Tentative Minutes of the IEEE P802.11 Working Group

Plenary Meeting
Hilton Head Island, SC
March 11-14, 1991

Monday, March 11, 1991, Afternoon.

The meeting was called to order at after 3:00 PM, Vic Hayes, chairman of IEEE P802.11[1] being in the chair. The total attendance for the Monday morning meeting was thirty eight.

1. Opening

1.1 Introduction: All people in the room were invited to mention their names and affiliation.

1.2 Voting rights are obtained in P802.11 by attending two plenary meetings out of 4 consecutive plenary meetings, voting rights are granted at the third meeting attended. One interim meeting may replace one of the required plenary meetings. Attendance at a meeting requires your presence in the meeting room for at least 75% of the time as determined from the circulated attendance list. Failure to attend interim meetings does not count against voting. Important information is exchanged at interim meetings. Attendance is necessary to build understanding and expertise. It was suggested that failure to attend interim meetings should count against voting rights. Dr Paul Eastman (Chairman of IEEE 802.4) points out that we do not have the right to make an exception to IEEE 802 voting rules. Vic Hayes will check to see if voting rules can be changed, since it is not good if people do not go to the interim meetings.

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Larry Van Der Jagt asks if failure to attend the Kauai, HI meeting shall count against voting rights. The last time a trip to Hawaii was scheduled those members who could not have gone due to corporate policy were given a dispensation. This time it is at the chairman's discretion.

Larry Van Der Jagt moves, seconded by Bob Crowder:

If you don't go to Hawaii it shall have no impact on voting rights. ***(6-5-7) Passed***

Discussion:

The cost of going to this meeting at Hilton Head is larger than the cost that will be incurred by many who go to Hawaii, - then again, the cost of going to Hilton Head is rather high. Larry Van Der Jagt asks if the standard shall only represent those with the deepest pockets?

Michael Masleid wonders if an impact on voting rights from the Hawaii meeting might not encourage corporations to allow their members to attend? A poll of those present indicates half do not yet know if they will be able to make it.

1.3 Attendance list: Please mark on the attendance list if you are a member of the IEEE or are willing to become a member. Also indicate if you are a member of the IEEE Computer Society or are willing to become a member. (It is also important to know who may be members of TCCC. Sec.) Dave Bagby claims that membership in the Computer Society does not imply membership in the IEEE. (This may have something to do with ACM. Sec.)

1.4 Logistics: Meetings will start at 8:30, breaks will be matched to the hotel schedule.

Copying arrangements will be directed through James Neeley.

Document distribution at the meeting is done using pigeon holes (a file system). Obtain a slot number from James Neeley and be careful to get the documents in your slot.

Bookings at this hotel are still available at the group rate. If you are checked into this hotel you can have your rate changed to the group rate at the front desk.

1.5 Other announcements: Richard Scott, Dr. Jonathon Cheah, Orest Storoshchuk, Bruce Tuch, Steve Wilkus, and Rick Albrow send their apologies, they are not able to attend this meeting.

Remember to register and pay the meeting fee, this is required to maintain voting rights and to defray cost of conference consultants, copying and equipment.

2. Approval of the minutes of the previous meeting.

2.1 Approval of the minutes of the Gaithersburg meeting. Document IEEE P802.11/91-13.

Simon Black offers several corrections to the description of DECT on page 16. The corrected paragraphs with changes are as follows:

DECT ~~is~~ offers a logically connectionless service. It supports broadcast data from base to portable. Of course there is a call set up requirement. Connection set up time is fast - less then 50 milliseconds. Authentication may be required for set up, which would take time. Authentication is used to restrict access of any sort to the network. Encryption can be used to protect data. Once a station is authenticated a fast switching (registered) mode can be maintained.

A portable station can set up a connection to a server (host computer) by using the DECT fixed wiring interworking connection. Throughput up to 768 kbit/s can be maintained using one carrier with 23 forward slots and 1 reverse slot. The control of how many carriers are sucked up by data service seems to be unenforced. 11 carriers are guaranteed (by the Memorandum of Understanding). If there is enough demand for DECT, then ~~50~~ 30 MHz more will be allocated bringing the total to 50 MHz.

Chandos Rypinski points out that his comment to Dale Buchholz's ***"Straw-Man" Protocol Model"*** is difficult to understand as presented in the minutes on page 21: "The station has an RA (radio attachment) and layer . . . keep the wiring closet and equipment room out of the scope." The Contribution: ***Architecture -- Topology and Protocol Stacks,*** February 21, 1991, Document P802.11/91-21 clarifies the position.

Note Rick Albrow's comment on the minutes, that the detail level is much appreciated by those that are unable to attend.

It is noted that the level of detail in the minutes is very useful, however, the mix of surnames and Christian names causes some trouble in following discussions. It is agreed that full names will be used. (I will comply when possible, but I can't always tell who is speaking. Sec.)

The minutes are approved by consensus with the corrections noted. The chair thanks Michael for . . . of a job.

2.2 Matters arising from the minutes - financial statement: Dr. Jonathon Cheah hosted the Gaithersburg meeting. Money ($50.00 each) was contributed by attenders to pay for audio visual equipment rental, refreshments and out of pocket copying costs for the meeting. Two attenders arriving late in the week paid $15.00 each.

Income from Gaithersburg meeting:

$50.00 x 36 =	$1800.00
$15.00 x 2 =	$30.00
Total income:	$1830.00

Expenses at Gaithersburg meeting:

AV equipment and refreshments	$1288.91
Copy work by Chandos Rypinski	$194.25
Copy work by James Neeley	$115.84
Total expenses:	$1599.00
Remaining balance:	$231.00

The remaining balance is to be used to cover extraordinary audio visual equipment costs at this meeting.

Robert Buaas moves* that we accept financial statement, James Neeley seconds.** ***(15-0-0), passes

Paul Eastman points out that the finances must be cleared by John Montigue. The $231.00 carry over may be a problem, it may have to be turned in to John Montigue.

3. Reports

3.1 Report from the Intermediate 802.11 meeting. The Chairman reports that we had 40 participants and 20 voting members at the Gaithersburg meeting. There were 12 contributions including 4 on architecture. The architectures appear different, but they are really much the same if terminology is agreed on. This leads us to Dave Bagby's work for this meeting, an attempt to make a common vocabulary. Many more contributions were offered for this meeting, 21 so far with more coming in.

3.2 Report from the executive committee. The Chairman reports that the **Executive Committee will proceed to change the status of IEEE P802** from a standards project to a standards subcommittee. The rules for a standards project are not the same as the rules for a standards subcommittee. The important difference is that the people who have the last vote must be IEEE or Computer Society members. It is preferred that members of the working group be members of the IEEE or Computer Society, however, it is possible to be a member of the working group without IEEE or Computer Society membership.

There are **5 IEEE standards available** for distribution at this meeting:

IEEE Std 802
Overview and Architecture

IEEE Std 802.1D
System Load Protocol

IEEE Std 802.1E
Media Access Control (MAC) Bridges

IEEE Std 802.3h-1990
Layer Management

IEEE Std 802.3i-1990
System Considerations for Multisegment 10 Mb/s Baseband Networks (Section 13)
Twisted-Pair Medium Attachment Unit (MAU) and Baseband Medium,
Type 10BASE-T (Section 14)

These standards are available free, one each, only to registered participants. Members of the working group that produced each standard may apply for their copy Tuesday from 2-5 PM. Voting members of any working group may apply for their copies Wednesday afternoon from 1-5 PM. Any registered participant may apply for their copy on a first come, first served basis Thursday from 9 AM to 3 PM. The list of P802.11 members has been submitted to the administration of distribution.

The IEEE is working toward mechanization - **support of electronic distribution of the standards**. Vic Hayes is working toward **bulletin board service**. Do we in the working group wish to support this effort.

Discussion:

Does this mean we will no longer get mail?

Dave Bagby speaks in favor of electronic media as an alternative but not as the only method. There is no common ground for text processing. The situation is worse still for graphics.

Liam Casey points out that if all documents must be produce on a certain package (software and hardware platform) it will decrease the submittals (and participation).

Bob Crowder likes electronic mail but points out that it is a burden to print.

Larry Van Der Jagt points out that high volume copying machines are the most cost effective.

What about using AlphaGraphics in Phoenix? (As a way to distribute the cost of mailing to the attenders instead of the officer's companies.) Answer: The additional delay sending material to Phoenix added to the existing delays in document creation and distribution makes it harder to keep up with the six meeting per year schedule.

Dave Bagby points out that "How do you pay for the documents?" is not the question being asked. Do we wish to support electronic media? - not as the only method, this is not the appropriate method.

A poll was conducted:

In favor of electronic media as a mechanism to replace paper? (5-21-1)

In favor of electronic media (BBS, E-Mail, USEnet News) as a method to confer informally? (27-3-2)

4. Registration of contributions.

11/HH/1 ***Hilton Head Temporary Documents.*** James Neeley, March 11, 1991.

11/HH/2 Offer to provide a copy of the Management Summary of the PA Consulting Group study. Michael C. Moorman.

11/HH/3 ***Before the Federal Communications Commission: Petition for Rulemaking "Data-PCS".*** David S. Nagel, Vice President, Advanced Technology G, Apple Computer, Inc. January 28, 1991.

11/HH/4 ***Before the Federal Communications Commission: Motion for Extension of Time.*** Laura W. Moorhead, Legislative Affairs Manager, Government Relations, NCR, March 5, 1991.

11/HH/5 ***Summary of Statement of FCC Chairman Alfred C. Sikes on H.R. 531, the "Emerging Technologies Act of 1991."*** Alfred C. Sikes, Chairman, Federal Communications Commission, February 21, 1991.

11/HH/6 ***Interference Characteristics of Microwave Ovens in Indoor Radio Communications.*** J. Y. C. Cheah, Hughes Network Systems.

11/HH/7 ***A Spread Sheet for the IEEE802.11 Transmission Link Calculations.*** Jonathon Y.C. Cheah, Hughes Network Systems.

11/HH/8 ***A Proposed IEEE 802.11 Radio LAN Architecture.*** Jonathon Y. C. Cheah, Hughes Network Systems.

11/HH/9 ***How to Process Technical Issues.*** Dave Bagby, March 3, 1991.

11/HH/10 ***Vocabulary and Proposed Working Definitions.*** Dave Bagby, March 1, 1991.

11/HH/11 Reference to ***A New Model for the Clustering of Errors on Telephone Circuits.*** IBM Journal of Research and Development 7 (1963), pp. 224-36, taken from ***Chaos Making a New Science.*** James Gleick.

11/HH/12 ***Understanding the GM Oshawa Video.*** Michael A. Masleid, Inland Steel Company, March 9, 1991.

11/HH/13 ***The Multiray Model.*** Michael A. Masleid, Inland Steel Company, March 9, 1991.

11/HH/14 ***Security Issues for Wireless Networks.*** Robert A. Buaas, The Buaas Corporation, and Raphael Rom, Sun Microsystems, Inc. March 11, 1991.

11/HH/15 ***Infrared Wireless Networks.*** Richard C. Allen. Presentation to IEEE 802.11, Hilton Head, SC. March 11-15, 1991.

11/HH/16 ***Market Driven Function Requirements.*** David Bagby for Toshiba America Information Systems, Inc. Rick Dayem for Apple Computer, Inc. Raphael Rom for Sun Microsystems, Inc.

11/HH/17 ***802.11 MAC Layer - Some Proposed Characteristics.*** Paulette Altmaier and Jim Mathis, March, 1991.

11/HH/18 ***Correlative Minimum Shift Keying (CMSK) Line Signal with Measured Video and RF Spectrum Shapes.*** Chandos A. Rypinski, LACE, Inc. December 27, 1990.

11/HH/19 ***Access Protocol for IVD Wireless LAN.*** Chandos A. Rypinski, LACE, Inc. December 28, 1990.

11/HH/20 ***Equipment Type Definition and Market Analysis Methods by Type.*** Chandos A. Rypinski, LACE, Inc., February 21, 1991.

11/HH/21 ***Architecture -- Topology and Protocol Stacks.*** Chandos A. Rypinski, LACE, Inc. February 15, 1991.

11/HH/22 ***Tradeoff Between Modulation Bandwidth Efficiency and Medium Reuse Efficiency.*** Kiwi Smit, NCR Systems Engineering B.V., March 5, 1991.

11/HH/23 ***A Method for Demonstrating the Impact of Multipath Distortion on Modulation and Demodulation Techniques Proposed for Standardization.*** Larry Van Der Jagt, Knowledge Implementations Inc.

11/HH/24 ***Local Area Network Market Analysis and Forecast.*** Ken Biba, February, 1991.

11/HH/25 *A Modest Proposal for a Asynchronous, Data Intensive, Wireless Local Area Network.* Ken Biba and Xircom, Inc..

11/HH/26 ***Digital Cordless Radiotelephones Summary of Canadian Tests to Date.*** Walt Sonneville, Sonneville Associates.

11/HH/A ***Rough Summary of the Issues Identified in the 3rd Meeting.*** Vic Hayes and Michael Masleid.

11/HH/B ***Order Response to Motion of NCR to Delay Deadline of Apple Petition.*** Donald Johnson, NCR Corporation.

11/HH/C ***Similarities Between 802.9 IVD LAN and 802.11.*** Dale Buchholz, March 11, 1991.

11/HH/D ***Attendance list, IEEE P802.11 Meeting, 11-15 March, 1991 Westin Resort Hotel, Hilton head Island, South Carolina.***

5. Adoption of the Agenda

The large number of contributions leads to fears that some issues will not be covered. Larry Van Der Jagt wonders how many think that the FCC comments need to be given a high priority? James Neeley points out that we should substantiate our comments. Chandos Rypinski points out that sometimes a large number of people supporting a position to the FCC is also important, if lacking substantiation.

The contributions were assigned to appropriate places in the agenda, and the agenda was adopted as proposed.

Dave Bagby argues that no time should be given to the presentation of contributions. People should read the contributions this evening. Meeting time should be devoted to discussion and clarification only. Kiwi Smit agrees that the presenters should not read their papers to the group. In addition we should create from the papers an Ibis list of the form:

Issue

Position

Arguments

Michael Masleid (realizing that he at least would not be able to read the material in the time available) argued that the presenters should be allowed to allocate their time so as to introduce or summarize their work.

Dave Bagby agrees to a time allocation, say 10 minutes for introduction, then a discussion of issues pro and con.

(Note that this did not work too well. The attempt to resolve only one issue in the second paper presented, Document 11/HH/16, took too much time. This is partly due to the false Ibis assumption that issues are separable. Many of our issues are not separable because of implicit system optimizations for specific markets. To assure that all contributions are heard, the group will decide to limit discussion of presentations to exposition and questions for clarification. Arguments against positions are not allowed. This means that positions presented here without recorded arguments **may or may not** be supported by the group. Sec.)

This completes Mondays agenda. The meeting adjourned at 5:28 PM, scheduled to begin Tuesday at 8:30 AM.

Tuesday, March 12, 1991, Morning

The meeting was called to order at 8:43.

6. Establishment of Architecture.

6.A Procedures. Before beginning with the bulk of agenda item 6 the group reviews Dave Bagby's paper for insight on resolving issues.

6.A1 Introduction of contribution by Dave Bagby, ***How to Process Technical Issues.*** March 3, 1991. Document P802.11/91-28, temporary document HH9.

Dave Bagby explains: Having attended a couple meetings - where many points are raised and nothing is resolved - it is apparent that we need a way to get to conclusions. There is a method used by some ANSI committees to get to a decision given that not everyone will agree on an issue.

When a new issue is identified it becomes an open issue. When at least 2/3 agree on the resolution of an open issue it becomes a closed issue.

A closed issue can become an open issue if new arguments are raised, or at least 2/3 agree that the issue must be reopened.

Dave Bagby moves, Michael Masleid seconds, **to: Adopt this method (802.11 Issue Processing) as a way to deal with issues.** ***(12-0-4) passes***

Discussion:

There is concern about 2/3 agreement. Larry Van Der Jagt attempts to get clarification. Dr Paul Eastman points out that the IEEE P802 operating rules call for a 75% agreement of those voting ye or nay on technical issues, and that the Chairman resolves what is or is not a technical issue.

Dave Bagby replies that he did not intend to subvert the existing IEEE rules. Dr. Rick Dayem asks: If there is an existing set of rules do we need to make new ones? Dave Bagby replies that as Robert's rules go we are pretty loose.

An important feature of Dave's motion is the hysteresis. Once an issue is closed it stays closed until less than 1/3 of those present still support the issue. This avoids thrashing on hot issues. Larry Van Der Jagt expresses concerns: What is a quorum? At P802 it is whoever is present at a plenary meeting. Does this imply that three people who make it to the Hawaii meeting could close all issues, and without new argument 100 people later could not reopen or change the closed issues?

