Tentative Minutes of the IEEE P802.11 Working Group

Interim Meeting
Palo Alto, CA
September 9-12, 1991

Monday, September 9, 1991, Morning

The meeting was called to order at 8:50 AM, Vic Hayes, chairman of IEEE 802.11[1] being in the chair, Jim Neeley vice chair, Michael Masleid secretary.

1. Opening

1.1 Introduction: All people in the room are invited to mention their names, company, and normal work place. At this time there are 20 voting members present. This is not a quorum, which requires 37 voting members. Voting members should obtain a token, a strip of paper from James Neeley.

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.

1.3 Attendance list. The attendance list is passed around mornings and afternoons. You must sign into the appropriate half day - records are closed at the end of each half day.

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1.4 Logistics. Cost sharing for the room is handled by Bill Stevens. Report to him how many days you are here so that he can calculate the rates. Bill Stevens is also taking care of copying, however, give any material to be copied to James Neeley. If you are missing the mailing from last meeting see Jim Neeley.

1.5 Other announcements. Our thanks to Bill Stevens for finding a place that meets our price guidelines.

2. Approval of the minutes of the previous meeting

2.1 Approval of the minutes of the Kaua'i meeting. Corrections: On page 9 (document P802.11/91-87) at 6.2.1 strike "and P-persistent CSMA" in the next to last line. There is no vote to approve the minutes for lack of quorum.

2.2 Matters arising from the minutes. None.

3. Reports

3.1 Report from the Executive Committee

Victor Hayes reports that the draft letter to be sent to various national RF administrations was presented to the Executive Committee in Kaua'i. They said we repeat things too many times in the letter. (The standard format - say what you are going to present, present it, then say what you presented.) The Executive Committee wanted to do a letter ballot, which is in progress now. Let's discuss off line how to prepare a cover letter in case the national RF administrations want to get back to us.

IEEE 802 will begin using the official Computer Society rules. This implies a hierarchy: First, the Computer Society, then Standards Activities, then the 802 Standard Sub Committee (it was Project 802, now it will be a sub committee).

The 802.11 Standard must be approved by us, and by our sponsor. This may be a group of 150 people or so from the IEEE or Computer Society. There will be many sponsor groups to cover the various 802.Xs.

We are the developing WG TAG. (Members of the working group are encouraged to be members of the IEEE, but that is not mandatory.) Members of the WG TAG may participate and vote. Non members may participate at the chairmans discretion.

Both the sponsor and the WG report to the Exec Committee.

There is a new style of the Computer Society Standard Handbook. There is a ballot for new functional requirements.

Richard Allen asks how the sponsors will be chosen. Victor Hayes responds that to become a member of the sponsor group you write to that group, giving your IEEE member number, and you are in. Who exactly you write to is not known, it is too early to tell yet.

4. Registration of contributions

New documents, and those with presentations still pending are:

Objectives. (Tentative Agenda.) Vic Hayes. September 1991. Document IEEE 802.11/91-86.

Tentative Minutes of the IEEE P802.11 Working Group, Interim Meeting, Worchester, MA, May 6-9, 1991. Michael A. Masleid. August 5, 1991. Document IEEE P802.11/91-72.

Tentative Minutes of the IEEE P802.11 Working Group, Plenary Meeting, Kaua'i, HI, July 8-11, 1991. Tom Phinney. August 8, 1991. Document IEEE P802.11/91-87.

Wireless Local Area Network Requirements: Office Applications. Ken Biba editor. September 1991. Document IEEE 802.11/91-91.

A Hybrid Wireless MAC Protocol Supporting Asynchronous and Synchronous MSDU Delivery Services. Ken Biba. September 1991. Document IEEE 802.11/91-92.

Proposed Liaison Statement from 802.11 to T1P1. Dr. Rifaat A. Dayem. Document IEEE 802.11/91-93.

Selection Basis for Architectural, Modulation, Channelization and Frequency Reuse Methods. Chandos Rypinski, September 4, 1991. Document IEEE 802.11/91-94.

Sequentially-Used Common Channel Access Method. Chandos Rypinski. September 4, 1991. Document IEEE 802.11/91-95.

Access Method for Channelized System Using Distributed Logic and Not Requiring Infrastructure. Chandos Rypinski. September 4, 1991. Document IEEE 802.11/91-96.

Channelized System Access Method Using Infrastructure Control. Chandos Rypinski. September 4, 1991. Document IEEE 802.11/91-97.

