for <u>coherent</u> receivers the <u>slower</u> you go. More problems with phase noise for <u>non-coherent</u> receivers the <u>faster</u> you go.
Rui T. Valadas	In documents 93/79 and 93/154, which have been presented to this group already, I analyzed the baseband schemes NRZ, Manchester and PPM. The conclusion is that PPM is the best. This correlates well with the conclusions that the fiber optic people reach. We saw 8 dB gain with 16-PPM versus NRZ. We cannot afford more dB than we need.
Dr. Kamilo Feher	Were there proposals for FDM other than Peter Blomeyer's proposal?
Francisco Jose Lopez Hernandez	I agree with Peter. It is better than baseband, faster rate. We must have many more bandwidth. If FDM works, it is much better than 1 MBPS channel per room. If cheap 40 MHz LED or faster can be found, then it can be easily expanded. Gets us away from fluorescent interference in baseband part.

Dr. Kamilo Feher	What is the frequency of interference?
Dr. K.C. Chen	Fluorescent interference is between 50 KHz and 500 Khz
	Low cost is most important. What kind of face noise can we endure? Probably about 1 percent. 5 MBPS would have different impact.
Rui T. Valadas	Be happy to have multichannel IR PHY, but it might have some technical problems.
	Also we need the most sensitive scheme - that's baseband.
	From 1 MBPS to 10 MBPS we need much more power, most sensitive - that's baseband.
Dr. Kamilo Feher	Most sensitive? Do you mean more reliable?
Rui T. Valadas	Yes
Dr. Kamilo Feher	There's no argument that baseband is always more reliable than any modulation scheme.
	Do you have numbers for your bit error rates?
Rui T. Valadas	Yes, in document 93/79
Dr. Kamilo Feher	What is the market question which drives FDM? Why do we need more than one 1 MBPS channel in a single room?
Roger Samdahl	I have always excluded multichannel from my thinking on this.
Rui T. Valadas	This problem is not so critical in radio because of the natural isolation provided by IR.
Peter Blomeyer	Not so. We have seen installations where there are a hundred IR application users in the same medium, in the same room. Consider a warehouse or large conference room.
Rui T. Valadas	Mac will support single channel PHY. Can have several Access Points on the same channel, but PCF cannot overlap.
Peter Blomeyer	It must be possible to operate devices on more than one channel at once.
Rui T. Valadas	What is the purpose for multichannel

Peter Blomeyer	In nearly every installation there will be multiple applications, in the same room. E.g. ad hoc networking as well as instrumentation. Some of those other applications will be using baseband schemes which are not compliant with our PHY. Multichannel allows us to avoid their interference
Richard Ely	If we are to make progress, we must decide. There is a proven market for 1 MBPS baseband. Additional channels are more work, and should be considered later, if at all.
Peter Blomeyer	Must have baseband and high frequency multichannel. No chance for us to standardize before IRDA beats us to market.
Roger Samdahl	IRDA is 100 KBPS baseband
Richard Ely	We must start at baseband.
Dr. K.C. Chen	Let's propose a baseband using past work as a basis, and reserve higher rates. Prepare a comparison of performance for March.
Roger Samdahl	I have already committed to pull together 1 MBPS proposal from prior work by March. If wee can have work on higher data rates by March we can decide then. If you want to work on 1 MBPS, contact me.
Dr. K.C. Chen	Video needs 1.5 MBPS, we're the only group which can go beyond 1.5 MBPS easily and it's foolish to foreclose the possibility so early.
Roger Samdahl	Baseband to video at 1.5 MBPS?
Dr. K.C. Chen	Aware of a implementation of baseband 10 MBPS system as long ago as 1991 • 1 MBPS anyone do • 2 MBPS trivial effort beyond 1 MBPS • 4 MBPS more difficult • 10 MBPS power and coherence become limiting factors
Roger Samdahl	Up to 4 MBPS, baseband 16-PPM works in a 30' room
Dr. K.C. Chen	The threshold for baseband (any modulation technique) is somewhere around 10 MBPS.
Rui T. Valadas	10 MBPS prototype in progress now using Manchester encoding. believes that the limit for 16-PPM is 4 MBPS
Dr. Kamilo Feher	Is it better for five guys to have 2 MBPS or for one guy to have 10 MBPS
Peter Blomeyer	With my proposal, you can have both.

Roger Samdahl	As long as baseband does not contaminate the FDM. I want to propose a minimal baseline for 1 MBPS with simple baseband extensions to 2 MBPS and 4 MBPS. I cannot do the non - baseband proposals, but I do not wish to preclude them.
Peter Blomeyer	We must decide in march or so. I am prepared to pursue this until march.
Richard Ely	I want to vote today.
MOTION: (Richard Ely)	That the IEEE 802.11 IR PHY adopt 16-PPM Baseband modulation as the standard for 1 MBPS, 2 MBPS and 4 MBPS.
Dr. K.C. Chen	Must consider performance first. Let's postpone.
Dr. Kamilo Feher	Unfortunate to choose now. Because of time constraints, GFSK guys chose early and are now paying the price.
Roger Samdahl	Peter's proposal does not preclude 16-PPM for baseband.
Peter Blomeyer	Vote on this motion will not help much by performing the easy task. The hard task is not baseband, but going beyond to accommodate problems in world. Must propose a <u>total</u> solution. Strongly oppose this motion.
Dr. Kamilo Feher	I oppose as well. GFSK at 1 MBPS was an unfortunate choice. Requirement to interoperate with GFSK is now causing problems going to higher rates.
Dr. Kamilo Feher	Move to postpone indefinitely
Dr. K.C. Chen	Second the motion
Vote	8-2-1
MOTION 2 (Dr. Kamilo Feher)	That proposals for new architectures be no longer accepted after end of march meeting.
Peter Blomeyer	Second
Vote	11-0-0
Rui T. Valadas	New proposals should come with performance data.
Dr. K.C. Chen	We need to concentrate on pulling together existing performance data now on 1 MBPS.

Roger Samdahl	<Adjourns Meeting>