The Chairman closed the discussion at this point, pending study of obvious discrepancy with P802 rules. (The implied ability of 33% of the membership to maintain a technical issue if at any time the issue was supported by 67% of the membership is probably in violation of the intent of the P802 75% rule. Sec.)

6.1 Requirements from the various user applications on the WLAN Service provision.

6.1A Introduction of contribution by David Bagby for Toshiba America Information Systems, Inc. Dr. Rick Dayem for Apple Computer, Inc. Raphael Rom for Sun Microsystems, Inc. ***Market Driven Function Requirements.*** Document P802.11/91-34, temporary document HH16.

A set of 12 functional requirements have been identified and agreed to by representatives of SUN, Apple, and Toshiba. We invite more, this is not an exhaustive list. It is concise and precise in exposition. Some of the issues are important and controversial, we have not tried to avoid controversy.

1. No end user licence required.
2. Supports collocated, uncoordinated network operation.
3. No distribution system required.
4. Same station works in a system with and without a distribution system.
5. Station mobility up to pedestrian speed (no factory mobile, inventory control).
6. Optimized for local area data (no voice, no isochronous service).
7. Low power drain (battery powered).
8. Small size (size of credit card).
9. Low cost.
10. Self contained, implementable standard.
11. Time is of the essence.
12. Radiated power control (Toshiba does not agree to this position).

Discussion:

The Chairman request decomposition to issues, 1st issue: No end user license. Arguments?

The Secretary interrupts: This is going to kill too much time. Chandos Rypinski suggests that it is important to listen, not to argue at this time about the issues presented. They should give us pause - but we should not pick them apart now.

Bob Crowder points out that this is a significant and large market segment. We need perhaps a contribution from other market segments. That this a coherent set of issues is important. Spreading it over 50 pages of issue list destroys its utility.

This brings up the question: What Market is driving this Functional? Rick Dayem believes it represents the portable computer market. Dave Bagby says that we didn't call it that, let's call it the computer market. (Actually it sounds like the palm and wrist watch market based on size and power. Sec.) Dave Bagby agrees that he spends most of his days working on portables, but points out that he doesn't view this list as all that is required, it is only that which the group of three could agree on.

Michael Masleid moves **to identify this list as the portable computer market. Nathan Silberman seconds.** Vote to call the question: (16-0-0). **Vote on motion:** (7-7-1). This is a tie. The Chairman votes against, ***the motion fails.***

Other attempts to label the market segment represented or to close the discussion failed for lack of second. Dr. Rick Dayem think that the Apple, Sun, and Toshiba desktop computers are very different products (and can't be lumped together as a market segment).

Kivi Smit asks if the market requires that stations be able to **roam internationally?** Rick Dayem reply - yes, if possible. (Roaming: transit from an area with coverage through an area without coverage to an area with coverage. Sec.)

Simon Black asks if "No end user licence required" implies totally **unrestricted operation?** Dave Bagby replies no, there needs to by type acceptance, or something done by the manufacturer. Chandos Rypinski believes that making it easy to use is good. Citizen Band radio required a license, but that required no more than filling in a postcard. Registration makes it possible to see what your neighbors are (or are capable of) doing. The system requires some kind of constraint. Dr. Rick Dayem notes that the market requires ability to (roam) move from point to point. Chandos Rypinski: as per cellular telephone. Dave Bagby says that the market requirement is really that the burden of licensing not be upon the end user. The emphasis must be on niceness to the end user.

It may be interesting to expand on the comparison to cellular phone regulation. Cellular phones work in many areas, but some spots are not covered. (A functional requirement for phones to talk to each other directly - out of reach of tariffs - would be terminated with prejudice in the cellular market I think. Sec.)

Dave Bagby points out that there are two modes. If there is a permanent distribution system than a site license may be necessary. Point to point for just two guys may not need any such.

Chris Hallinan says that licensing can not be as simple as a postcard. The owner of the equipment must understand the issues that may be in place. No one can take that responsibility away from the end user.

Dr. Paul Eastman points out that it is not our decision, it is up to the government. Ken Biba points out that the market requires that the radio network must be at least as easy to use as a wire network.

Licensed or unlicensed operation is at our discretion in our choice of what bands are supported.

Don Johnson points out that type acceptance implies cooperative behavior by the equipment (this means deferring to existing traffic, though some think it also implies demand allocation Sec.). Dr. Rick Dayem agrees.

Don Johnson continues: If we can promise the FCC that we wish to operate in the allocated spectrum in an unlicensed manner . . .

Paulette Altmaier and others: It **needs to be a little like FCC part 15, but with an additional layer that disallows unrestricted interference** (from some other primary user). It is also important to be able to run multiple networks with multiple protocols, and to allow interworking and graceful degradation. If the Standard can achieve this well, we will have credibility. We can not trust (depend on) the FCC to get it right. We do trust IEEE P802.11 - at least for the data service. As soon as possible we must get to the FCC. The FCC has more requests than it can deal with. They need to be given coherent direction, not more request.

The Chairman, not hearing objections to point 1 assumes the issue is closed. (This worked for about 90 seconds. In fact it is out of order since unanswered objections are on record from Motorola. Sec.) Dr. Rick Dayem points out that it is important to note the things that are contentious and those that are not.

Bob Crowder objects to skipping ahead to find non contentious issues, lets do this in order.

Richard Lane (Motorola) responds on point 1. Regarding marketing segments - recall other presentations on licensed versus unlicensed: **The banking industry is against unlicensed operation.**

Larry Van Der Jagt expresses exasperation with the attempt to deal with an issue in isolation, extracted from clusters of issues associated with markets. The following alternative is offered: A designer needs 3 parameters:

1.) How many terminals per 100 square meters?
2.) Reasonable upper bound on burst throughput for an individual terminal.
3.) Average throughput for an individual terminal.

Dave Bagby replies that we are not ready with that information now, that is part of what will be an iterative design process.

The meeting breaks for coffee to resume at 10:32. It is decided that at this rate it will not be possible to cover all presentations, and so authors will be allowed 15 minutes for introduction followed by 15 minutes to answer questions for clarification without attempts to resolve issues.

Regarding "**uncoordinated network operation**", the assumption is that no HUMAN coordination need be required. (The hardware or protocol may do coordination, but must not require human intervention.)

Regarding "**no distribution system required**", the emphasis is that stations must be able to communicate with each other (over some useful distance) when no distribution system is present, but that is not meant to be the only supported mode of operation, this is reiterated as point 4.

Regarding "**mobility up to pedestrian speed**", the station must be able to communicate while it is in fact moving.

Larry Van Der Jagt: This is a design parameter - the velocity at which it must work - as are the others I have asked for. Why limit this one, then refuse to talk about the others? Dave Bagby replies that we know this one, we don't know the customer requirements for the others.

Paulette Altmaier asks if Dave Bagby really wants operation while in motion - is quick relocatability enough? Dave Bagby responds that the distinction is between mobile and portable, and that he wants both.

Jim Neeley responds that point 5 should be interpreted as follows: Dave Bagby presents a market that moves at pedestrian speed maximum. This may require one type of physical layer. There may be another physical layer required for a faster moving market. Dave Bagby describes a large, slow moving market. My (Jim Neeley's) computer is not portable. Michael Masleid's moves faster, but tends not to move while he is typing. (Well actually, since I use it on buss and plane . . . My guess is that Dave Bagby anticipates ability to up or downlink files while in transit? Sec.)

Simon Black explains that mobility is a subset of portability. (Ouch!) From point of view of security, motion out of the home network is a very different problem. Dave Bagby points out that mobility is required only within a contiguous coverage area in the scope of point 5. (This doesn't address Simon Black's concern which relates more to Kiwi Smit's earlier question on roaming. Sec.) Jim Neeley points out that if you leave the coverage area then of course you have moved out of the LAN. This gets into definitions that are to be discused later.

Further digression on area of coverage and distribution was blocked, limiting discussion to clarification of point 6.

Is **isochronous** the same as real time voice? Dr. Rick Dayem explains that isochronous guarantees real time data. Voice is one example of real time data, there are others. Dave Bagby doesn't wish to pay for voice (in delay to market, or in complexity).

With regard to **low power drain** - the issue may be operating time. Think in terms of a percentage less than X of the power budget of a portable computer, (battery capacity of 10 or 20 watt hours for the heaviest).

What is meant by **small size**? Dave Bagby answers that it should be practical to reduce the interface to credit card size. The standard should not address this now, nor is it necessary to achieve such size reduction now. It is important that the standard should not make such size reduction impossible (for instance, by requiring a huge connector. Sec.)

What is the measure of "**low cost**"? Should it be compared to the cost of an equivalent wired connection? (Be wary of legal issues here. As a standards group we are not allowed to do anything that might be interpreted as price fixing. Sec.) Dave Bagby replies that it would be nice if the interface cost less than the machine it attaches to. Dr. Rick Dayem points out that this is a hard one, since this is the portable (!) market, to be ubiquitous it must compare to cabled costs.

Does this imply that the Standard must be based on existing components? Dave Bagby replies no - development cost is not the issue, the eventual cost to manufacture is the issue.

(I:) Should an easy transition to wired networks be provided for - a PHY layer bridge or repeater? (Raphael Rom? The discussion was blocked since it is not in the scope of the current discussion.)

What about 802.2 and voice LLC. Dave Bagby replies that he doesn't want to mess with a new PSAP.

Liam Casey questions "**self contained**"? The distribution system is a separate facet, if the distribution system references another standard then ours is not self contained. Dave Bagby contends that our charter only includes MAC and PHY, our scope does not go beyond the LLC boundary. LLC is not in this groups charter. - But the distribution system may be below the PHY layer. Simon Black argues against "stand alone" - there are other things that surround P802.11 (- some may want to interface to DECT between PHY layers. Sec.)

(Confusion at this point is not recoverable. The group does not have a common notion of what "distribution system" means. This is not a matter of definition, but of understanding and selection from among several distinctly different approaches. Sec.)

Bob Crowder asks P802.11, regarding the statement "**time is of the essence**": Say it takes three years to cover all of the functional requirements that the various markets place on this Standard. If it would take only eighteen months to accomplish what is shown in document P802.11/91-34, would you prefer that? Dave Bagby replies. "I'll take the 18 months."

Michael Masleid complains that procurement and installation takes a long time. As a user I am not interested in something that is flawed from the start and will have to be replaced before it is completed. I am particularly not interested in products that will be subjected to incremental improvements that obsolete previous products.

Dr. Rick Dayem responds: If spending a few more months leads to a standard that will last, say with a 3 to 5 year life - then it is worth spending 24 months to create it - but we must reach balance. Quick.

12. Radiated power control (Toshiba does not agree to this position).

Richard Lane asks what do you do with wireless, what are the tradeoffs that the users want? There must be tradeoffs. When moving maybe only E-mail is needed. If doing 3D solid modeling? Dave Bagby replies that he wants the PC market, but without wires. They will take anything that works, and will replace it with anything that works better.

Richard Lane asks about the niche markets. Dave Bagby responds first do partial markets, then do more later.

Regarding "**radiated power control**": watch out for BAD words. Dave Bagby comments that Toshiba is not apposed to this. There is no opinion on maximum power. Kiwi Smit points out that this is **not a functional requirement of a market**, it is a design solution.

Is there a safety issue related to power control? Are there perceived dangers per the market? **YES.** Dave Bagby replies that I will say that it is safe. They will sue if I am wrong.

6.1B Introduction of contribution by Ken Biba ***Local Area Network Market Analysis and Forecast.*** February, 1991, Document P802.11/91-17, temporary document HH24.

Ken Biba: The first part of the paper references primary and secondary sources of information on the current state of the market. The second part is my opinion of where this takes us.

Wirelessly go where no LANs have gone before.

(Please refer to the document. The following captures only a few points and opinions. Sec)

It is projected that shipments of wired LAN nodes will exceed shipment of wired voice nodes in the early 1990's.

Laptop computers are become a significant part of the units sold. (Values shown are unit volume, not dollar volume.)

Unshielded twisted pair dominates as the connection method. Unshielded twisted pair is even being adapted to FDDI. This is cheap. It is foolhardy to compete with wired networks.

The 1989 US Shipment Market Share for LAN OS Clients is dominated by Novell.

Novell requires low delay and high bandwidth. (Low latency and high throughput, as provided by 802.3 at light loads, say 10% or less - this implies low utilization efficiency. Utilization efficiency is a measure of real capability / theoretical capability. Sec.)

Choice of MAC, (say P802.3 vs P802.5) has nothing to do with channel capacity. (Delivered capability at the application layer is meant here. Sec.) The last (least) important thing is the MAC. That doesn't matter, since LAN load, Network Operating System (NOS) choice, LAN adapter design, and channel capacity dominate.

Opinions:

The wireless market will develop first from necessity, then to convenience, and finally to enterprise wide. Wireless is hard - it will cost more.

Putting more wire in walls is easy, getting more spectrum is hard.

Data Service requires, before all else, fast access. Voice requires continuous throughput. These requirements are inherently divergent.

There is little market demand for integrated voice and data or for real-time transmission.

Discussion:

Liam Casey points out an apparent discrepancy regarding operating systems share and LANs. Ken Biba replies that a network operating system like Novell doesn't care what kind of network it is on. Apple talk is becoming obsolete because of speed. (Apple computer points out that ether talk is faster.)

Kiwi Smit asks what are the sources for the market data. Ken Biba replies that that is outlined on the first page of the document: Dataquest, IDC and so on, however, what is presented is an aggregate. Ken Biba assumes responsibility for any discrepancies.

There is some (one order of magnitude) disagreement on number of ethernet nodes. This may have something to do with counting terminal server connections.

Ken Biba emphasizes the small average size of networks. Dave Bagby points out that the average is really only 10 or 15 clients per server or stations per segment - there is a workgroup orientation to the size of nodes per network.

(This may lead to a fatal misconception. Segments are small. Networks are not. The number of segments in a given piece of air may cause trouble. If it turns out to be possible to segment the air then the distinction does not matter. If air must be shared by several segments then it will be difficult to use low utilization efficiency protocols. Ed)

It is stated that most networks never have high loading. Typical numbers are 10% or less. The reason for high bit per second numbers is to support burst communication. While that is partially true, low average loading also occurs because CSMA/CD protocol does not work well at high loading. Practical experience indicates that at an average load above 30% the network must be segmented.

The meeting breaks for lunch and reconvenes at 1:15 PM.

Tuesday, March 12, 1991, Afternoon.

6.1C Introduction of contribution by Paulette Altmaier and Jim Mathis. ***802.11 MAC Layer - Some Proposed Characteristics.*** Document P802.11/91-35, temporary document HH17.

Paulette Altmaier presents some proposed characteristics - some direction - on the MAC issues to try and identify, agree to, and converge on fundamental issues. (This is an incomplete representation of what was presented. Read the contribution. Sec.)

The key requirements are:

Unrestricted portability. The network goes with the computer. This may imply a requirement for unlicensed use. It may imply that any required distribution system is self contained in the computer. The fixed distribution system is looked on as complementary as apposed to required.

The MAC should be optimized for local area data. The need for a wireless data service is immediate. P802.11 is the only standards body with that has data as immediate priority. We should focus on data service now, isochronous service later. **We recognize that isochronous service cannot be piggybacked after the fact.**

The MAC must support autonomous collocated networks, we are using a shared physical channel. Each network must take into account that there are other networks, we can not guarantee that each network will have its own clear channel.

Administrative bounding is required, since physical bounding is not possible. This seems to **require a globally unique LAN ID** so that identical traffic appearing at the same time on separate LANs can be filtered. A node in a collocated space should not communicate with more than one of the routers attached to the collocated networks.

The LAN ID should be in the MAC layer to permit use of the standard LLC header.

The channel access mechanism should be chosen to regulate access within an autonomous network, between autonomous networks on the same physical channel, and to allow robust operation with dynamic LAN membership (portable computers).

Channel sharing must be supported by autonomous networks sharing the same physical channel.

Clarification:

How can the LAN address be administrated? (It is proposed in the paper that the address be derived from the 48 bit address of one member of the autonomous network - but that begs the question, since the purpose is to resolve membership on two autonomous networks. IEEE 802 48 bit address space assignment might be possible, but is difficult for an ad hoc network. The obvious solution is to use a station mediated infrastructure, with the LAN address derived from the access point generating station or SMT proxy. The point of the presentation is the need for the address, not how the address is generated. Sec.)

Raphael Rom asks: How should broadcast (broadcast address, not radio broadcast of course) be mediated - through a distribution system? Answer: Since radio does not give full coverage additional mechanisms are needed.

(Unidentified speaker.) In mediating between two collocated LANs, do you imply cooperation only among P802.11 compliant networks? Paulette replies that mediation is only important (possible?) among members, so we need unique spectrum.

Then have you considered what you will do if no spectrum is allocated, or if other vendors build proprietary networks that are not compatible with P802.11 in the same spectrum? Paulette replies that we do need mediation. If there is a free for all, you might triumph, but it is not good. It is possible to avoid noise that is probabalistic (This includes but is not limited to Average White Gaussian. Sec.) using correlation. If the interference is similar in characteristics to your own, then correlation is not as useful, you must coordinate.