RF Modulation Proposal: Quadrature Double Sideband Reduced Carrier With Two NRZST Baseband Channels. Chandos Rypinski. September 4, 1991. Document IEEE 802.11/91-98.

Power-Drain Considerations for Full Time and Sleep Mode Radio Receivers. Chandos Rypinski. September 4, 1991. Document IEEE 802.11/91-99.

Bandwidth and Capture Using the Multiray Model. Michael A. Masleid. September 7, 1991. Document IEEE 802.11/91-100.

Meetings Ad-Hoc Group Initial Report. Rick Albrow. (Simon Black presenting.) September 5, 1991. Document IEEE 802.11/91-101.

Battery Efficient Operation of Radio MAC Protocol. K.S. Natarajan and Chia Chi Huang. September 1991. Document IEEE 802.11/91-102.

Wireless Market Observations. Robert Rosenbaum. September 1991. Document IEEE 802.11/91-103.

DECT and LAN use, an Analysis. Jan Kruys. September 1991. Document IEEE 802.11/91-104.

Preliminary Draft Recommendation FPLMTS.SRVC (Rev 3) Services Supported on Future Public Land Mobile Telecommunication Systems (FPLMTS) (Question 39/8) Document 8-1/50-E, IEEE 802.11/91-105.

Modifications to Report 1153 on "Future Public Land Mobile Telecommunication Systems" (Question 39/8) - Document US TG 8/1-nn, IEEE 802.11/91-106.

5. Adoption of the Agenda

The group sorts through the submissions and fits them to agenda items. None of the questionnaires have been returned yet. Agenda item 11.3, Regulatory liaisons, will be moved to Tuesday morning to accommodate Michael Callender's busy agenda. (Mr. Callendar must leave Tuesday, he is Chairman of CCIR Task Group 8/1.) Larry van der Jagt asks that not all liaison reports be moved up to Tuesday for fear that the technical presentations will be lost. Victor Hayes says not to worry, there is time. The agenda is approved without objections.

6. Results of the Questionnaire

There are no returns on the questionnaire. In Europe a consultant is trying to get sponsored to interview twenty-odd folk to get the European view.

Chandos Rypinski has the latest update of the questionnaire - the post Kaua'i revision. Larry van der Jagt asks what is the groups intention? [There are 4 times as many people that went to Kaua'i or Palo Alto exclusively then there are who attended both meetings. Sec.] Victor Hayes responds that in Kaua'i the questionnaire seemed to have a positive impact - but does any one intend to fill it out? Mil Ovan says yes, and approves of the approach. Any others? Simon black, Dick Allen, James Neeley, Bill Stevens express commitment. Non members are welcomed. [As they say in Chicago - vote early, vote often.] Someone needs to involve the airline telecom service providers - ACETA??

7. Results from the Bulletin Board

Nathan Silberman reports that the California Microwave Wireless LAN BBS is not working perfectly yet. The phone number is 1 800 24 802 11. For those outside the United States use 1 408 720 6473. Use "IEEE" as the initial password. Members will be able to post files, non-voters can down load, third parties will be

read only. Ralph Manfredo needs a list of members and access priority. Victor Hayes is to call Ralph directly. The list includes about one hundred people. The voice line phone number is 1 408 720 6216.

James Neeley points out that the BBS is a good way to get the market requirements - an early goal should be to get the questionnaire up. [So far - October 4th - the BBS is not working perfectly. Sec.]

8. Requirements (Methodology)

The meeting resumes from break after 10:15 AM. There are no contributions on methodology.

9. Requirements (Vocational and derivative requirements)

Ken Biba explains that, in hope of coming to closure on requirements, vocational groups have been formed. Ken will chair an ad hoc meeting at lunch today to plan when the vocational groups can meet to form an integrated requirements document - at least in time for input to the November meeting. A number of people, including Simon Black, Dick Walvis, Larry van der Jagt, Richard Allen, Mil Ovan, Nathan Silberman, and Tom Siep volunteered to help.

9.1 Introduction of contribution by Ken Biba, ***Wireless Local Area Network Requirements: Office Applications.*** September 1991. Document IEEE 802.11/91-91.

This paper reformats what was done at the Kaua'i meeting regarding office environments. I have added to the list and explained what some of the names mean. I am hoping here to get to the generic requirements for office LANs. Computer Aided Design and Manufacturing (CAD/CAM) have been added to the list. It is also necessary to support all the other standards (802.X and FDDI), and do 802.1 and the exported MAC services of 802.2, and the secure data exchange of 802.10. All of these things must be a part of the work we do.

