Tentative Minutes of the IR-PHY Subgroup
Monday, November 8, 1993
West Palm Beach, FL

The meeting was called to order by Tom Baumgartner at 8h45. These minutes were originally taken by Frederic Bauchot and edited later by Tom Baumgartner.

Agenda is approved with full consensus.

Minutes of previous meeting adopted with full consensus.

Presentation of the submission P802.11-93/212, "PPM Infrared PHY Strawman Proposal," from Roger Samdahl, Photonics Corp.

Paper presents 16 PPM which is used in 1 Mbps product now shipping but can be used for data rates up to 5 Mbps. The goal of present product is operation in a 30 foot by 30 foot room. The importance of increasing field of view up to 90 degrees to capture wall reflection is made clear. The reflectivity of the floor has also been found to be significant (they have experienced carpeting with very low reflectivity). PIN diode size is a compromise between cost and sensitivity.

Paper proposing a strawman specification for a 1 Mbps PPM PHY layer for IR systems. The importance of orientation for portable and PDA's is also made clear in the paper. Pulse shape proposal in the paper (10% to 90% rise and fall times). Preamble proposal in the paper. The PHY Layer Specification Summary table is missing a Tx intensity specification but pulse height is shown in Figure 4. This is the total power into a half plane averaged over the symbol period. Roger said the only way he knows to measure this is a calibrated integrating sphere. Roger said he doesn't know how to specify in a standard interference sources such as Sony wireless headphones or remote TV controls.

Del Hanson: It is very difficult to keep transmit power within 3 db range considering manufacturing tolerance, temperature, etc.
Roger: Ungraded IRLED's from the manufacturer have a power output range of 3 to 1; even graded the range is large. Photonics runs a test for operating distance in open area to achieve 10E-5 packet error rate. The distance in this test turns out to be 21 feet; the spread is 6 inches. This would indicate that we have consistent transmit power, maybe due to the averaging effect of using a number of transmit diodes. One reason that consistent range is important is symmetry of operating in a peer-to-peer situation.

Figures 7 and 8 show receiver electrical signals from pre-amp, not light signals. The equalization symbols are required after the preamble to allow the capacitively coupled receiver to stabilize.

The paper talks about collision avoidance (CA) mechanisms. During the interframe gap the AGC gain goes high. Fluorescent light pulses can get amplified enough to look like a signal pulse but the repetition rate is too low to be a real signal. When the AGC gain goes down in the presence of a real signal the fluorescent light pulses cease to be a factor. A LocalTalk and a 1 Mbps PPM system can operate while co-located with the CA mechanism. There is no end of frame delimiter in present product. Typically errors are identified by detecting other than one pulse in a symbol.

Pulse spread limits the practical upper data rate for PPM; 4 Mbps is marginal.

Peter Blomeyer: suggests that going to narrower pulse would allow higher speed. [Editor's note: This suggestion needs some more discussion.]

It is Roger's intention, though not necessarily Photonic's corporate position that the ideas presented here are not covered by Photonic's patents.

Presentation of the submission P802.11-93/197, "Signaling Methods of IR PHY," from KC. Chen, National Tsing Hua University, Taiwan.

Paper comparing BER performances for several modulation schemes: OOK, NRBI, Manchester, 16PPM, MRLC (new scheme proposed by the author). An ideal detector was assumed for each modulation. The MRLC scheme performs the best for very high speeds (100 Mbps). KC believes that IR should be going to high speeds because radio costs will drop and speed will be the remaining differentiation.

Rui Valadas: At what speed is Manchester and PPM performance the same?
KC Chen: With the same optical path Manchester is always better.
Rui: Does not agree.
KC: We have different conclusions because we are talking about different optical paths.
Peter Blomeyer: Why is speed the only important reason for using IR in KC's opinion?
KC: Does not see any other sustainable advantage; but this is a "religious" discussion.
Roger Samdahl: IR has advantages such as bounded by walls and no hidden nodes.
KC: Customers may not see these advantages as we do.

Presentation of the submission P802.11-93/217, "EXIRLAN - A multichannel, high speed, medium range IR LAN," from Peter Blomeyer, AndroMeDa GmbH.

Paper addresses co-existence of several systems in the same location. Coherent with F. Le Maut paper on flexible standard (93/155).

Band = 1 baseband channel + 8 narrow band channels. Baseband = coexistence band which uses Pulse Phase Modulation (zero has high in first half of bit time and one has high in second half of bit time). Narrow band uses QPSK (FQPSK is another candidate). Consortium of semiconductor manufacturers is being founded. HW available in 2Q94. DKA is working on standard in Europe.

Presentation of the submission P802.11-93/219, "Comparison Study of Commercial LEDs and PINs for Wireless LANs," Manuel J. Betancor, Las Palmas University, Spain.

LEDs and PINs split as a function of rise time and emitted power. Few manufacturers offers products with short rise time and high optical power. Best LED's are Hitachi but expensive. Best PIN diodes are RCA and Centronic.

Unofficial update of IrDA (Infrared Data Association) by Tom Baumgartner. At Sept. meeting HP SIR (Serial IR) modulation proposal was adopted. SIR design objectives is for low end, short range, handheld devices. Highlights: 1 mW, 3m range, <$2 cost, 880 nm LED.