The could grant spectrum to be shared by all indoor wireless services: We may have to negotiate with hostile protocols

Dave Bagby questions: You advocate CSMA protocols. You point out drawbacks, but do you have more detail? Paulette answers yes - but it will take a day to present this - and it is of course contentious.

Simon Black points out that differentiation using LAN ID assumes use of a CSMA/DC protocol. If timed rings are used (Slotted Aloha Demand Access? Sec.) then the stations may miss the ID. Paulette answers that the differentiation of ID's needs to work only if there is danger of communication. (As pointed out above, it then becomes a problem in routing.) Simon Black continues: Otherwise it is only interference.

Bob Crowder began a discussion of CSMA protocols. (My record of this may be incorrect. I am not familiar with the nomenclature. Sec.) Ethernet is "1 persistent": If two stations collide, then when one runs, the

other starts as soon as the one is done. in "P persistent", when one runs, the other waits until silence after one runs. (I assume that in "P persistent" a third station may slip in, avoiding collision with the second. Sec.)

6.1D Introduction of contribution by Chandos A. Rypinski. ***Equipment Type Definitions and Market Analysis Methods by Type.*** Document P802.11/91-20, temporary document HH20.

Chandos Rypinski's contribution observes that it is not likely that a single solution will meet the needs of all who want wireless service, therefore it is necessary to look at several classes of service that might be provided by the standard.

What are the motivations of those who want wireless? There are those who need mobile, and those who wish to avoid costs. One example of the latter is the shopping mall. (The cost per network connection in a shopping may be higher that the cost per connection in the open office, so the mall may go through air even if the office is not cost effective. Sec.)

We need to begin be defining several types of clustered classes. (The clustering is of function requirements and market needs.)

P1 is the **personal** computer and consumer market. Well and good that voice is not needed here. Mayhaps the personal computer and consumer market need not work to 802 functional requirements.

I1 the **industrial** market. It is not Radio Shack. here capability, reliability, and accuracy are important. Voice intercom is included.

A protocol can be designed to serve both. Both might live within the same frame work.

C4 is for higher performance **commercial** office desktop and portable computers, and includes ISDN service.

W16 and **W24**(infrared) are for engineering and laboratory **workstations**, the data rate exceeds 10 Mbit/s, and include telephone capacity.

(Read the submission for a more detailed outline. Sec.)

This set of classes provides a range of services ranging from service adequate for the portable computer up through "does everything" networks that support workstations at 16 Mbit/s. Is there a wireless market that is not approximately served by these classes?

Questions:

Jim Neeley observes that in the paper a shorter range is assumed for C4 (Commercial) than is supported for P1 (Personal) or I2 (Industrial) service? Chandos Rypinski replies that the belief is that more margin is required for C4.

Nathan Silberman asks why not increase power. Chandos Rypinski answers: More power for more range? It is always a disappointment, due, if nothing else, to obstacles. (The fade into the diffraction zone behind an obstacle can be 40 dB. Increasing transmit power by x 10000 is not likely. Sec.)

Ken Biba points out that in the list there is a range rate trade off. This is technically driven, not market driven. Chandos Rypinski answers that the market does not always want what is do able. (There are occasional grumblings from the technical folk in the meeting about marketers wanting to set pi = 3.14, or maybe just 3. Sec.)

Bob Crowder points out: I observe that the difference between P1 (Personal) and I2 (Industrial) could be options in the protocol or in the MAC. I think that Chandos is on to something that is important - bringing into concordance the various markets.

Simon Black asks: In each case where you show ARQ error correction, do you see a need for FEC (forward error correction). Chandos Rypinski replies no. Correct errors when you have them. I assume errors are chaotic. Don't pay the price of FEC all the time, only pay (by retransmission) when it is needed. (But note that FEC is used by some to correct systematic errors due to motion. Sec.)

Ken Biba observes in these classes great commonalty and strong convergence differentiated by speed.

6.1E Introduction of contribution by Chandos A. Rypinski. ***Architecture - Topology and Protocol Stacks.*** Document P802.11/91-21, temporary document HH21.

(As always, read the contribution for the real thing, this is only a summary of the introduction. Sec.) Chandos Rypinski's contribution observes that there is linkage between protocol, topology, and layer structure that is unique to wireless medium. A central control function is needed which is not present in any other 802 MAC.

(The central control function exists "below" the PHY layer, in what some have called media, and central control is something of a reflection pool view of protocol stacks. There is the potential for no end of confusion here if the reader fails to keep track of the context. Since it is practical and proper to bridge "real" networks into this media entity it is not possible to keep track of the context. Sec.)

Chandos Rypinski points out that when a distribution system is used cost goes down as more distance is covered by wire and less distance is carried by radio. (There is a range vs rate tradeoff assuming cost is held constant. There is also a range vs cost tradeoff, assuming rate is held constant.) The wiring needed is likely to be present in office environments following EIA/TIA 568 "Commercial Building Telecommunications Wiring", with a hierarchy of unshielded twisted pair (UTP) connecting to wiring closets connecting to equipment rooms.

By the way, the protocol stacks must include voice in the original design if it is ever to be included.

Now assume that a wiring closet controls some area. It will have UTP from some of its ports to (wireless) access points. The closet itself is a multiport bridge. Some of the closet's ports go to a higher level (the equipment room), however, the closet itself is a free standing machine in the sense that it can mediate local communication without the need for external control. It is a packet handler.

There are two PMDs (Physical Media Dependants). The first is the connection to twisted pair, the second is the connection (modem) to the antenna. (The connection to twisted pair is of course also a modem.)

The protocol that connects the station through the access point to the wire closet, and the protocol that connects the wire closet to the equipment room could be identical.

Discussion, Questions:

Liam Casey asks why there is no MAC between the UTP PMD and the wireless PMD at the access point. Chandos Rypinski answers that it is not needed. MAC designers are always fascinated with using characteristics of the media for control functions. This makes it impossible for them to design a MAC that is media independent. (If the MAC used by 802.11 is media independent, it implies that nothing changes going from UTP to wireless, and so no MAC is needed to accomplish that! Sec.) Liam Casey continues: What about power level? There is no equivalent for that in UTP.

Bob Crowder asks: Isn't this a PBX with radio telephone service? Chandos Rypinski answers that it may parody the PBX, but it this does packets first, then other things.

6.1F Introduction of contribution by Robert A. Buaas and Raphael Rom. ***Security Issues for Wireless Networks.*** Document P802.11/91-32, temporary document HH14.

Should we be concerned with security and privacy in ways that others are not? Wireless is different. This paper supports the need for security and privacy. The previous media were private, so site security was adequate. Electromagnetic **radiation is not site secure.**

Transferred data (payload) needs **privacy.** Signalling data (overhead) also need to be protected - (To protect the identity of those communicating.)

What about **denial of access**? On a wired network, if there is a problem with jamming, use segments, use work groups. On radio that is harder to arrange.

What about **authentication**? This is a two part problem. First is to separate those who participate from those who should not participate. Second is to know beyond reasonable doubt that those who participate are who they say they are.

Most applications require authentication but it is seldom done, they assume that the lower level communication facilities.

Authentication requires a data base, either local, or via an agent.

Security is implemented using public or private key crypto systems.

There are four communication models: Direct peer to peer, forwarded peer to peer, direct broadcast, and forwarded broadcast. Direct peer to peer and direct broadcast requires that everyone knows everyone's keys. That is a problem. Forwarded peer to peer and forwarded broadcast requires knowledge only of the forwarder's keys. That is not a problem.

Issues remain on crypto system strength, key management, generation, and distribution.

Because existing systems that should have security do not have it - existing systems assume that the physical medium is secure - wireless security should be done below the MAC layer.

Discussion:

Chandos Rypinski asks: Keep secret who is receiving? Answer: Traffic flow analysis can reveal information that sometimes should be kept secret.

Shouldn't security be done at a higher layer? Answer: Current applications that run in the clear will no longer be protected by site security, because of that there is a strong desire to put the protection at a much lower layer - (So that the current applications don't have to be changed).

Liam Casey asks: A jamming signal will kill the channel. What about denial of service? Robert Buaas answers that jam resistant channels can be built. Authentication actually helps with jam resistance.

Chuck Thurwachter points out that existing UTP radiates, existing wired LANs are subject to remote eavesdropping, therefore security must be ubiquitous. If we are putting it at the MAC layer we are looking at issues that are not our concern.

Ken Biba asks how P802.10 does security and how should we interact with them? Answer: Use as much of P802.10 as we can, and then talk with them about how we differ from the current work of P802.10 - interoperate where we are the same, but differ where we are different.

Dave Bagby asks if authentication, (Is this the person or not the person claimed?), occurs above or below the MAC layer? Dr Paul Eastman answers that this can be done inexpensively in the PHY layer if we think about it now. Putting it in at the beginning cost almost nothing at all. - Though in the United States there is some limitation on how strong the crypto system can be.

Nathan Silberman points out that the economics must be taken into account. Many industries don't care about security and won't pay an extra penny for it. Answer: The cost is zero if we put it in now.

Bob Crowder: There is free lunch, there is a patent issue. The SDE (Secure Data Exchange) is above the MAC layer, we must not interfere with P802.10's work. Robert Buaas answers that SDE is a resource to use, not to change. We must find out how what we want to do fits with what they have done.

Encryption at the PHY layer should use a high speed private key. Use the public key (which is slower) to do the fast private key exchange. Cost for the license is not large.

Howard Rubin points out that using authentication to screen conflicting signals at the PHY layer makes good sense.

If there are three people in conference room (an ad hoc network), then will they need a key server? Robert Buaas answers that they will need to be added to the data base, or the agent may be present in the group of three, or the ad hoc group could get the key from the hotel, or use a universal key.

Ken Biba says expensive algorithms are one problem, what about cost to the channel bandwidth? Answer: In practice, clear text is exclusive or'd with a cypher stream. There is no increase in bandwidth of the channel. At the receiver, the encrypted text is exclusive or'd with the same cypher stream. All that is needed is to get crypto system synchronization.

Nathan Silberman observes that this is no different than the method used in spread spectrum. Answer: Spread spectrum is one of the crypto systems. (The difference between spread spectrum and what is described in the previous paragraph is that the chip rate in spread spectrum is an integral multiple of the symbol rate. In the preceding paragraph the chip rate, if I can call it that, and symbol rate are the same. Realize however that some here are thinking in terms of using the spreading code itself as the crypto system - and that does impact bandwidth in some designs. Sec.)

(I:) Dave Bagby wonders if some of this might take the place of CRC checking? If cryptography is used must it always be used? Can some traffic be sent in the clear? Can there be a common (known to all) crypto key?

This is radio broadcast. Sometimes the FCC becomes concerned about encrypted radio transmission. Will this be a problem? Answer: No problem inside the United States. We must be concerned about where the product is exported. There have been export restrictions on some cryptography.

What about source routing? How can you route if you can't read the signalling data? Answer: Put the crypto system between MAC and PHY - that way the bridge is in the clear.

The meeting breaks at 3:05 PM and resumes at 3:32 PM with a presentation on vocabulary.

6.3 Establish definitions.

Introduction of contribution by Dave Bagby, ***Vocabulary and Proposed Working Definitions.*** March 1, 1991. Document P802.11/91-29, temporary document HH10.

When you are up to your neck in alligators, it is sometimes difficult to remember that the reason you are here is to drain the swamp. Before now I was walking in the swamp. Now I am swimming in it.

What I did was first, look at last meeting's notes and sort out all the things and concepts to find a common ground, then create basic terms that cover those things that have been discussed.

I think the definitions cover (span) the things we have discussed. These titles for concepts may differ from yours, but please let us form a common ground.

In the beginning there was a station:

Figure 1

Boring, isn't it. We must have two stations:

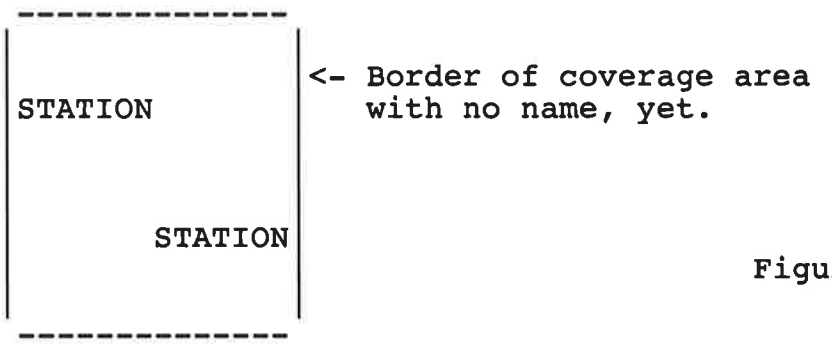

Figure 2

A station being something that contains a P802.11 MAC and PHY. Note that the network in Figure 2 has 2 stations AND NOTHING ELSE.

An almost orthogonal subject is the distribution system required by the PAR. It has an access point.

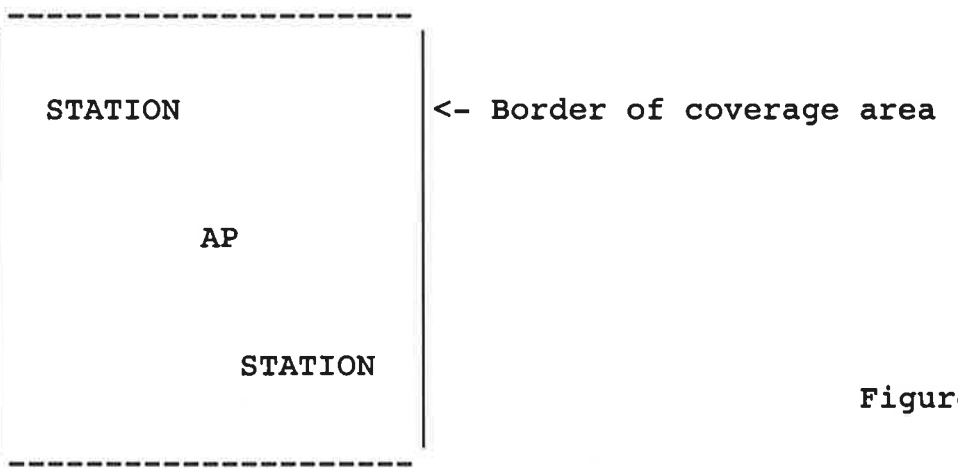

Figure 3

The border is different now. Call this (inscribed volume) the APC (Access Point Coverage). (Note that this is the Basic Service Area (BSA) as originally introduce and defined by James Neeley. Sec.)

Now imagine two of these things (APCs) tied together with distribution system media (DSM). The (possibly discontinuous) inclusive boundary of the two is the Extended Service Area (ESA). (This is in agreement with James Neeley's original definition. Sec.)

What about the coverage area shown in Figure 2, the 2 station only configuration. Swamp time! Some here want a slotted protocol. Well, that doesn't require a third cop (policeman). One of the stations could provide the slot ring generation. I define this coverage area (volume) as the Basic Service Area (BSA). An ESA is not associated with a BSA. An ESA includes one or more connected but possibly discontiguous APCs.

(The boundary of any coverage area (volume) will defy description, however, for an ad hoc network (peer to peer with no forwarding) the coverage volume is approximately an enclosing sphere the diameter of which is equal to the radius of coverage of a station. For a network with a forwarding station or access point, the boundary is approximately a sphere centered on the forwarding station, with diameter equal to TWICE the radius of coverage of a station. The forwarding station increases the coverage volume by 800%. Sec.)

Discussion:

Raphael Rom asks what about the cop function, the protocol infra structure generator? Dave Bagby answers that this can occur if needed in one of the stations in Figure 2.

(There is a fondness for swimming birds of the family Anatidae. I will spare you the details. Sec.)

Raphael points out that if there is a station generating the protocol infra structure then Dave's definition of the BSA volume is changed. (Use of a forwarding station increases the volume 800%. . .) Dave Bagby answers that that is then changed into the APC model. Raphael Rom argues that the protocol will obsolete Dave's definition for BSA.

Liam Casey wonders why there is an issue. Dave answers that the presence of a third physical entity MUST NOT be required for the network shown in Figure 2. (It is important to some that two personal computers brought into the same space, say a hilltop in some wilderness, be able to communicate. - Without having to remember that one or the other party needed to bring an access point box along. Sec.)

Larry Van Der Jagt disagrees with Definition 1 (Station). The implication that a station contains a computer is probably not right.

Liam Casey asks if Definition 2 (Basic Service Area) needs an anchor point? Must it be centered on a station? Dave Bagby answers that the volume is determined by where the stations are at, but it is not a simple shape. (In particular, the center of the volume is likely to be empty of stations. Sec.)

Liam Case asks if Definition 6 (Distribution System) should not require propagation beyond (above) the MAC interface. Answer: We are talking about sub PHY distribution, not supra MAC.