The wireless LAN that doesn't support Novel Netware will not sell much. The wireless LAN must do Novel Netware also. This is an implicit requirement on any standard that we make.

Anticipated node types range from workstations to telephones and televisions (digitized packet television or real-time video service).

Node population is under 1000 stations per hectare, or 100 square feet per station. The average population is about 12 nodes per network.

File access request and response creates a 60:40 distribution of small (80 octet) to large (600 octet) packets. The duty cycle is very bursty. Minimum transfer delay is mandatory.

File transfer yields a stream of MSDUs (with 20:80 distribution of small to large packets) with no delay requirements. Residual BER must be below 10^{-12}.

[Please look at the MAC Services Requirements on page 5 of this contribution. This tabulates services and required MSDU Size, Session Throughput, Duty cycle, Delay, Delay Variation, Privacy, Integrity, Fairness, Lost Packet %, Outage %, and Residual BER. Sec.]

Real-Time Voice MSDUs are 32 octet fixed, at under 64 Kb/s, with Residual BER under 10^{-3}. Video MSDUs are 600 octet fixed, at under 3 Mb/s, with Residual BER under 10^{-6}.

Ken Biba invites others to provide MAC Service Requirements formatted as shown on page 5 of the contribution.

Discussion:

Richard Allen asks that we get very precise definitions of all the terms that we are using: ETSI TR 51 has precise definitions.

Chandos Rypinski brings up additional issues with Real-Time Voice. Is this an intercom - or is it an extension of the public switched network? The requirements for participation in the public network are quite restrictive (and argumentative). James Neeley does not treat the "or" as exclusion - is connection (to the public network) in addition to or separate from the isochronous service? If leaving our service - our domain, do we suggest the standard to which we are connecting? Chandos Rypinski will prepare a contribution.

David Leeson points out that duty cycle has more that one definition. It can mean that fraction of time that the station is using the network. It can also mean the fraction of time that the station is sending data while the station is using the network.

12. Architecture

Simon Black's presentation (91-101) is deferred. MAC Service definition and External Liaison is skipped over for now. The meeting continues with Architecture.

12.1 Introduction of contribution by Ken Biba, ***A Hybrid Wireless MAC Protocol Supporting Asynchronous and Synchronous MSDU Delivery Services.*** September 1991. Document IEEE 802.11/91-92.

["Synchronous" in the context of this paper is identical to the meaning given "isochronous" by many in this group. See pages 44 and 45 of Ken Biba's paper for a glossary of definitions. Sec.]

Described is a hybrid MAC protocol that integrates asynchronous and synchronous services. One service provides predictable bandwidth, size, and low transfer delay, the other service provides minimum variance.

The protocol is media independent. (It can work with RF in the ISM bands, with diffuse infra-red, with other media). The protocol give primary support for asynchronous data traffic, with a layer above the asynchronous data service for optional support for synchronous data traffic.

The paper has a large scope. There was little time to work. This paper must be considered preliminary. Anyone who wishes to help, please do!

The central goal is to support both asynchronous and synchronous service. The emphasis is reducing latency for the first, and variance for the second.

Rifaat Dayem asks if this protocol supports real time voice and factory [real time isochronous data]? Ken Biba answers: Optimistically, yes - but those requirements are not quantified by me. I make a plea, that those who know the requirements quantify them for me.

The architecture is a layered design with a peer to pear PHY layer supporting multiple media and a peer to pear MAC layer supporting asynchronous and synchronous data service and internetwork extension. The PHY will support ISM bands, diffuse infrared, and other media.

The protocol is augmented LBT (Listen Before Talk) with positive acknowledgement - the synchronous service uses reservation TDMA.

Dale Buchholz asks: Does the synchronous data service ride above the asynchronous service? If so then the positive acknowledgement is wasteful. Ken Biba replies: Yes - this is more overhead, but it is not prohibitive. It is possible to do 8 to 10 voice channels and still have half the bandwidth left for data in a 2 meg channel.

Rifaat Dayem asks if the synchronous service is connection oriented. Ken Biba answers no, but it can be used to form connections. This does violate layering since hooks are mandatory.