Del Hanson of HP gave more information about the IrDA SIR specification. One meter and 3 meter SIR link proposals (both inter-operable at 1 m). The main difference between 1 meter and 3 meter operation is the quality of the receiver but will require LED selection for transmit power. Speeds other than 115.2 Kbps can be negotiated. Their spec. for transmit power is peak power during the pulse. Specification methodology presented: list of parameters with min/max values to be specified (derived from some equivalent stuff done for 802.3 and 802.5). The group thought that the items listed in the SIR specification might be applicable to our specification so the list is included at the end of these minutes. Test methods must be developed for SIR. Discussion on SIR co-existence with IEEE 802.11 units especially with higher transmit level to reach 3 meter spec.

Peter Blomeyer: Germany will require every IR device to be labeled.

General

Room available for Wednesday night, but we will break for lunch, come back and try to complete today before 3 PM.

Next on the agenda was further discussion of list of parameters exchanged between MAC and IR PHY: idea to add a third column to the 802.11-93/83r1 document. Since no attendees have worked on this topic it will be postponed to next meeting.

Presentation of the submission P802.11-93/218, "IP statement from AndroMeDa GmbH", from P. Blomeyer, AndroMeDa GmbH.

Presentation of the submission P802.11-93/220, "Safety on Laser Diodes," FJ. Lopez-Hernandez, Madrid University.

This paper presents a method of making laser diode beams safe to human eyes. Based on spatial coherence elimination. Laser diodes were expensive but the high volume of CD players have brought the prices down.

Presentation of the submission P802.11-93/211, "FSK modulation scheme for IR PHY", by Francois Le Maut, IBM.

Draft proposal of a FSK modulation, assuming 'aimed diffused' scheme. FSK not most efficient use of bandwidth but implementation will be low cost because standard high volume integrated circuits are available. Must design driver to avoid harmonics. In-band signaling assumed (to eliminate unused frequencies). How to cope with 802 requirement of 100 meter range? Channelization required for collocated network operations. Comparison with Manchester modulation, on several aspects:

- Cost: 1.5
- Multiple data rate support: yes
- multipath sensitivity: 0.5
- Support of multiple co-located networks: yes
- power consumption: 1.0
- Stress on LED: 0.75
- Preamble length: 1.25
- SNR: 1.0

General

Motion proposed by Roger Samdahl, seconded by Francois Le Maut to seek clarification of how Functional Requirements paragraph 5.2.6 on range of 100 meters applies to infrared.

yes 7, no 0, abstain 1.

Next meeting objectives discussion:

Tom Baumgartner: Re-address the coexistence aspects (such as with HP SIR).
Peter Blomeyer: Formalization of base band vs. modulated band. Establish an upper frequency for baseband signal to allow for modulated bands. Some response that we must be careful not to limit baseband operation above 1 Mbps.
Roger Samdahl: Relationship between power consumption and modulated systems
Tom: We cannot hope to decrease the speed below 1 Mbps (802 requirement). Point was raised by Peter.
F.J. Lopez-Hernandez: Definition of low cost: "Something that costs less than a cable"...
F.J: Idea of combining several modulated channels to achieve higher aggregate capacity.
Francois Le Maut: Idea to adaptively modify the baseband channel width to find the largest capacity. Starting point would be 1 Mbps. Good approach to cope with noisy environments. Should not induce HW cost, but rather some implementation complexity for the control logic.

Issue of isolation from the HP baseband system.

Tom Baumgartner: We should try to get a representative from 802.11 to attend the IrDA.

IrDA SIR Link Specification Items

Active Output Specs.

- Center Wavelength (nanometers)
- Maximum Intensity in Angular Range (mW per steradian)
- Half-angle Range (degrees)
- Minimum Intensity in Angular Range (mW per steradian)
- Rise Time and Fall Time, 10%-90% (nanoseconds)
- Optical Overshoot (%)
- Pulse Width (% of bit time)
- Rising Edge Peak-to Peak Jitter (nanoseconds)

Active Input Specs.

- Maximum Incidence in Angular Range (mW/cm2)
- Half-Angle Range (degrees)
- Minimum Incidence in Angular Range (mw/cm2)

Link Interface Specs.

- Signaling Rate (Mbps)
- Link Length (meters)
- Bit Error Ratio

Receiver Data (not interface spec.)

- Receiver Upper 3 db Bandwidth (MHz)
- Noise Current (pA per square root of Bandwidth)
- Detector Responsivity (µA per mW per cm2)
- Ambient Sunlight Incidence (mW/cm2)
- Internal Threshold Level for EMI Immunity (nA)

Calculated Performance

- Receiver Input Noise Current (nA)
- Sunlight Ambient Noise Current (nA)
- Total Receiver rms Noise (nA)
- Specified Signal/Noise Ratio for BER
- Required Internal Detection Threshold Level (no EMI) (nA)
- Specified Minimum Incidence in Angular Range (µW/cm2)
- Received Minimum Incidence Signal (µW/cm2)
- Received Minimum Detected Current (nA)
- Defined Detection Threshold (nA)
- Link Optical Loss Margin (dB)
- Detector Relative Loss at Wavelength (dB)
- Maximum Linear Detected Current (mA)
- Link Optical Attenuation (dB)
- Specified Receiver Optical Dynamic Range (dB)
- Channel Response Time (µseconds)
- Center of the Eye Loss (dB)