Dick (?) asks: Do stations do both (direct and forwarded communication)? Dave Bagby replies: They do one or the other - in my opinion. It is not precluded that a BSA exist within an APC.

Don Johnson asks: What if there is only one APC? Dave Bagby answers that that is then identical to the ESA.

Don Johnson asks: So what if one of the two stations is actually generating the time slotted protocol infrastructure? I think that the physical addition of a dedicated access point to the premises is the salient point. Dave Bagby answers: No. This is a logical issue, not a physical one. Imagine two stations communicating through mediation of a third station. (The third station is generating infrastructure and also forwarding.) The third station is an Access Point, and forms an Access Point Coverage volume.

Rick Dayem points out that an Access Point is meant to provide local coverage and also to connect to a Distribution System Media to create an Extended Service Area (volume) larger than the single Access Point Coverage. (The access point is also a reasonable place to make connection or bridge over to wired local area networks.) The Access Point is degenerate in the case that Don Johnson and Michael Masleid are talking about, in that it does not also provide connection to a DSM. Answer: If the routing done by the degenerate Access Point is quick, then the degenerate Access Point is only a repeater. Rick Dayem complains that by these definitions the degenerate Access Point forms an Access Point Coverage that is an Extended Service Area. (Since, as defined, multiple names correctly describe the same object, the utility of the names is lost. There is a problem here with differentiating between the differentiation of logical entities and the differentiation of physical entities.)

Don Johnson points out that he is having trouble with the logical entity "Access Point" as something implemented by one of the stations in an ad hoc network. Don Johnson wants to use Basic Service Area as the name for the coverage areas of both the peer to peer and forwarding implementations of ad hoc networks. Dave Bagby responds that the peer to peer and forwarding ad hoc networks are logically distinct.

Liam Casey claims that the degenerate Extended Service Area is important. Dave Bagby answers that it is covered.

(Does a degenerate Extended Service Area connect to the wired Local Area Network? Sec.)

Introduction of contribution by Ken Biba and Xircom, *A Modest Proposal for a Asynchronous, Data Intensive, Wireless Local Area Network.* Document P802.11/91-25, temporary document HH25.

(This paper contains an extensive set of vocabulary definitions. One definition is similar to a definition in the preceding paper. Many of the components, functions, and linkages required as part of a Wireless Local Area Network are described and justified. An emphasis of this paper is minimization of new invention. It is not proposed as a complete architecture. Some of what is proposed may be impossible to do as presented. Read the paper. Sec.)

Ken Biba explains a bias: Let's get on with it and build for the dominant market. The necessity of mobile communication is key market pull for wireless LANs. Cost savings is not the key market pull. Keep voice and data networks separate. Optimize the data network for data support. Low delay delivery end to end is the key parameter here. P persistent CSMA is the preferred method. The scope ranges from 2 station networks to enterprise wide wireless LANs.

The network must be self configuring and secure from casual data theft.

The MAC should support multiple PHYs. I believe that diffuse infrared will work. Radio communication may require frame fragmentation and reassembly.

Frame delay must be limited. This is provided through use of the CSMA media access mechanism. **CSMA is a proven mechanism particularly when frame length is long compared to transmission delay.** In such a case it provides high utilization, minimal infrastructure, and simple implementation. CSMA/CD in contrast would be likely to require full duplex communication to a central node for any size network.

Since this architecture uses small microcells there will be few collisions. **All that is required is the ability to sense energy and to send and receive data.** (In may not be practical to meet these requirements using radio. As I understand it, the presence of energy at microwave frequencies not indicate transmission. The absence of energy does not indicate the absence of transmission. Sec.)

MAC framing and addressing will likely need local positive acknowledgement to improve the frame error rate. A routing protocol is needed to support datagram transmission from microcell to microcell as needed to follow a roaming station.

Clarification:

Simon Black questions the use of CSMA. If station A wishes to communicate with station B, and station C is communicating with station B, and station A is not able to sense that C is transmitting, then station A will trash the communication in progress. The network will not meet the IEEE P802 function requirement for frame loss. Station A may not be able to sense C due to a C->A relative fade, or because station A is in a noisy local environment. This is called **the hidden node problem**.

It is suggested (by Raphael Rom?) that the receiving station transmit a busy tone so that all transmitters will know not to transmit. (But the ability of A to sense a tone from B is not correlated with the ability of B to be trashed by A, the fade pattern of different frequencies and modulations are not the same. Worse yet, even a modulation burst from B to A, same modulation, same frequency, does not always correlate with A to B on the indoor radio channel due to reciprocity failure - reciprocity holds in free space because the intrinsic impedance is constant. The drive point impedances of A and B are seldom the same indoors because of the standing wave patterns. Sec.)

Ken Biba points out that if the cells are small than collisions are less likely. (Strictly speaking, if the number of stations that can collided times the likelihood that a one of those stations will transmit is small, then the likelihood of collision and frame loss is small.)

It is argued that the BSA definition states that all stations are in contact. Reply: You can't count on it. The station does not have a dictionary.

Bob Crowder wonders if the adjacent CSMA BSAs (defined by Ken Biba as contiguous service areas that allow intercommunication) operate as a cooperative environment. Ken Biba responds that he prefers synchronization of adjacent BSAs using different hoping sequences.

The question about non cooperative adjacent BSAs was not answered - given the definitions used it is a semantic puzzle anyway.

Kiwi Smit asks: How do you separate the LANs? Isn't that necessary in the protocol? Ken Biba answers that this is CSMA, not TDMA. (Actually, the paper assumes that there are enough channels so that adjoining networks are distinguishable. This doesn't address Paulette Altmaier's earlier observation that a station appearing in two (non) adjoining networks may pose a routing problem. Sec.)

Kiwi Smit asks: Why not switch to a deterministic protocol for high loads. Ken Biba answers that you always end up with large delays as the load reaches the capacity of the channel. Stay at light loads, you should not operate beyond 70% of capacity.

Bob Crowder points out, on the issue of bridging and node identification, there is a plan to extend the 802.1D spanning tree algorithm to handle the position. Ken Biba replies that we wish to make that thing go faster. Bob Crowder complains that that this will take at least two years even if we knew what we are doing.

Paulette Altmaier points out that using hoping code to separate adjoining BSAs is dependent on having adequate channels. Using wider channels is a problem with the FCC. As the number of basic service areas increases by a small fraction above the number of available channels there will be too much interference. Ken Biba responds that at 900 MHz there are 84 channels, so the channels can be reused.

Larry Van Der Jagt asks why use frequency hopping instead of direct sequence spread spectrum. Ken Biba answers that he is afraid of the number of code bits that he needs. It is not inexpensive. In his experience MSK and PSK hoppers work at lower power and are lower in cost.

It is stated (by Rick Dayem?) that in the ISM band interference is at focused frequencies. Frequency hopping with forward error correcting codes is more effective than spread spectrum in this case.

There are no further questions. The Chairman observes that it is 5:12 PM, and that there is a P802.4L work transfer to attend at 8:00 PM. We shall continue tomorrow with introduction and clarification of documents, after which (if there had been time) we will come together and identify the open issues. I have seen two definition documents. Could they (Dave Bagby and Ken Biba) come up with a common proposal of

definitions that they will give us to take home? Dave Bagby wonders about the probability of succeeding at that.

Wednesday, March 13, 1991, Morning.

The meeting was called to order at 8:36 AM. This is the fourth meeting of 802.11. Voting members of P802.11 and past members of P802.4 can get 5 books, standards made by P802; get in the queue at the registration office and wait. Tomorrow anyone registered can get the books. Please sign the attendance list. Establishment and continuation of voting rights requires your presence at at least 5 out of 7 sessions. You must also register with IEEE P802 to participate in a share of the cost of these meeting. Failure to register results in loss of voting rights and . . .

There is a request for tutorials in our meeting time on bridging (P802.1) and security (P802.10).

7. Technical Issues.

7.1A Introduction of contribution by Chandos A. Rypinski, ***Access Protocol for IVD Wireless LAN.*** December 28, 1991. Document P802.11/91-19, temporary document HH19.

(This paper contains a detailed description of an access control protocol that takes into careful account realities imposed by wireless media. Little complexity is added to accommodate 802.6 and isochronous compatibility. Emphasis is on maximum utilization of a limited resource. A hierarchical centralized distribution system is assumed. Read the paper. Sec.)

I need to impose on you this time and go into detail on this - on what is important, and how to accomplish it. This is a proposal. Slings and arrows are expected. Everything is negotiable, if there is reason to change, it can be changed, but there must be a starting point.

What is the scope and intentions? Start with three autonomous laptops? No. - Don't give up hope, but the high density network must be solved first so that all needed pieces will have places. Yes. The **default access control** will allow individual stations to build autonomous networks.

The protocol (as presented here) is not dependent on features of the backbone (DSM) technology. The protocol assumes a packet moving backbone.

The first point, and first point of controversy, is this: I think the correct place to make the access decision is where the knowledge needed to make the access decision exists. I therefore think a central manager is needed. Do not confuse this with a PBX. The central manager is a point where APs cluster.

Full use of the channel time is needed. CSMA does not make full use of channel time. Even the widely used CSMA/CD access method is **not capable of using a medium much over 20% of the time.** When pushed to its limits, there is a possibility of "avalanche" breakdown. **CSMA is OK if contention is rare, - if the duty cycle is less than 10%. There must be a back up form of contention resolution to define worst-case delay.** I will return to this later.

When should the next message start? As soon as the last one ends! This rules out fixed time slot TDMA. The distribution of message lengths is camel backed. Real packets are not always short, they are not always long. They are not of equal length. They are not of random length. (This is the sum of two distributions with different standard deviations and very different mean values. Sec.)

Think of a packet as the payload. If payloads are all smaller than a boxcar then putting one payload per boxcar is a bad way to send things. If one payload fills fifty boxcars, and one more only half full, that's OK. The correct length for a frame is the length that fits the load. Adaptive length is imperative if the protocol is to be useful.

Error correction takes place as needed. When the message is lost it is repeated. This works best when the packet (or chunk or fragment) is short. With the use of short packets (or chunks or fragments) **Automatic Repetition (ARQ)** of errorred packets imposes a small and decreasing penalty as radio technology is improved.

I suggest segmentation of 288 octets. (For 16 Mbit/s systems.) If too much load is submitted to the net segmentation can be used to interleave service among several stations rather than give the medium entirely to

one user for the duration of an arbitrary length packet transmission. The network should share capacity among those claiming access. That is an oversimplification of the actual algorithm, but it would take too long to go into now.

Worst case access delay is an important issue. Assume 3.0 milliseconds on average, 5.9 milliseconds maximum. (Longer for 1 Mbit/s systems.) This is very important for voice and some industrial users. - We really should list key parameters and how important each parameters is in each market.

Everything that needs to be done is done with binary messages sent in the bit stream. There are **NO NON DATA CHARACTERS!** There are **NO SIGNIFICANT PAUSES!** All signaling is in the bit stream.

(My presentation at the 802.4L work transfer meeting Tuesday night included a demonstration that coverage areas on some receiving planes are interpenetrating fractals in the indoor radio environment. This was meant as an attack on protocols that assume position of a station has much of anything to do with what that station can communicate with. Chandos understands propagation, I did not mean to imply otherwise. There was an understandable reluctance to talk about cellular distribution the morning after, however. Sec.)

Now, it is agreed that coverage areas are not nice clean squares, still, it is a useful starting point. Overlap is a good thing anyway. Space diversity is a good thing in radio. The port used is not a geographic thing anyway, it is based on headers and what is heard. The packets are short, and handoff is not the same problem as in cellular - the packets are logically able to take an arbitrary path. This is not the same as in cellular telephone, where the handoff problem exists because of the established circuits.

Propagation time (through the physical media - that's plural. Sec.) is an important parameter. In this special case propagation time is small. When propagation time is not a problem, you are probably not getting your money's worth out of the protocol. I assume 4 microseconds. Refer to the slide - page 8 or 15.

This is a message based system. Its vocabulary is Table III and Table IV - page 10. The vocabulary is detailed, and needs revision, so again, this is a starting point.

Shown are some of the message sequences. (Remember that this is a message based protocol, control is established with messages, not signal detection or silence detection or out of band signalling or any of that. . .) These include the station originate message sequence, the station terminate message sequence, and the single registration sequence. (This may be included in the narrative description starting on page 4 of P802.11/91-19)

If a station in a local cluster is busy do you deny the grant to an external requesting station? P802 rules imply that you must make the grant.

Registration? If the site descriptor doesn't match the station it may decide it doesn't fit the site parameters.

The Access Manager is a tender point. It is common equipment (equipment used in common by all on the network). It is not a single point of failure. (Bob Crowder interjects at this point that is many points of failure.) (However, like a broadband head end, if redundancy and care is used in the design, it is not a single point of failure. Sec.) Chandos Rypinski continues: I believe in reliability too. Simplicity and straight forwardness may lead to better reliability. Good management of a set of hubs can lead to good reliability. The use of common equipment leads to vastly improved reliability because management is vastly simpler and because station design is simpler. There are many more stations than common equipment.

Revisiting the **default access control** again: Each MAC chip, or at least those capable of operation at 1 Mbit/s, should contain the Access Point protocol component. Then the first station (in an ad hoc network) needing service, and not hearing and invite, goes on to generate the invite.

(There is a discussion about need to access and credit card verification, and another on virtual circuits. Sec.)

The protocol shown has high payload efficiency and good channel utilization. In contrast, CSMA is good up to 30% channel utilization., beyond that collisions cause traffic (throughput) to go down or worse. Now in CSMA(/CD), the traffic is not all payload, it includes padding. For short messages that is a lot of padding. No one works near 30%. They avoid loads approaching 30%. I will not say what the safe load is on a P802.3 network - I'll leave it to someone else.

Conclusions:

Everything can be done in one protocol.

All significant applications must live in one house. If we segregate we will have no clout, no frequency, no political significance, and no market. **We must find the technical solutions, and stop telling each other that your need is insignificant.**

Closure motions, discriminating against inefficient systems among other things, were prepared but not presented.

Discussion and Clarification:

Larry Van Der Jagt asks if this design is proprietary. Chandos Rypinski answer: Unfortunately, no. I am incompetent as a businessman. I have done much work here - free.

Don Johnson asks how coincident networks work, is there degradation and sharing. Chandos Rypinski answers that at light load they coexist. At heavy load planning is needed, it is not covered adequately in this work yet. I am not planning on using different frequencies, instead I will use capacity (air time) sharing. Since traffic peaks usually don't coincide, this is likely to work pretty well. Adjacent stores could do the coordination through radio, wire, or the protocol. Actually, access points are the only "need to know" elements, so it is not too hard.

Jim Neeley asks if it will work under FCC part 15? Chandos Rypinski answers yes, it is medium independent.

Dave Bagby asks: What happens with the default access controller (in an ad hoc network) in a room that is covered by the full infrastructure? Chandos Rypinski answers that that has not been derived yet. (Two things are obvious though, the first, that the default manager is not really needed, second, if it does "kick in", it will operate under the rules for coincident networks. Sec.)

Dave Bagby asks about priority: At high load, does the data service starve out the voice service, or does the voice service starve out the data service? Chandos Rypinski answers that the common access management controls this as a management parameter. Voice can be limited to, say, at most 25% of the traffic capacity, so that the voice circuits cannot saturate the available capacity.

Jim Neeley asks what is the access delay? It does not appear in the tables. Chandos Rypinski answers that it is octets and depends on the line rate. It includes two octets of preamble, and some processing, so there is no straight answer.

Jim Neeley points out that the analytic results are dependent, highly sensitive, to path delay. Chandos Rypinski replies that 400 meters of wire (at 50% c) and 400 meters of air is assumed, that is 4 microseconds.

Liam Casey points out that Apple Computer did not want local addressing. Chandos Rypinski replies that we could talk a long time on that. The local short address is more efficient. Liam Casey replies that he does not like convoluted algorithms needed for unique addresses.

Kiwi Smit asks about training time. Chandos Rypinski replies that one octet is discounted for training. It is a technical problem.

Is there a ceiling for datagrams? Chandos Rypinski replies that datagrams use all available capacity. "Voice" is limited to some maximum number of virtual circuits. Datagram fills all the available capacity it can find.

7.1B Introduction of contribution by Kiwi Smit, ***Tradeoff Between Modulation Bandwidth Efficiency and Medium Reuse Efficiency.*** March 5, 1991. Document P802.11/91-22, temporary document HH22.

(This paper points out that MAC and PHY design have dependencies. The architectural wish - a marketing decision that affects MAC design - of frequency reuse, imposes restrictions on PHY design that conflict with the desire for high raw bit rate and high signal to noise ratio. Read the paper. Sec.)