The MAC PHY interface is defined so that multiple media can be supported. At the interface, the PHY provides signal detect, receive clock, data. The MAC provides transmit clock. The MAC also provides power control and channel select to the PHY - the MAC "tunes" the PHY if permitted.

The core of the LBT protocol design is positive clear to send, positive acknowledgement, non persistent LBT with modified binary exponential backoff on busy/collision/error - LBT with hidden station enhancements (LocalTalk).

Assume A wishes to transmit to B. Small packets are sent back and forth - then a burst. It is a four way handshake. A small packet (A -> B) for RTS (ready to send), a small packet (A <- B) for CTS (clear to send), a large packet (A -> B) for MSDU (data), a small packet (A <- B) for ACK (acknowledge).

What happens if there is an exposed communication? Assume now that D wishes to transmit to C, but D is hidden from A (C is exposed). If A and B have set up, then C will have heard (A -> B) for ready to send. D will be deferred by C. [There is a different example shown on page 7 of the document. Sec.]

This is not a protocol that lends itself to theoretical analysis, so the move to simulation is required.

Bruce Tuch asks: But isn't this bad for support of Novel Netware due to the overhead? Ken Biba answers that the clear to send provides early collision detect - so it works better.

Ken Biba continues with a description of how the synchronous service works: The hook for synchronous service is the network allocation vector. This is the forward time when the node perceives that it can talk - the time when a station is allowed to instigate a RTS-CTS-MSDU-ACK transaction is controlled by the network allocation vector. The vector allocates time for asynchronous and synchronous services. The vector itself is built from a special MSDU sent by a synchronous allocator that also provides timing.

Question: Is there a broadcast MSDU? Answer: Yes, the synchronous allocator uses a multicast in the asynchronous MAC protocol to set vectors. Continuing: The preamble and checksum are negotiable, I am not expert on this. The handshake is:

RTS CTS DATA ACK (or NACK)

Simon Black ask: But the CTS must be linked to the RTS source? [To avoid sending DATA due to receipt of someone else's CTS.] Ken Biba replies that the timing would have to be precise to fool it.

Analysis suggests payloads of 32 to 1500 octets. With 80 and 600 octets at 60:40 loading, delay (latency) is 1.3 times the normalized MSDU size at 10 percent load. Delay is 7.5 times the normalized MSDU size at 50% throughput. At 120 percent offered load, 86 percent will get out - see the hybrid simulation. This is the classic presentation of this sort of thing. (Transfer delay is needed too, though.)

The goals for synchronous service is to minimize the complexity for asynchronous service. The network will have a special station within the BSA (Basic Service Area) that provides synchronous timing and also bandwidth allocation. The special station sends a beacon MSDU - a multicast asynchronous packet that defines time, and local network allocation vectors that indicate the allowed times to transmit. The scheduler sets evenly distributed allocations (time slots) for synchronous service.

The scheduler is a special station, but it is like all the others. The scheduler probably lives in the AP (access point). Requests for asynchronous or synchronous service are make in asynchronous time slots. Asynchronous slots are quicker, since they bypass the scheduler.

David Leeson comments that it seems synchronized systems will not be allowed in the ISM band. (For fear that they will monopolize the band?) Bruce Tuch responds: So write letters (to the FCC). Ken Biba remarks that it looks like the Apple petition is not going to make it.

Ken Biba continues: How to make big mole hills out of small mole hills? To extend the network, the access point is dual homing, one to the wireless network, the other, at the wired AP, a special bridge with no spanning tree algorithm because it is always a leaf of the tree. Surpassingly, this can support roaming stations as well.

Transparent inter and intra network MSDU forwarding is accomplished by having the station register with only one AP. The station is registered as a local service to that access point. The AP is promiscuous. If there is no local response from the wireless network, it forwards the MSDU onto the wired network.

Rifaat Dayem ask: What are the station IDs, and how are they arrived at? Ken Biba answers: It uses 48 bit IEEE addresses. [Since APs are stations they do have unique addresses - but I suspect that Rifaat Dayem is worrying about network IDs, anticipating a problem with multiple jurisdictions. Sec.]

Ken Biba continues: If a local station generates RTS, the local AP will step in with a CTS if no other local station replies. The AP may buffer undelivered MSDUs so that lost or roaming [or sleeping] stations can be re-picked up. Jim Neeley points out that 802.1 has allowed us the hooks for MAC bridge functions.