There is only one radio frequency spectrum, therefore this medium has to be used efficiently. One approach is a cellular system. For a fixed area or volume (say a cubic kilometer) and fixed available spectrum, we must improve the bits per Hertz and reuse if **we wish to increase the average bitrate per area or volume.**

This can be done by taking advantage of attenuation with distance to allow frequency reuse. The model shown assumes an isotropic homogeneous medium, a fixed loss exponent with distance, a fixed cell size, and some large area that must be covered with cells.

The problem will be with signal to interference ratio (SIR), not with signal to noise ratio SNR. Two cells using the same frequency must be far enough apart so that the distance between communicating stations in one cell (R) is large compared the distance between stations in one cell and stations in the other cell (D). How large depends on the allowed SIR and loss exponent (n). The number of channels required so that cells using the same channel are far enough apart is proportional to the square (or cube if filling volume) of D/R. Medium reuse efficiency is here defined as the inverse of the number of channels (N) needed to get the required SIR.

(The paper examines Shannon channel capacity and obtainable values using M-PSK. Sec.)

It turns out that average bitrate per area does not depend on the number of frequency division channels, N. The bitrate per cell goes down as the number of cells goes up, and so the product doesn't change. **From a performance point of view it seems wise not to choose frequency division multiplexing. A flexible time division multiplexing scheme will lead to higher performance under low load (burst traffic) conditions.** But keep in mind that this cellular approach is not valid anyway, due to the highly anisotropic signal attenuation characteristics of the indoor channel.

Discussion and Clarification:

Dr. Paul Eastman and Chandos Rypinski point out that on a voice channel, bit loss is OK, but bit loss in a packet results in a lost packet. (Assuming that the isochronous channel is being used for voice, or something of the "new milk, not old wine" class - right? Sec.)

Don Johnson asks for clarification of the figure (6 and 7) showing reuse efficiency as affected by M-ary PSK, the figure does not show values less than four. Kiwi Smit explains that the peak value occurs near four, two levels and much more than four levels are not good.

7.1C Introduction of contribution by Michael A. Masleid, ***The Multiray Model.*** March 9, 1991. Document P802.11/91-31, temporary document HH13.

I have become worried that we are getting too much of an image in our minds of a cellular distribution system using nice square cells or hexagonal cells, or something like that.

I don't disagree with the idea that two antenna produce two distinct coverage areas, but is the coverage area describe by a radius (say half the distance between the antenna) or by something else entirely?

We keep talking about a Rayleigh fading channel with 1/4 wavelength coherence. This seems to imply that the cells interpenetrate and things pop up where they shouldn't be, and perhaps it ends up being a rather messy thing. Maybe a fractal.

Using a simple model, just an empty featureless room, we can use a little electromagnetic theory to treat the reflection of the antenna off of floors and walls and ceilings as a mirrored room. Remember that specular reflection occurs off of mirrors, and a mirror is anything that is smooth compared to a wavelength. At microwave frequencies that's pretty big. Anything smoother than a cobble stone street is a mirror, the reflection coefficient may not be high, but it is a mirror, images are distinct over quite some distance.

The images of rooms in walls and floor and ceiling build up like cells in a crystal. (A computer image is run that shows antenna being added to a three dimensional image that shapes itself into a tetrahedral crystal.) If you keep track of reflections to the fourth order, four bounces, you have to trace out 129 rooms. The paper gives the formula for how many cells - its "n something" to the third power more or less.

The color prints shown are of a rectangular room. There are four sets of crosshairs, arranged more or less at random. The cross hairs are meant to be colored green (but it turns out to be yellow), blue, red, and white. These represent transmitting antennas. Receiving antenna locations cover a uniform plane located below the transmitting antenna, but above the floor. This was done using a computer model with several different reflection coefficients to get several different prints, but before turning that loose though, I went through and did the rough equations that you see in the paper.

The first thing to think about when you do reflections is that if the wall's bouncing 90% of the energy back at me, then the energy that I'll have in the room is going to be composed of what I transmitted, plus 90% in the reflection, plus again 81% in the reflection of the reflection, plus again 70 something percent and on and on and on in a series.

So if you do sigma of 1 plus 0.9 plus 0.81 plus. . . you get 10! So 90% of the power in the room is due to reflections. Almost all the significant power you are going to receive is in reflections. It is the bouncing around stuff that's going to be what's interesting. - and it is likely to mess up the cellular pattern a bit.

When I shot the rays out (in the model) I kept track of distance, the attenuation due to distance, the phase shifts in time, and then summed as a (vertically polarized) vector. This is sensitive to antenna polarization. In this case I assume (aomidirectional) differential current element vertically polarized antenna at transmitter and receiver. The prints are of only the vertically polarized E field. Directional antenna would look different, I'll do that next week. These prints will give an idea of the geometry. The video from last night shows it better as the rays propagate around, but this will give a feel for what the geometry was (See the print that says FRAME=24). The blue area shows the field strength from the blue antenna, the green is the field strength from the yellow antenna (sorry about that), the white and grayish stuff is from the white antenna, and the red is from the red antenna that you can't see because of the red background. The height indicates field strength (and yellowness or whiteness). The print shows only first order reflection from ceiling walls and floors, for something like wet concrete. (Actually this is in error, the reflection coefficient should have be negative for wet concrete, which would have more or less phase shifted the crests shown by 90 degrees. Sec.)

A slide is shown that includes reflections to the second order. This includes 25 images of rooms in the computer model. The pattern is more complex.

An interesting thing in all of this is that the distance doesn't make a bit of difference. If I go out to a certain reflection distance, attenuation of the signal is reciprocals of radius squared, and the number of things that are reflecting at that distance, the number of rays that are tracing, goes up as radius squared, and so distance cancels out. The energy in the room has to do with the (time) span of the room measured once (It would be simpler to say the surface area of the room. Sec.) and the reflection coefficient.

Slides are shown for higher reflection coefficients. They are labeled by VSWR, which is more commonly used in coaxial cables. VSWR 9 corresponds to a reflection coefficient of -0.8, VSWR of 19 corresponds to -0.9. The pattern shows that maxima from each of the antenna fill any particular area. The distance between maxima in the pictures is typically 1/4 wavelength. This isn't a bad thing. Suppose there was a group of workstations clustered in a tiny area - each could pick a separate cell. (Given the way the picture looks, it is unlikely that they would all end up in the same cell anyway. Assuming each had more than one antenna, they could actively migrate apart. Sec.) When you think four transmitting antenna, don't think four cells. Think four antenna and nine thousand cells. The handcuff algorithm? Make it efficient. It's going to have to work quick. I also suspect that the difference between moving at pedestrian speeds of 3 miles per hour, and at vehicular speeds, may not make a . . . of difference in the protocol. If you inhale, you have moved - allot.

The model is not able to be modified to show the effect of a refrigerator rolling through the room. You may be sure that a reflector thrown into the midst of it will have a significant impact. The point is not that uncover antenna placement causes a mess. The point is that if we are uncover in a simple environment and get a mess, then no matter how clever we are in a complex environment we will have a mess. It's also not that one should be afraid of messes. This is complicated, but if you know about it, you may even be able to take advantage of it.

Questions, Slings, or Arrows:

Don Johnson asks: Is this all on a single frequency. Michael Masleid answers yes: The model shown is good for code division multiplexing on a single carrier frequency. It can be redone for multiple carrier frequencies.

Don Johnson asks if the drawing assumes CW (continuous wave) transmission. Michael Masleid answers (somewhat evasively) that the model keeps track of all amplitudes and arrival times and so could also be reformatted to show delay spread. The time span needs to be computed from the span of the room times the negative inverse natural log of the reflection coefficient times a confidence value larger than 1. See the

bounding limit equation. (Actually, the span of the room is 6 meters, the order is 4, and so the time span is 80 nanoseconds, equivalent to a moderately high chip rate code. Sec.)

There are questions about further work on this model, showing relationships between signal strengths and other things of interest. That will be done when time permits, and if a way can be found to represent the information.

A question is asked: Why is there so much difference between the print for VSWR=2, and so little between VSWR=9 and VSWR=19? Michael Masleid answers that in the case of VSWR=2 the reflection coefficient is assumed positive, for a dielectric reflector, this causes maxima at the walls. For VSWR=9 and VSWR=19 the reflection coefficient is negative, for a metallic reflector, which causes minima at the walls. This causes a radical difference in the entire pattern. (Again, the positive reflection coefficient is a bad assumption. It applies to the reflection leaving an oil filled pool. Real building materials have negative coefficients. Sec.)

(Some questions, and who asked them, are undecipherable on the tape.) A question is asked about cellular: Michael Masleid responds that the indoor environment should still be used as cellular, just realize that to move from one cell to another requires no more than an antenna on each corner of your CRT. Another way to look at it is this. Dave Bagby feels that with a lap top computer, all that is needed to move out of a fade is to move the computer over a little bit. For a robot moving along its appointed path, to slip over sideways a little bit is impossible, it will have to move through, and possibly stop in a fade. Spatial diversity, either having multiple receive antennas or multiple transmit antennas (this is an example of multiple transmits), gives you a way to fill in those holes. One of the things that the IEEE functional wants is that you **be able to cover the area that you said your were going to cover.** One of the things that radio can't give you is just exactly that. The idea that 10% of the people who think they are on the network are in fact not on the network is not good. This is a way of solving that problem.

A question is asked regarding the signal strength of the antenna not generating a relative maxima. Michael Masleid replies that isn't shown. It might be just below the value that is at maximum, it might be completely gone.

A question is asked about which of the proposed access methods might be best adapted to these effects. Michael Masleid answers: I can't properly answer that. I am partial to the methods shown by Dr. Jonathon Chea and by Chandos Rypinski, that have central entities to resolve who is coming in on what path better. I merely suspected that I would end up with this when I started the program development a week ago, now I know, but haven't thought out the consequences.

Paulette Altmaier asks: Why do you claim that distance doesn't matter. Michael Masleid answers: I lied. Imagine that I have a centrally located radiator putting out 10 Watts, and over hear at the wall the incident power is 100 mW per square meter. After that one distance effect, distance no longer matters. (You could say energy from a point source is reduced by inverse radius squared, but the wall bounce is best treated as a planar source, and that doesn't attenuate. Sec.) There is a one over r squared at the beginning of the equation, but that's all, it can be looked at as periphery power density.

(Unknown speaker.) If we take this supposition that scattering is good, should we be seeking to increase the number of reflectors and transmitters to make the number of cell types more pervasive, rather than the reverse, of trying to paint the walls to reduce the reflection content? Michael Masleid responds: I am trying to maintain a positive outlook on this, since I believe it is the reality I must face, I want to convince myself that it is a good thing. It turns out that I can't increase the number of cells beyond this. (But you can increase how many cell types there are. Sec.) The minimal fractal dimension, if you will, is a quarter wavelength. I can't resolve more detail than this at the wavelength that I am using. I've run this at higher lattice densities, and it makes no difference past a quarter wavelength. There's a ~~minimum~~ maximum you can do no matter how you try to scatter it. Certainly if I went to 18 GHz it would all get much much closer together, it is just sensitive to wavelength. Ultimately it (actually using a true microcellular design) will depend on what we find out works in terms of protocol. We've got to trade off between "here is true reality" and the other reality of "market and cost". They will approach each other in steps.

(Unknown speaker.) It almost looks like there are no areas that have no coverage. Is that true? Michael Masleid answers that it is easier to tell in the video, where black is drawn last as no signal. If no area is black, then all areas are covered. But remember, this is a hollow room. It should not be hard to fill it. It is

more interesting when you put the chairs back in the room. Even if there are no nulls shown, don't draw any conclusions from that.

Dave Bagby asks: If I pick a spot anywhere in the drawing, an it is, say, red, then the red signal is most prominent at that spot. Is that a correct interpretation. Yes. What has been done is that at each spot all energy arriving from one antenna is formed into a vector sum used to assign height and shade of color. That is run through hidden line removal. The color? For the green antenna - low amplitude is deep green, high amplitude is bright yellow. This gives a bit of a topographical feel. The same is true for blue, red, and white. They don't get mixed.

Dave Bagby: Then it doesn't say at a red spot all I can possible hear is the red antenna? Michael Masleid: No. It is just the highest. Dave Bagby: Then it may be possible that it doesn't matter that red is higher, perhaps one of the antenna is providing adequate signal everywhere? Michael Masleid responds: That is true over some area. I can attempt to plot that - but I can tell you that some of these (hidden values) are in deep nulls - some aren't. Dave Bagby: Then at some places I could hear three, and need only pick one. Michael Masleid: Right. The idea of diversity is that there are notches in any given pattern. The more patterns I have the less likely that all the notches will be coincident. Sometimes there's nothing under the color, sometimes there is. If I can think of a way to show it graphically I will try to.

Chandos Rypinski observes. If it is so that there are virtual antennas behind every reflector, which of course is fact, that means that the existence of one antenna is multiplied many times in real situations, and this is the principle mechanism for shadow filling. What may be a shadow for the real antenna may not be a shadow for the virtual antenna. Michael Masleid worries that without enough temporal resolution and bandwidth it may be impossible to resolve the signals from the virtual antenna, or that the signal from the real antenna is cancelled by the signal from the virtual antenna. Chandos Rypinski reemphasizes that perhaps the real antenna signal is shadowed. Michael Masleid asserts that indeed that will not cause a problem, the virtual antenna will fill in. Chandos Rypinski points out: True, at least for signal, if not for high data rate. Michael Masleid agrees, the multiple reflections cause (too much) delay spread. - And that can be fixed if you have immense bandwidth and can resolve every one of those paths. Then you are all right.

Larry Van Der Jagt asks what is the minimum resolvable signal level in dB that is represented as a color in the print. Michael Masleid responds that the color printer can only resolve 10 levels, the animation resolves 16, but the lowest level shown is zero power (the display is linear) so the dynamic range X/0, and dB 20log(0), don't apply the way it is presented. It is the wrong way to look at it, it is divided by zero.

Lucian Dang asks if this is resolving data on the Rayleigh fading model only. Michael Masleid answers: No. I am assuming that the Rayleigh fading model is correct, but what is drawn is what is calculated (from a physical model, not a statistical model). It would be interesting to go through the data and see if it fits the Rayleigh model. The motivation for going through the exercise was that I was told that propagation followed a Rayleigh distribution, and looks like waves on a swimming pool. I though that if this is so, then if I colored the waves (in a manner of speaking) and overlapped them I would get this pattern - and I did.

Lucian Dang continues: There are some who claim the distribution is Rician (sp?). Michael Masleid responds that it would then be even more interesting to run the statistics on this and see what it really is.

Paulette Altmaier asks a question regarding receiver antenna diversity. Michael Masleid responds that it does not produce a well formulated experiment (there are two many ways to arrange n receiver antenna and move them over an x y plane) as an alternative, perhaps it would be interesting to do four antenna on a quarter wavelength square? It's not so much a problem of computer time, it is 75 seconds per run, just to many possible ways to arrange n antenna. I can do the four antenna one. I wish I could figure out how to put a chair in the room though. Someone suggest using a refrigerator instead. Michael Masleid responds that that is easier.

7.1D Introduction of contribution by Michael A. Masleid, Reference to ***A New Model for the Clustering of Errors on Telephone Circuits.*** IBM Journal of Research and Development 7 (1963), pp. 224-36, taken from ***Chaos Making a New Science***, pp. 90-94 James Gleick. Temporary document HH11.

(There is no document distribution. The book ***Chaos Making a New Science*** is readily available and makes interesting reading. Sec.)

As I read the article, I realize that there is nothing that I can say that says it any better than the article itself. Of course I will talk - briefly - anyway.

One of my puzzles, listening to people trying to do noise models over the last 5 years, is the constant talk of noise coming in bursts. I have done extensive work, my factory generates noise - blows holes through circuit boards in fact.

In the GM Oshawa Microwave tests we had left the impulse response test equipment running. It would occasionally see things. A typical thing would be a pulse - a noise impulse, followed by another, and in a little while another. Then nothing for long periods of time, and then maybe another big one, or two, or maybe a whole chain infinitely close together.

The book describes (among other things) Mandelbrot's work with IBM engineers in trying to describe noise. Mandelbrot realized that the seldom on and mostly off again nature of noise describes a type of pathological mathematics from the 19th century called a Cantor dust. A Cantor dust is an infinitely dense set that has no area. Imagine a line drawn on a sheet of paper. Remove the center third of the line. Now there are two lines, one third as long. The middle third is missing. Take away the middle third of the remaining two segments. Now there are four line segments. Take away the middle third of each of those. Repeat the operation for awhile. All that is left of the original line is a "dust" of points, that tend to occur in bursts. If the original line is thought of as a frame, (or a bit, or the days work, it doesn't matter too much), the dust is the errors, or at least the interference. The IBM engineers collected the data for Mandelbrot. It didn't fit the model however, - until Mandelbrot realized that the engineers had thrown away sections of measurement that they "knew" were not interesting, or in error.

What is the moral of the story? Lots of error recovery mechanisms, and error recovery mechanisms at all levels, is a good idea. If you think about how real networks work - with channel filtering, ACK/NACK, frame retry, application program recovery - they have error recovery at many levels. Burst error recovery, even spread spectrum, can be thought of as ways to deal with the peculiarities of noise.

This doesn't sit well with the central limit theorem. Have you ever listened as a flock of three thousand geese fly overhead? According to the central limit theorem it should sound like GWAAAAAAAAAAACK. It should average out. It doesn't! There is always one goose that's closer, and so you hear the HONK, against a background of honks, against a background of noise. The reality of it is that noise is made by people, and sometimes they go to lunch, and sometimes they work allot, and sometimes they're next to you, and sometimes there not. Sometimes the noise source is intense. The ultimate noise source we had found was Larry Van Der Jagt's son's toy military helicopter. It is the same size as the microwave, - Helmholtz and Marconi on a small scale.

Conclusion: We will be successful if we do as all before us have done. We must provide a rich variety of ways of dealing with noise (errors) at all levels in the protocol.

Questions:

(Some questions and speakers are undecipherable on the tape.) It appears that an assumption is made that noise is always infinite? Michael Masleid replies: I am not comfortable with that either. If noise bandwidth is larger than the input filter, it will be reduced, it will have an analog value. On the other hand, other noise will just blow away the front end, cause it to saturate, that is always going to happen. We have to fix that. we can't allow the amplifier to remain blitzed for three minutes. It can't be like fiber where the detector might avalanche and melt.

Larry Van Der Jagt points out that we discovered in P802.4L that spread spectrum has an advantage over other modulation against impulse noise if the receiver is allowed to clip the noise impulse on a per chip basis.

The Chairman expresses thanks for entertaining presentations.

7.2 Infra-red. Introduction of contribution by Richard Allen, ***Infrared Wireless Networks.*** March 11-15, 1991. Document P802.11/91-35, temporary document HH15.

I need to draw a distinction between the kind of channel that Michael Masleid was describing, and the kind of channel that infrared presents. First, and overview of infrared. There is some confusion. There are three

distinct topologies: Point to point, directed, and diffuse. What you have heard about infrared would apply to one or another. It will be all jumbled up.

You may think infrared is line of sight (and so is no good for communication), or easily blocked (TV remote control), or slow (but there are systems at 10 Mbit/s and higher).

A typical point to point has a couple of lasers on the roof top and a fairly high data rate and very narrow beam width. - That's not what we will be talking about here.

Another approach is diffuse - flood the room with light. We will talk a lot more about that later. In between is a third kind, a hybrid of the two - directed infrared. That uses a fairly broad beam aimed at a spot on the wall or ceiling that we use as a passive reflector - not specular - scattering.

Each type has certain characteristics associated with it.

Point to point using a laser and careful aim gives great distance (600 ft+) and high signal to noise ratio, so 10E-8 error rates are achieved at greater than 10 Mbit/s. The ones built with LEDs are safe, there is no biological hazard associated with them.

Directed beam is typically in the range of 70 to 80 feet. 10 Mbit/s is doable, 1 Mbit/s is typical in todays market. Alignment is simple, point it until the green light comes on. Anyone can do it.

Diffuse is one of the more interesting ones to work with. It relates directly to the portable application. There the range is shorter. If you want to keep it simple without a repeater you should think of a range of 30 to 40 feet. You can trade off battery power for feet. Data rate is 1 to 10 Mbit/s. Diffuse can meet all requirements.

Each type has its advantages. Point to point can be kept pure, the beam width is narrow enough so that no one else is going to be in the beam width. Directed is more efficient than diffuse in terms of their optical power, but they do require simple aiming. Directed has the advantage of space diversity. Each system can own its own spot on the wall or ceiling. Diffuse systems have the advantage that no aiming is required. Since infrared doesn't go through walls, security is good. Not going through walls could be a disadvantage, but in typical marketing fashion we turn that into a feature.

Diffuse doesn't need a line of sight path, it needs some area that is in common view of all. This is easy to find in an open office environment. The range is not great, but remember that small is beautiful. An early spread spectrum system by Aegilus (sp?) had a range of 600 feet. That puts to many users onto the same system sharing a limited bandwidth. At 70 feet you can get down to 20 or 40 workers in each cell. That is a good number when you go to size a network. Small is also good because there is no single point of failure. If something breaks down do you want 600 people to out to lunch? Two thirds of the office workers in the United States work in an open office environment. It is a fairly large market.

A diffuse system works by flooding the room. Some here have seen a demonstration. The receiver could be placed under a table, aimed at the floor - it was absolutely reliable. User aiming is not required, it is a very robust communication. The range is somewhat limited of course, for a room the size of this auditorium you might need a repeater on a desk in the middle of the room. It is very low power, typically 20 mJ/Kbyte to transfer the data.

There are preferred modulations. My favorite is pulse position modulation. To send 4 bits, use pulse position in one of 16 time slots. This causes four times bandwidth expansion, but it also gives 18 dB improvement in signal to noise ratio because of the way detectors convert power to electrical signal.

For portable applications? A typical laptop with a 7.2 volt, 1700 mA/hour capacity battery, and a battery life of 2 - 3 hours typical usage, works out to use an average power of 4 - 6 Watts. A diffuse IR modem will have a low impact. Typically it will be 1% if listening, and 2-10% if transmitting.

The wireless desktop market would be nice to have, but it is a saturating environment, and hard to sell. Those who have invested don't want to waste their investment. They are not likely to go back to there management an say "I changed my mind".

Questions and Clarification:

Larry Van Der Jagt asks if this uses the same components as fiber optics. Is it sensitive to sun and room lights? Richard Allen answers: The wavelength used is peaked at 875 nanometers. It will fail if pointing at the sun. Most systems use the ceiling where it is seldom illuminated by the sun. Tungsten lights are a problem, but they can be filtered. The only real problem occurs if shot noise gets high - you have to not saturate the front end receiver. Don't point it at the sun.

Liam Casey asks, will it work by a window? Richard Allen answers: If you can take the heat, the infra red link is also likely to work.

Liam Casey asks what about security? Richard Allen replies: Imagine using a Questar telescope and detector diode? Infrared treated windows could stop you, and if not, it is out of design range anyway. Using a bigger telescope doesn't help because field of view is reduced as aperture is increased

Chandos Rypinski asks about ~~photo~~light-emitting diodes. Richard Allen replies that the rise time improves as drive increases, it is the reciprocal of the square root of current density. Use of pulse position modulation helps here. Noise increases with the cube of bandwidth.

Richard Lane asks if infrared is likely to be only a portable computer market? Richard Allen answers No. The other markets are sharpening there knifes. A number of components are available.

Lucian Dang asks about use of other colors? Richard Allen replies that it is not DFM, it is best to use the optimum frequency of the detector. Having red, yellow, green lights around the room would be an annoyance. It is a time shared channel. The diffuse system does not well suit token ring.

The Chairman thanks Richard Allen for his presentation. ***If slides are shown in a presentation that are not also in the submission please give two copies to the chairman. This is an aid in creating the minutes.*** It is noon. The meeting will break for lunch.

Wednesday, March 13, 1991, Afternoon.

The meeting resumes at 1:33 PM. Note that the liaison with ETSI does not exist. Because the PAR is not yet approved by the New Standard Committee we cannot go beyond the United States.

8. External Liaison

8.1 USA FCC petition. Presentation by Jim Lovette, on temporary document HH5: ***Summary of Statement of FCC Chairman Alfred C. Sikes on H.R. 531, the "Emerging Technologies Act of 1991."*** Alfred C. Sikes, Chairman, Federal Communications Commission, February 21, 1991, and on Temporary document HH3: ***Before the Federal Communications Commission: Petition for Rulemaking "Data-PCS".*** David S. Nagel, Vice President, Advanced Technology G, Apple Computer, Inc. January 28, 1991.

Jim Lovette explains that document 5 is a summary statement by FCC Chairman Alfred C. Sikes concerning the Dingleman bill, which would require the government to give up 200 MHz of spectrum below 5 GHz. This is justified as needed for LANs and other new technologies.

The bill is emerging in House of Representatives, I testify as Apple Computer's technical witness. Sikes recognizes the existence of DATA. WE have made the agenda - we are third or fourth below the Middle East War. The history of this act: Last year it made it past the House, but not the Senate. It was resubmit in January.

The amount of spectrum varies from 180 - 200 Mhz. The argument is that regulation, the mystery, (what are they using it for?) is getting in the way of progress. Turn the spectrum over to us, and anyone else who makes a case for it.

The band news is we (data PCS) are late. There has been no input on the need for data before we came. Data has been overlooked. The FCC says "Gee, were glad your here, we've been waiting to hear your story."

This is a HIGH WATER MARK! The Communications Act 1934 was last thing of this significance.

(A number of reports and hearings are cited, NTIA, P802.11, WARC 3rd inquiry, the United Kingdom DTI report which could revolutionize the UK as the consent decree did the United States, The Apple Petition, High Performance Computing Bill, WARC IAC. Sec.)

The Administration (President Bush) introduced a competing bill yesterday (Noon, 12-March-1991) that calls for auctioning spectrum to the high bidder. That's the band news. the good mews is that we may avoid this.

It could take two years to identify all of the spectrum to be freed.

CSPP (Computer System Policy) composed of DEC, HP, Compaq, IBM, Motorola, Control Data, Unisys, NCR, Tandom, Apple, Sun; the CEO's are to draft an endorsement of the Apple Petition. Apple is represented by David S. Nagel. I am here to link the Washington folk to the people in this meeting.

There is a lot of stuff that wants the spread spectrum bands. (Think about the future public land mobile, a network of the future THAT WILL FIND YOU.) The needs are spectrum dependent. There is 1E+9 dollars (That a Gigabuck! I'll use G$ for short? Sec.) on the dice roll here. The Administration wants auctions. **The estimates are 7 G$ to develop 50 MHz, with 80 G$ in investment and license sales. By comparison, Desert Storm cost only 15 G$.** Much less than what the spectrum is worth. President Bush is aware of the deficit. He wants revenue, so we are in a political and economic forum, against competitors who's fortune depend on this. - But the government is intrigued by wireless computers, and what that means to them personally.

The public utilities, fire departments, police, don't want to lose their frequencies. The utilities say computers don't need wireless. - They are late to petition, but still, we must get our words in also.

Apple Computer calls this "Data PCS", but "Data PCS" is not an apple issue, it is a statement, a platform, a process, a lightning rod. Paulette Altmaier is one who has put word into the petition. It is inadequate and incomplete by intent. The Apple name shall need to disappear from it. P802.11 is in this process. It is a lightning rod. Of the 9 who met, 8 were apposed to us. They are apposed because we will take away their frequencies.

Discussion:

Why are we doing a spectrum initiative if we have the ISM bands? The position is that this is not adequate! Do we have adequate spectrum? There is PCN? Reliability. They need 99%. We need 10E-8. Wow.

How much spectrum? We asked for 40 MHz, because that is what we will get, of the 140 MHz that is being examined. Forget about going for 100 MHz. Don't bother for 10 MHz, its not enough.

When will we get it? We will get it by end of the year (if we get it). The FCC wants to have a stake in the ground in time for WARC 92, for the sake of American Industry.

What is a Wireless LAN? A garage door opener? What about a Nintendo game? If we open it to all, we will have nothing! Coexistence - can we coexist with real time voice? Why not? Can we live with point to point microwave service? Here is the World - you get what is left - that is Coexistence.

What about regulation? We (P802.11) work at a lower level. We get into modulation, directivity, packetization, power level control. The FCC doesn't want to care about that. They want us to deal with these issues - to submit things to the FCC as technical experts.

I am not asking for your support. (You may pick up forms in the back of the room.) I am asking for you to make it your own program. Can you generate support. There will be hundreds apposed to us.

What is the probability that we will get spectrum? I sense, it is hard to explain, when we were negotiating for frequency: The whether is gone. There has been a sea change in November, December. "Tickle me here" is how it is going.

Chandos Rypinski asks: Have you seen any effect due to our comments. Jim Lovette answers: I saw some effect. There is an industry group that is very interested.

We are wearing away at a stone. The FCC is now expecting output of this group. The group's comment has value, and that does not diminish the value of the individual's comment.

Tony Shober asks: There have been PBX groups asking for indoor wireless, will the FCC allow indoor PBX to be lumped with Data? Jim Lovette answers that it is all encompassing. The FCC had no idea what they opened up. There are 57 new applications. A variety of input, voice PCN, including many premisses, or low orbit satellites, a continuous range of services with no delineation out to infrared.

The FCC wants simple solutions. P802.11 is simple but doesn't go far enough. There is none for voice on air on public places. We say that P802.11 group knows what it wants.

Tony Shober claims that it is not technically feasible or wise on same frequency, this is under active debate in this group. How will this difference of opinion help? Jim Lovette answers that if we only agree that we need frequency we have made our point. At Apple, our computers are multimedia, we don't want to eliminate voice, the two look the same to the network. Data and voice can be in packet format, and if both have fair access to the media, it is fine. We don't care, the FCC doesn't care, and if this group doesn't care then FINE.

What about products now in this spectrum. Jim Lovette answers: If Scully stands before a group like this and his radio doesn't work then we (the Apple Computer employees) are out of a job. **Two years from now will a product built for 900 MHz still work**? Spectrum fills up fast when it becomes available. We have a home now, and we are working to fill it, but we need a new home real soon. There is nothing fatally wrong with the present product, (and we look for graceful words to say that) but we need a new place to go.

Nathan Silberman points out marketing faults. The voice proposals that talk about data also do good voice at five cents a minute. Data is offered, but it is voice modem data. That is not enough data. Imagine 2400 baud at 5 cents a minute. That won't save much on electronic document distribution.

It is stated that DECT is not the ideal way to offer 16 Mbit/s. Simon Black responds that DECT does offer up to 500 kbaud. GSM and CT2 are not the same thing. DECT is much better, it is denser (more Mbit/s/area) and it can be private. DECT may be optimized for voice, but it does good data. Jim Lovette responds that DECT is not wrong. We are glad for its presence.

Nathan Silberman asks: How will your petition resolve the problem that 90% of ISM users will move into Apple band anyway. Jim Lovette replies: The FCC differentiates usage by all sorts of things, business, border data, modulation, frequency and propagation, by how rich, by how many lawyers. This is where we are most insecure. Is a Nintendo a PC? How about a can opener. (They ask) Can you help us sort this out?

Paulette Altmaier responds: What happens if all who are in the ISM band are moving from the ISM band? Use of a self regulated protocol will help us here.

All we want is an equal playing field. Now we have Megawatt CW and kilowatt spread spectrum devices - and us. Can we at least reduce the set to those of the same type and power? You can buy a wireless device from Payless (a store chain) to transmit from the living room VCR to your bedroom television. It is on all the time. The FCC still believes in spread spectrum (as the solution to all these problems).

I saw an internal government report, to see if there is a place for PCN and for our PCS. They have access to more information than we have.

Bob Crowder points out that we have lots of people going to the FCC, what about trade groups? Jim Lovette answers, we try to get a voice heard.

Dr. Rick Dayem asks if, since the FCC has PCN and data PCS petitions, is the FCC thinking of allocating the same spectrum to each? Jim Lovette answers that we provide a platform. Apple has a specific petition. They have the choice to discard, deny, or treat. They put the petition on public notice in 10 days, (that is the fastest the government has moved since House Resolution 1,) to close in 30 days. We bypassed the Notice of Inquiry!

Dr. Rick Dayem implores that we keep PCN and data PCS separate. PCN is a very long process, it needs a global superstructure. They cannot afford to make mistakes along the way. (We can?) We can get data PCS to work if only two stations are properly equipped.

Jim Neeley states: To get IBM to respond in support, it must be with the qualification that P802.11 be delegated for the technology to access this medium, and that delegation shall imply a method where the FCC can regulate interfering users. This gives the protection and enforcement of licensing without its requirement for licensing.

Jim Lovette replies that the FCC will not delegate regulatory responsibility. The FCC wants us to write the regulations. We (Apple Computer) want the industry to do it (write the regulations). We (Apple Computer) will provide the room, the coffee, and a medic. They don't want us lobbing grenades. Apple will do a tea (party), any time, any place, to get this done. The time table is brave, courageous, and essential for 1992.

There is a time clock. If it doesn't meet the needs of WARC, or 1992, we can't wait that long (on the frequency issue). We need to be equitable with voice. If we can get that, we can get the 80 G$ resource.

Jim Neeley ask: How fast to allocate? Will the FCC allocate to the Standard as it evolves? This is a circular thing. We need to get spectrum, we need to be given time to expertly use it. Jim Lovette responds: Go to them. They want to be tickled.

Dr. Paul Eastman points out that they will welcome support from this group in search for dedicated allocation.

Dr. Paul Eastman moves, seconded by Chandos Rypinski, to:

Establish an ad hoc group to write a draft on behalf of the IEEE P802 Executive Committee to the FCC in support of allocation. (Which in turn may be supported by individual's companies.) (17-0-0)

Discussion:

Jim Neeley notes that the intention is to draft, then submit to P802.11 as a whole, then to the P802 Executive Committee, then to a Lawyer, then to the FCC.