Question: How do you age out the register? [Once a station is registered, how does it get unregistered if it dies or is moved? Sec.], Answer: Periodic power control of the wake/sleep state is used to scan the stations. Awake messages announce the continued presence of the registered station. Registration at a new AP will deregister the station at other access points through the infrastructure.

Larry Van Der Jagt asks if the AP is in a preferred location? Ken Biba answers: Yes. It is assumed that all can hear and talk to the AP.

Access to the network and infrastructure is limited to legitimate stations by using 802.10 controls.

Power control is managed at the AP, which keeps and updates the power state and schedule of the stations. It is assumed that a higher layer protocol will fix lost MSDU's. [Assuming the AP hasn't buffered them? Sec.]

After lunch we will continue with the simulations. These were done using the extend commercial simulation package for the Macintosh. Each run takes four days.

Monday, September 9, 1991, Afternoon

The meeting reconvenes at 1:40 PM with a discussion of the need for E-Mail or FAX for rapid distribution of critical documents. Victor Hayes will avoid including transmission of the mail list when using enhanced FAX.

Ken Biba continues the presentation of document 92: The performance simulation model assumes a total number of 20 stations with identical traffic characteristics, exponential MSDU arrival rate, and non exhaustive MSDU service. Propagation delay is dominated by the transceiver R/T turnaround time, which is set to a moderately aggressive 10 micro seconds. [See the paper for detailed descriptions. Sec.]

The MSDU length is bimodal, with 60% of the packets small (1000 bits per MSDU), and 40% of the packets long (5000 bits per MSDU).

Offered load is measured only with respect to new traffic generated by stations and does not include retries or re-transmissions.

Positive acknowledgements are included for all MSDU (this does not include the synchronous traffic).

The first simulation is representative of the synchronous service alone. (Reservation TDMA). This provides linear throughput with offered load, and is stable at overload (meaning no fall off in throughput). Transfer delay is exponential in overload.

Normalized transfer delay time from initiation of send operation to the completion is received at receiver, this is average 10 to 20 times the (packet size) say 30 milliseconds

Figure 6.3 in the document is using the ALOHA simulation. It is unstable above 18 % offered load.

The simulation of non persistent LBT Listen Before Talk asynchronous service shows linear throughput to 80-87% (at 100% offered load), then stable at higher offered load (at least per the simulation). Again, transfer delay increases exponentially on overload. The 12.5 millisecond frame size is a compromise for throughput and transfer delay.

As PHY speed is varied, maximum throughput as a percentage of offered load decreases. It is at 75% at 5 Mb/s. As PHY speed increases the "a" value is increasing, and causes increasing instability, a sharp peak (followed by collapse) in throughput. (No instability was noted at 1 Mb/s.)

The PHY error simulations are done at 2 Mb/s. These are channel sensing errors and bit errors. Error rates of 2%, 10%, and 25% are tried.

At 2% error rate, throughput drops from 82 % to 65-70%.
At 10% error rate throughput has dropped to 50%.
At 25% error rate throughput has dropped to 35%.

The transfer delay graphs show that as offered load exceeds the throughput peak you are starting the exponential increasing transfer delay.

The simulation indicates that performance is still acceptable up to 5 % error rates.

The hidden station simulations are done at 2 Mb/s, with 5%, 10%, and 25% hidden stations.

At 5% hidden stations throughput drops from 82% to 70%.
At 10% hidden stations throughput drops to 40-45%.
At 25% hidden stations throughput drops to 30-52%.
[The data points are very scattered. Sec.]

Simulation of 2 Adjacent LANs with 25% probability of overhearing gives 70% throughput with instability on overload.

Simulation of 4 Adjacent LANs with A and B overlap, B and C overlap, and C and D overlap, gives 100 % throughput with instability on overload. [Each LAN offers approximately 25% load, and most of that gets through. Sec.]

Comments on power control: In an indoor environment it doesn't help achieve spatial isolation. Either the MAC deals with adjacent BSAs or the PHY must find a way to provide isolation. There will even be leakage in FDMA if the environment is too tight.

Ken Biba, regarding 100% throughput at 100% offered load for adjacent BSAs: I view these as good results.

Larry Van Der Jagt observes that if each of the four adjacent networks is offering just above 25% load it becomes unstable. Ken Biba answers: Then the high level protocol will tend to back it off.

There is a discussion between Dale Buchholz and Ken Biba. Dale claims that network peak loads are 20-30%. Ken says that this is not true, burst tend to be moderate. [Both Dale and Ken avoid having more than 10 stations per segment on their networks. Dale's machines tend to be Sun UNIX, Ken's are more likely to be MS-DOS. Sec.]