Question to establish ad hoc. . . (17-0-0)

The Chair for the ad hoc group is Chandos Rypinski. The group will need a room suitable for 10 people through the night, starting at 5 PM. (And ending at 3 AM as it turned out - having implemented through air media with flying discs. Sec.)

The meeting breaks at 2:58 PM for coffee, returning at 3:31 PM. Regarding external liaison with the **European bodies**: Frequency allocation is done by country. The Conference of Postal and Telecommunication Administrations have a commission called the European Radio Commission. On their agenda they have some allocation in the 2.4 GHz radio band, say 10 MHz. Could we send a letter to them with regard to radio LAN spectrum requesting more spectrum than what they are thinking about?

Simon Black points out that at the last (ETSI) RES meeting, the cordless LAN group decided to study user needs and market issues for cordless LAN and report back and make recommendations in June.

The Chairman points out that we are still working under the P802.4L PAR at this time. We will not be under the new PAR until NESCOM, next week some time. (And so we can't interface beyond the United States.)

Dr. Rick Dayem says: Though I is not familiar with the bodies involved, time is of the essences. I am in favor of doing something now.

Jim Neeley agrees: Anything in support of world wide allocation is good. Set an add hoc group to work on CEPT.

(The motion by Dr. Rick Dayem was ruled out of order due to membership rules. Sec.)

Robert Buaas moves, seconded by Bill Stevens, to:

Have the add hoc group write a draft letter to provide our input to the frequency management group of the CEPT. (12-0-1)

(The ad hoc group did not have time to work on this. Sec.) Richard Lane abstains, observing that we have no charter beyond the United States.

Australia - Nathan Silberman reports that they allow something like spread spectrum. Nathan Silberman will research.

Canada -Spread spectrum is allowed in the 902 to 926 MHz band. They are in the process to rewrite regulations in general to more closely conform to FCC part 15. They are also working to support things that are momentary, that come on only once in awhile. They want to go along with the US, but if there is something special that you want, write them a letter.

CTIA is the Canadian Telecommunications Industry Association. Are they asking for spectrum harmonized for WARC 92? It is a good idea to send them a letter too.

Can the add hoc group also draft a letter applicable to Canada?

8.2 ASC X3T9. The P802.11 committee has no request for higher data rates at this time. Michael Masleid advises again that X3T9's informal position is that if P802.11 needs to use elements similar to the ASC X3T9.5 FDDI protocol family - perhaps for distribution, then P802.11 should use identical elements, and not create something almost like the FDDI family, since this would cause (further) confusion in the marketplace.

8.3 Other working groups.

8.3A ETSI. Simon Black reporting: For more information see Simon A. Black Document P802.11/91-10, ***DECT-A Standard for Cordless Data Networks***, January 4, 1991, Document P802.11/91-10, temporary document (Gaithersburg) G14.

ETSI = European Telecommunications Standards Institute.
DECT = Digital European Cordless Telecommunications. (RES-3).
RES-3S = Services and Systems Requirements. Complete, will become public.
RES-3N = Network and Systems, Voice - firm draft, Data - preliminary draft.
RES-3R = PHY and MAC, 95% firm.

Regarding the action item: ETSI draft standards are only available to members, but ETSI does have arrangements to allow other standards organizations to have access. Perhaps the IEEE has observer status with ETSI? There exists overlap meetings.

Simon Black points out that at the last (ETSI) RES meeting, the cordless LAN group decided to study user needs and market issues for cordless LAN and report back and make spectrum recommendations in June.

Dr. Rick Dayem emphasizes, regarding the ad hoc cordless LAN group's June report, that he would like a contribution from this group (P802.11) to RES, to make the spectrum allocations as similar as possible.

8.3B T1 Dr. Rick Dayem reporting on T1P1: I have made a contribution to T1P1 that outlines P802.11 as follows:

The Vision: Wireless Computers

The Need: Connectivity to the LAN and WAN

The Challenge: Technology, Standards, Regulatory Agencies

A brief history of P802.11

P802.11 mission and scope

Dr. Paul Eastman points out that a liaison may pass on information with no need of executive approval. If the liaison wishes to shed or accept items in project scope, the liaison needs approval of the IEEE P802 Executive Committee.

8.3C Other The Chairman is invited to make a presentation to the ECMA TC 32 group to explain P802.11, and what they could do in this area. The Chairman reports: I will request that they set a task group to liaison and feed P802.11 their EC requirements.

(Unidentified speaker.) What is going on in Japan? The Chairman replies: All I know is that they seem to be against spread spectrum. In the last 6 months they have restructured things on wireless. There are two emission levels set: One is below the level of unintentional use, the other permits short disturbances.

ETSI RES-3
DECT REFERENCE DOCUMENT
VERSION 2.1

European Telecommunications Standards Institute
BP 152-F
O6561 Valbonne
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Regarding the Study for CEC - See last meeting's minutes.

Room 5030 is reserved for the ad hoc group from 5 PM till 8 AM. This completes the day's agenda.

9. Miscellaneous

9.1 Informal discussion on collocated networks.

Larry Van Der Jagt expresses frustration with the group's apparent eagerness to break (After that many presentations they may have been "burned out". Sec.) when we haven't begun to resolve technical issues. The Secretary decides to lead an informal technical discussion to see if any good might come of it. (The following discussion is extracted from tape. It is neither wise nor possible to represent exactly what was said. Sec.) The Secretary eschews the IBIS list for the moment, and opens the discussion with the question:

Michael Masleid asks: Let's assume that the ad hoc group is successful but the FCC grants spectrum (not to P802.11 but) to Data PCS. If we do obtain a dedicated spectrum, and someone doesn't want to do what P802.11 dictates, can they do any old thing they want? I claim they cannot, because without a protocol for media access we and they could never coordinate.

Dave Bagby says that in IBIS, this can be opened with the issue (I:) Should we assume dedicated spectrum space? That would have caused us to come back latter and address: Yes, we should, and No, we shouldn't. An interesting problem with this (IBIS) format for keeping track is that it seems to imply that the issues are orthogonal. I suspect that many of them are not.

What if we don't have dedicated spectrum space? Michael Masleid responds that the question (as presented) doesn't mean anything if we don't have dedicated spectrum space. Dave Bagby says that is not necessarily true. There are products out there in non dedicated spectrum space, and they do work - though you may want to put a figure of merit on what you mean by working - it is certainly not zero. Michael Masleid responds (in light of the petition for dedicated spectrum) that it would be wise to take the position that they don't work. Dave Bagby points out that that (protocol coordination in non dedicated spectrum, or possibly a technical position in support of dedicated spectrum) is another issue. Michael Masleid wishes to separate issues from political positions. Dave Bagby says he might agree with a political position, but objectively argues that treating with political positions may not be the correct thing to do.

Bob Crowder points out that we can not assume we will get dedicated spectrum space. Dave Bagby says that is the point I am trying to drive in: (I:) Do we assume dedicated spectrum space? We have a process that we have adopted for coming to an answer to questions like that. If we can reach a quick answer, yes or no, to that question, **THEN**, we can go on to pursue those subsequent questions. I am not arguing for spectrum space or against spectrum space. I am saying rather than assuming it (dedicated space), when we write down an issue, let's make it explicit so that we can look back at the history record and know what it is that we did.

Michael Masleid (with a sigh, having blown 5 minutes now on whether or not we can make an assumption, one way or another, about future historical fact before proceeding.) OK. Dave, in the somewhat limited time we have here, I merely want to do an experiment in trying to resolve an issue with a narrowed scope. Let's make the assumption that the great ones have given us 40 MHz of spectrum. Let's make the additional assumption that for some political reason P802.11 doesn't have enough regulatory clout (a fairly good assumption), to force absolutely everyone to use the P802.11 MAC. We assume that company X, Q, and W out there build something that intends to use the same spectrum, also for data communication, and we somehow want to coordinate our LAN with their LAN. Then the question becomes what do you have to have in order to be able to do that. This is sort of a technical and protocol issue. (The political answer is to use a shotgun.)

Larry Van Der Jagt says that: I think the issue is can we develop a template for regulations that will allow non P802.11 systems to coexist with P802.11 systems. If there is a spectrum allocated to operate under this template.

Michael Masleid answers: That is one part of the issue, another part is: Can two P802.11 networks that don't have common wire, or something, between them, even operate together in the same place. Both of those questions are interesting, and fit within the scope of the original question: Dedicated spectrum, but no control.

(Unidentified.) I would like to record another side issue - I don't want to stop what you are talking about though: On the assumed dedicated spectrum, I think the PAR says: Start in the ISM band, and then make the work applicable to other bands as well. I would submit to you that the ISM bands are not dedicated, therefore I would submit that: (I:) There is a question as to whether this committee should be addressing non dedicated as well as dedicated spectrum? I submit that that is not a resolved issue. But, if you do have dedicated spectrum, the question you are now addressing is relevant and valid and should be addressed. But I submit that at a higher level there is a question about whether you have to address non dedicated spectrum like ISM bands.

Michael Masleid interrupts at this point. Let me draw a distinction. It is one thing to work against strange interferers (in the ISM band), it is another thing to work against something that looks almost like you, but isn't (the same). I can deal (personally?) with trees and walls as I walk around, but I have a tendency to run into people. They have a tendency to have the same reactions I do, so they take the same (evasion) method: I end up stuck in hallways. AND SO: working against something nearly yourself is a slightly different issue than (working against) an interferer in an ISM band.

Don Johnson says: I don't think the issue is dedicated or non dedicated spectrum. I think the issue is: (I:) **Can we design a MAC and a control procedure for a group of systems that do obey P802.11, and which will operate next to each other, co-located, and autonomous.** Michael Masleid interjects: - with graceful degradation, or even no interaction at all? Don Johnson agrees, and continues: The other question then, is, in either case (dedicated or non dedicated spectrum): What is the relationship of those networks that follow P802.11 rules, to those networks that do not? (I:) **Can we also right some rules that are a lot less stringent than our own for other things (LANs) so that they can still coexist with us even though they don't follow fully what we're doing.**

Bob Crowder replies: I believe that it would be possible to do that (write rules) assuming that you had another network, like Chandos Rypinski proposed (similar features occur in Dr. Jonathon Cheah's architecture, also. Sec.), wherein the allocator of time slots actually listens to the other networks and determines the packet (which time slots that are free). If the FCC rules were written such that the packet (time slots free) could be very easily determined, (so as to obtain) no more than a certain amount of time (available) in an indicated slot, it would be easy to coordinate the networks.

Paulette Altmaier suggest that in the protocol of different MACs there could be a least common denominator could be used to share the channel.

Michael Masleid ask then: Who should be the one who creates the least common denominator, or does that become something that the FCC (does)? Reply: We should submit the least common denominator to the FCC. We would, because we know (the issues involved) better than they would.

Bill Stevens: The FCC would probably appreciate our effort for providing central coordination, saving them from the ensuing free for all while allowing coexistence.

(At this point the conversation reaches a tired sounding pause. Sec.)

Dave Bagby breaks the silence: In this experiment, one of the things I am observing is that there are two ways of approaching this conversation. One is to identify what questions need answers, the other is each time a question comes up try to come up with the and answer. I am for trying to identify questions, and if there are quick answers, resolve them, else put them away to be looked at a later time. It is not clear to me that other people are operating in that same mode. An interesting observation of the process.

Michael Masleid replies: Yes. In other meetings I had just collected questions (for latter collection into a conformance document) I was happy with the results, the others left goggle eyed.

Larry Van Der Jagt suggests that we could get consensus on what the most important issue to address first is and address it, then figure out what the second most important is and address that.

Michael Masleid replies: I can think of two very contentious ones: Voice or no voice, and fast motion or no fast motion.

Larry Van Der Jagt suggests the first important question might be the response to the FCC. We will ask for spectrum. Somebody is going to want to know what we are going to do with it. They'll want to know pretty quickly I would imagine!

Jim Lovette: The FCC would like for us to give a model which would be enforceable. The way that they - that we - would like to force the regulation is through the equipment authorization process. This means that independent of the content or goal or social merit or anything else they would like to be able to measure something on a watt meter or a spectrum analyzer or scope or something else. We have proposed a method (communicating among ourselves); That part of the equipment authorization application is the inclusion of, without approval or otherwise implied, of a description of the channel access protocol that we use. (Only) the hardware is under FCC control or observation. The higher level issues of what that hardware is doing should not be of interest to them (FCC). We should try to simplify it so that they don't have to be concerned with those issues.

Michael Masleid suggests: So with the submission for testing you include a statement saying, for instance, this is P802.11 compliant? - Or non compliant but non interfering?

Jim Lovette responds: No. We propose that we include how we are utilizing the channel, the first thing, say for instance we were using carrier sense: What are we listening to? What bandwidth is our receiver tuned to? What sensitivity? What is the emission band of the transmitter? - anything that has to do with the link. They would like to regulate hardware and emissions. We want to publish this for industry information. We don't want anyone to use an encroaching method of channel access that has as its intent prohibiting someone else from getting access.

Michael Masleid tries a test case: Certain classes of protocol that we may come up with will require some degree of coordination between all collocated things (LANs maybe) using it. Some classes that we might think about perhaps don't need coordination. In all likelihood, the more efficient the protocol, the more tightly it needs to coordinate with anything of its same ilk in the area. The more tightly it needs to conform, the more likely it needs to be in complete conformance with what we are doing except in regard to what the contents of the packet are for. Shall we as a body encourage that the FCC allow us the jurisdiction of the protocol that is used in the band? - Or shall we attempt to build our stuff (the Standard) so that lots of people can build things that are nearly similar, and can vary in a great many of the intermediate level details?

Jim Lovette responds that one of the issues the FCC does not want to do is establish rules in 1991 that are far seeing enough to encompass all development that you may have for the next 25 years. So the least regulation possible is desirable, to allow for innovation and allow for evolution of hardware and software. The earlier term that was used "least common denominator", is what they would probably be most receptive to.

(Unknown speaker.) Would you try to propose a strawman rule for this least common denominator? Jim Lovette responds: We tried - Paulette? (Paulette responds. I am not able to extract the explanation from the tape. Sec.) Jim Lovette continues: This has to be a node by node regulation. They would not be able to write rules that would cover a network, - that could deal with the architecture. The could pick a box, and put it on a measuring device and characterize it as to whether it fits or doesn't fit the regulatory frame work that they've adopted. Obviously, they may need a pseudo network to get the box to work for some things. That's the only enforceable way they can do it.

Chandos Rypinski: This problem of contiguous systems I think is so difficult that it strikes me as unlikely to be solved by tomorrow morning by 8:00 AM. In particular listening on the channel for whether or not there is a signal present already might be a tremendous burden on some other kind of system. I'd rather not predict whether that is feasible or not feasible at this point.

Dave Bagby: As an information gathering conversation I find this quite productive, but maybe I am reading too much between the lines, I thought there was a motion to have an ad hoc group go off and draft a letter that has a statement that 802.11 supports the allocation of spectrum for use in networks. I do not believe we set the ad hoc group off to draft a letter that says AND this is how we think such a network will be created and what you should endorse. Michael Masleid responds: That is correct, and I am on the ad hoc group. Paulette also responds that the ad hoc group has no endorsement other than we want the spectrum. (Paulette and Dave stay with the ad hoc group to the very end. Sec.)

Larry Van Der Jagt states that after the ad hoc group writes the letter, then we've got to come up with the goods!

Chandos Rypinski says that the maximum we can have in an FCC letter is: "That all users in a space have a comparable energy density in their transmitter, and insofar as is possible, the transmitters shall not be turned on except when they are in use. Jim Lovette disagrees, he does not think we can get to that level. Chandos Rypinski replies that if we could get to anything that's what we could get to. Jim Lovette continues to disagree.

Michael Masleid points out that resolution is clearly not possible by 8 AM, but are your positions always irreconcilable? Jim Lovette responds that we will (everyone in this room) agree to some common denominator on some of the issues, and we should try to find out what those issues are. Michael Masleid points out that the two Chandos raised are plenty fundamental. Take it as understood we will go for spectrum, not protocol.

Larry Van Der Jagt is concerned that Chandos statement will not be properly transcribed from tape. (So we do an ARQ. Sec.) Here is an exact quote:

"All transmitters should have a comparable energy density limit assigned and insofar as possible transmitters should not be turned on except when in use"

Robert Buaas says: I would like to remind the group that we sent a position to the FCC last meeting in regards to General Docket 90-314, and made specific recommendation. The reason I bring this up at the moment is we are talking about what the add hoc is going to do. I am looking at the text of what we said and I'm typing so that the add hoc group will have some material for potential use in the submission that we'll send. I would just like to remind the group that there are some things that we said. If you'd like I'll read them to you right now. Abstracting from the document, we said:

"A protected band for data communication possibly shared with like power density voice/telephone users, and certainly shared with the assigned primary users is badly needed. IEEE 802 requests that provision for radio LAN with signalling rates of at least 1 Mbit/s, and up to 10 Mbit/s be provided. The 1700 to 2300 MHz frequency region recommended by the commission is noted as highly desirable for this service, though higher frequencies are useable. If use is authorized for any PCS (PCN) in this band then simultaneously provisions should be made for non voice services using radio equipment with like power density levels. IEEE 802 believes that one of the bands: 1850 to 1990, 1990 to 2110, or 2110 to 2200, should be allocated for LAN data communication on a shared basis with the current allocation. (This does not necessarily imply shared use with the PCN, just with the existing point to point. Sec.)

Higher signaling rate local area communication equipment is an effective use of radio spectrum. This is true not only because of the short distance aspect but also because of IEEE LAN protocol which uses the LAN packet technology. Pursuant to that technology, the transmitter on time is likely to be only a few milliseconds per message, resulting in a high time shared capacity for each communication channel. The number of separate frequencies for overlapping coverages within a reuse LAN can be significantly reduced by modulation time and control techniques defined in a standards committee. In addition, known very short range radio technology is appropriate for this service, further minimizing interference to other users sharing the same spectrum.

Accordingly IEEE 802 urges the commission to expand the scope of its inquiry so that the competing needs for spectrum for LAN data communication services be concurrently considered. Should additional information be required about radio LAN technology IEEE 802 is interested in and will provide such information.

Thank you for your consideration.

Michael Masleid points out: That then is the flavor of what we have advertised.

The discussion goes on about what the ad hoc group is or is not authorized to do.

Larry Van Der Jagt offers a motion:

We authorize the ad hoc group to have a scope of work to draft a document that is appropriate for this group to send to the FCC under these conditions.

Bill Stevens points out that we have already voted to have the ad hoc group. They may go beyond the (assigned) activity if the group has time. They have liberty to proceed, but only after having achieved there first goal.

Ken Biba points out that we already may have painted ourselves in a corner by having the previous document say we can coexist. It was in a different context, but it may come back to haunt us. Chandos Rypinski points out that coexistence was with point to point microwave.

Paulette and others wonder at the proceedings. Michael Masleid responds: What we're doing here, to be honest, is - some of us have gone a long way to be here and talk about microwave, and the idea of adjourning at four o'clock was abhorrent. So we thought we'd make use of the time as long as we had you all here.

The chairman points out that we have to close at 5:00 PM. Is this a good point to stop? The secretary thanks the group for its patience an contributions. The chairman points out that the ad hoc group will meet at 8:00 PM in Room 5030. The ad hoc group is charged to draft a letter for comment on data PCS and a letter to the frequency management group of CEPT which may draw on information prepared for the FCC. Try also to prepare a letter that can also be sent to Canada.

We will have a presentation from P802.10 in the morning. The meeting adjourned at 4:59 PM, and will resume at 8:30 AM.

Thursday, March 14, 1991, Morning.

The ad hoc group began work at 8:00 PM, and adjourned at 3:00 AM, The meeting resumed at 6:30 AM and completed the draft FCC reply at 8:00 AM. P802.11 resumes the meeting at 8:45 AM

Robert Buaas and Jim Neeley are our liaisons to P802.10.

9.2 Presentation by P802.10 Interim Chairman

The Interim Chairman of P802.10 makes the following presentation: (Most of the presentation and discussion is not recoverable at this time. Sec.)

P802.10 is the LAN Security Working Group. We are developing a protocol that is at the bottom of LLC, although it is usually thought of as part of LLC. If you need these services located at LLC, don't reinvent them. If you need security services somewhere else in the architecture, please talk to us.

Security services include conectionless CONFIDENTIALITY - the encryption of each PDU on an individual basis, a DATA INTEGRITY mechanism - that detects modification in a single frame, data AUTHENTICATION provides a more certain knowledge of source, and ACCESS CONTROL - key management.

Key management may apply for spread spectrum. (The spreading code? Direct sequence codes that are long enough to provide security will not provide a high data rate. The NSA was not happy with the thought that we might use such a thing. Is it possible that a hybrid chipping code and crypto scrambler is implied? An assumption is being made that I either don't understand, or else is not valid for us. At any rate, it is not important to the presentation since a keyed spreading code or a keyed scrambler for non spread spectrum systems, will do for security. Sec.)

If we have knowledge of your need for keys, the same key management can be applied (to service P802.11 needs). We have chosen to put security at the bottom of LLC, as a sublayer above the MAC. It was put at such a high level so that it could be common across all P802 LAN interfaces. (This is meant to imply that if we find in needful to put security in or under the MAC layer, please confer with P802.10 for assistance and advice. Sec.)

The Secure Data Exchange entity is dependent on a higher layer entity to tell it to whom it should talk. For connectionless integrity the need is to avoid something changing the message. Financial institutions would want confidentiality also.

Keys can be different for Tx Rx pairs. The association is by an upper layer (via key management or systems management, say at level 7, but perhaps just above LLC in a collapsed stack.)

Some cryptographic systems change the data block size. This forces fragmentation which is dealt with in the appendix.

To do data origin authentication, it is necessary to transmit the source (identity) in a way that can't be modified in transit.

The SDE designator contains two reserved LSAPs from 802.1, these insure that if the PDU gets to a wrong address it will ID as an invalid LSAP (at non SDE entities).

Discussion:

How do you do source routing if the addresses are encrypted? Answer: Source routing can be preserved in spite of cryptography. (The bridges can have the keys, for instance.)

Dr. Rick Dayem points out that we may or may not use spread spectrum.

Until there is a firm draft for P802.11 it is hard to know what is really needed, the same is true about the details of key management.

10. Ad hoc Groups.

Report from the ad hoc group chaired by Chandos Rypinski, working on what is to become document IEEE P802.11/91-39.

We worked at several computers through the night, the last participants died by 3:00 AM: Paulette, Jim, Dave and Michael.

I am thankful for Jim Lovette's, Dr. Tony Shober's contributions, and many others, it was true group effort. The draft is composed in part of previous filings, a few other parts are reused, not just the opening.

The letter must focus on the purpose with as much weight as possible: The proposal in the comment is for new rule making, separate from others, (such as pocket telephone be it on premises or off premises). We contend that the best source is P802.11, and also throw in zingers, like economic importance, time is the essence, and so on.

And so begins the discussion, a veritable editorial feeding frenzy - only high points are recorded:

How can we say this in light of past statements?

Why separated PCN and data PCS spectrum? (Because the person using both may have the one in his hand and the other at his ear!) (As used here, a PCN is a network intended for and optimized for voice that might carry data. A Data PCS is a network intended for data. PCS may mean voice or data depending on context. This is not meant as definitions, just observation. Sec.)

For consistency use wireless data networks or communication.

Jim Neeley, regarding the cannot part. If we are not able to get dedicated spectrum what do we do? Go home? Or try to share with PCN?

On page 6, a question to the editor, is the last paragraph an editing accident? Michael Masleid responds: The editor was sleeping. The last paragraph goes away, it is a duplicate of something above.

There is no possibility of sending in too much comment to the FCC.

Break for lunch and further editing of the FCC comments.

Thursday, March 14, 1991, Afternoon.

The meeting resumes at 1:43 PM.

11. Tentative Meeting Schedule

Date	Month	Year	Place	Type of meeting	Location
6-9	May	1991	Worcester, MA	Intermediate	Marriot
8-12	July	1991	Kauai, HI	Plenary	Hyatt Regency Hotel
TBD	September	1991	San Francisco Bay Area	Intermediate	TBD
11-15	November	1991	Fort Lauderdale, FL	Plenary	Embassy Suites
TBD	January	1992	TBD	Intermediate	TBD
9-13	March	1992	Irvine, CA	Plenary	Irvine Marriot Hotel
TBD	May	1992	TBD	Intermediate	
6-10	July	1992	Minnesota	Plenary	TBD
TBD	September	1992	TBD	Intermediate	
9-13	November	1992	La Jolla, CA	Plenary	Hyatt Regency Hotel
TBD	January	1993	TBD	Intermediate	TBD
8-12	March	1993	?New Orleans/Hilton Head?	Plenary	
12-16	July	1993	Denver, CO?	Plenary	Sheraton Denver Tech Center
9-13	November	1993	Ft. Lauderdale, FL	Plenary	Embassy Suites

The following invitations for Intermediate meetings have been received:

New York New York area	AT&T
Chicago Illinois area	Motorola
Raleigh North Carolina	IBM
The Netherlands	NCR

11.1 Confirmation of Worcester (MA) meeting. The next meeting is May 6-9th. The Worcester Marriot, (508) 791-1600, FAX (508) 791-1796, catact is Tom Heidy.

Make flight reservations as soon as possible for Kauai, Hawaii.

11.2 Objectives for the Worcester (MA) meeting. The objectives of the Worchester are Architectural, Letters to Canada, CEPT, and Australia. Each has its own customs and telecommunications administrations.

11.3 Last Mailing date. The last mailing date, given the need for 4 weeks total lead time on the meeting, is April 6th. Any papers to be distributed before the meeting must be in the chairmans hands by that time.

12. Review of document list

12.1 Approval of output documents. Returning now to the nascent document IEEE P802.11/91-39:

Detailed editing continues. Some points of interest:

Wireless data networking.

Mobile has a particular meaning to the FCC, ours is correct per the dictionary, their meaning is people in automobiles, trains . . .

In all cases, it is Apple computer. Not Apple Computers.

The position represented here has not been reviewed by the legal departments of all the interested companies.

A straw poll (17-6) decides to remove exhibit A, the list of people and companies, from the document.

Robert Buaas offers a motion, seconded by Chandos Rypinski, to:

Forward the document P802.11/91-39 to the IEEE P802 Executive Committee. ***(12-0-0) passes***

Unfortunately the final edits were in "hidden" text. The error was not caught by the printer. The resulting document was rejected by the Executive Committee and had to be resubmitted for letter ballot.

13. Any other Business

Report from Dr. Rick Dayem on T1P1:

T1P1 and the paper to ECMA, regarding the need for ubiquitous . . . liaison . . . harmonizing the spectrum allocation.

Chandos Rypinski points out that this is ironic since the more difficult European concordance has been achieved by them (the EC), It is we (the USA who) have been the ones that ignore.

ECMA and IEEE P802.11 will jointly make and effort for frequency allocation for Wireless LANs through WARC.

Simon Black asks if it is in scope of ECMA to make requests? Answer: The Secretary General voiced that it will not be. The next in command may have a different point of view.

Chandos Rypinski makes the motion, seconded by Michael Masleid, **to approve the 3 liaison statements to be sent out.** (8-0-1) ***passes***

If unable to make the last mailing date, submit 50 (or better yet, 65) copies by mail or courier to the hotel. Get a permanent document number by FAX or E-mail.

Work items:

Examine P802 rules to see if 2/3 vote for reopening issues is consistent with the 75% approval rule for technical issues.

Determine what, if any, changes are to be made in voting membership rules based on attendance at interim meetings. (Vic Hayes)

Continue work on propagation considerations based on ray tracing (and diffraction) models. (Michael Masleid)

Obtain guidelines on how to deal with statements and discussions regarding cost and price. (Vic Hayes)

Japanese spectrum allocations. (Jim Neeley)

Presentation on P persistent CSMA protocols.

Make sure that the secretary has copies of any slides used in presentations before leaving the meeting. This is necessary for the minutes.

Appendix 1
Attendance list

Mr. SVEN OLOF AKERLUND	ELLEMTEL	+46 8 727 30 44
Dr. MARTIN ADAMS	BICC Systems Development Centre	+44 442 210161
Mr. RICHARD ALLEN	Wireless Research	408 354 8190
Ms. PAULETTE ALTMAIER	Apple Computer Inc	408 974 1949
Mr. DAVE BAGBY	Toshiba America Info Systems Inc	714 583 3846
Mr. KEN BIBA	Ken Biba & Xircom	415 665 1812
Mr. SIMON BLACK	Symbionics	+44 223 421025
Mr. CHARLES BRILL	AMP Inc	717 561 6198
Mr. ROBERT A. BUAAS	The Buaas Corpotation	714 968 0070
Mr. LIAM CASEY	Bell Northern Research	613 763 3569
Mr. BURCHALL COOPER	LXE	404 4474224
Mr. STEVE COOPER	Fibronics International Inc.	508 778 0700
Mr. ROBERT S. CROWDER	Ship Star Associates Inc	302 738 7782
Mr. LUCIAN DANG	Rockwell International	714 833 4352
Dr. RICK DAYEM	Apple Computer Inc	408 974 5780
Dr. PAUL EASTMAN	Fairchild Data Corporation	602 949 1155
Mr. MOHAMED ELREFAI	ANIXTER	708 677 2600
Mr. KEYVAN FARHANGIAN	Comdisco Systems Inc	415 358 3678
Mr. FARZIN FIROOZMAND	CHIPS and Technologies Inc	408 434 0600X4535
Dr. ALAN V. FLATMAN	ICL Kidsgrove	+44 782 77 10 00
Mr. PETER FORROW	Racal Research Ltd	+44 734 868601
Mr. CHRIS HALLINAN	BICC Communications Inc	508 832 8650
Mr. VICTOR HAYES	NCR Systems Engineering B.V	+31 3402 76528
Mr. JAMES HEALY	O'Neill Communications Inc	609 497 6800
Dr. BOB HEILE	WINDATA Inc.	508 393 3330
Mr. RICHARD F. HUNTER	Comm/Scope Inc	704 323 4851
Mr. LARRY van der JAGT	Knowledge Implementations Inc	914 986 3492
Mr. DONALD C. JOHNSON	NCR Corporation WHQ 5E	513 445 1452
Mr. RANDALL JONES	COMPAQ Computer Corp	214 985 4828
Mr. RICHARD LANE	Motorola Inc.	708 632 5045
Mr. JIM LOVETTE	Apple Computer Inc	408 974 1418
Mr. ANDY LUQUE	Open Communications Technology	503 389 6512
Mr. RONALD MAHANY	Norand Corporation	319 369 3552
Mr. MICHAEL MASLEID	Inland Steel Co. MS2-465	219 399 2454
Mr. JAMES MATHIS	Apple Computer Inc	408 974 8100
Mr. MARK MERRILL	Synoptic Communication	408 764 1538
Mr. T. MITSUTOMI	Sharp	714 261 6224
Mr. WENDELL NAKAMINE	GTE Speacenet	703 848 1223
Dr. K.S. NATARAJAN	**IBM T.J. Watson Research Center**	**914 784 7844**

Appendix 1
Attendance list (continuation)

Mr. JAMES NEELEY	IBM	919 543 3259
Mr. PAUL NIKOLICH	Racal Interlan	508 263 9929
Mr. RASOUL OSKOUY	Sun Microsystems Inc	415 960 1300
Dr. JOHN O'SULLIVAN	CSIRO Div of Radio Physics	+61 2 868 0397
Mr. ROGER PANDANDA	Fujitsu America Inc	214 997 7635
Dr. RAPHAEL ROM	Sun Microsystems Inc.	415 960 1300
Mr. HOWARD RUBIN	Texas Instruments	908 855 2301
Mr. CHANDOS RYPINSKI	LACE Inc.	707 765 9627
Mr. SAID SAADEH	Compac Computer Corporation	214 985 4238
Mr. CURTIS JOHN SCHMIDEK	National Semiconductor	408 721 7658
Mr. HAIM SHAFIR	Level one	916 985 3670
Dr. R.ANTHONY SHOBER	AT&T Bell Laboratories	908 949 7991
Mr. NATHAN SILBERMAN	Symbol Technologies Inc	408 446 2210
Mr. RICHARD SILLMAN	Sun Microsystems Inc	415 336 3670
Mr. RAYMOND SIT	Puredata Research Ltd	416 731 6444
Mr. KIWI SMIT	NCR Systems Engineering B.V.	+31 3402 76479
Mr. DAVID A. SMITH	Texas Instruments Inc	512 250 6397
Mr. R.E. (BOB) SMITH	NEC Systems Laboratory Inc	508 263 2627
Mr. MARVIN SOJKA	Norand corporation	319 369 3564
Mr. WALT SONNEVILLE	Sonneville Associates	301 869 4460
Mr. LOUIS STANKAITIS	ANIXTER	708 677 2600
Mr. ROBERT STEENBERGE	Teledyne Inc	619 260 4412
Mr. WILLIAM STEVENS	Apple Computer Inc	408 974 6307
Mr. CHARLES THURWACHTER	Square D Compnay	708 397 2600
Mr. OSAMU WADA	Fujitsu America Inc	408 432 1300X5120
Mr. R.E. (DICK) WEADON	Southwestern Bell Techn Resources Inc	314 529 7517
Mr. STEVEN WEISS	DCA	408 432 9111
Mr. MARSHALL ZERBO	Apple Computer Inc.	408 974 9116