The simulation of a single LAN Hybrid Asynchronous MAC shows linear throughput to 60% offered load, continuing to 85% percent throughput at 100% offered load, and apparent stability beyond that. This is more stable and has more throughput than LBT (at 2 Mb/s). **It appears that the Hybrid Asynchronous MAC will have better performance that the LBT protocol.**

Summary:

A wireless MAC serving both asynchronous as well as synchronous traffic will work using realistic wireless PHY assumptions.

You may have the simulation code if you have the software to run it. (The discrete event based simulation package ***Extend*** running on a network of Macintosh computers.)

Discussion about BBS:

Concerns about confidentiality and sharing simulation results re-opens the BBS discussion.

What about closed viewing of transactions on the BBS? Is this an open forum? Is there a need for a closed user group and a public area, say for schedules?

A poll for those in favor of a protected forum shows: **None in favor of a protected forum.** Chandos Rypinski points out, regarding simulation results, that he doesn't think he'd believe it anyway.

Nathan Silberman argues that we need a closed forum to prevent abuse of (connect) time - let's say we (voting members) get more minutes then they (third parties) get.

It is argued that the new people actually need more time to get up to speed for the meetings - but there is little sympathy for that argument. Larry van der Jagt suggests that they order the archives from Alpha Graphics instead. Put the instructions for doing this on the BBS. Besides - the archive is not in electronic form - it can't be read from the BBS.

12.2 Introduction of contribution by Chandos Rypinski, ***Selection Basis for Architectural, Modulation, Channelization and Frequency Reuse Methods.*** September 4, 1991. Document IEEE 802.11/91-94.

First I will explain why I have submitted so many papers.

The world can be organized into 4 choices:

1) Centralized or distributed control (gray scale).

2) Deterministic or Contention-based Access Method (gray scale).

3) Channelized or Non-channelized medium (binary choice).

4) Time-slotted or Header-based space allocation (binary choice).

[Other binary choices mentioned briefly are Low-rate or High-rate and Spread-spectrum or Narrow-band. These may well be constraints, not choices. Sec.]

These are the four choices. With regard to Infrastructure - I am really implying something about distributed logic. [In much of this presentation distributed logic and infrastructure are treated as a binary choice. In some contexts this is not the case. I have edited this transcription to agree with the more precise usage in Chandos Rypinski's papers. Sec.] It is a grey scale choice. There are many functions to be done. There are various ways the functions can be distributed (into centralized or distributed logic).

Part I of this paper goes on to discuss these choices and the associated issues in some depth.

Some combinations of these four choices make sense. Part II of the paper discusses major requirement groups and other, more specific, choices to be made (modulation, channelization, reuse method).

Part III of the paper describes access methods that evolve from the combinations of choices made.

Ken Biba remarks that we would like to have a channelized PHY but are resigned to the possibility that we may not have one.

Continuing with a discussion of Part I:

Precise definition of terms avoided at this point.

(Unknown speaker): Centralized or distributed control logic? I am very concerned, there is no crisp definition of this.

If it is not in the station it is infra structure. If the functions are defined and desired you can figure out where to put them.

If you have an infrastructure, it does not preclude direct station to station communication. It is possible to have a required infrastructure (that precludes direct station to station communication). It is possible to have fully distributed logic if desired (no infrastructure).

Infrastructure functions:

If you have an infrastructure, there are certain functions that are important: Access to external networks - Increased coverage to a minimum station. An AP can have far better coverage than the station (on a table top). It is the experience of the radio industry that the combination of AP and station has vastly better range than station to station.

[While it is true that we will often want to limit range, that is not the goal per se. We want to limit the range over which we interfere or are interfered with. The AP lends itself to increasing operating range and decreasing interference range. Sec.]

Addition functions: Organized access control that considers and resolves overlapping radio coverage from other access points (not necessarily on the same LAN).

Ken Biba's scheduler in the previous paper is a piece of infrastructure.

At any rate, these are indispensable (or certainly desirable) functions that can be provided by an infrastructure.

Centralization of Access Control or Distributed Access Control.

IEEE 802 has a history of distributed control schemes. The reasons for that are not nearly as strong now as they were then. The use of active hubs and discrete bridges is part of our history now also. We must judge on merit.

If use of infrastructure is granted (for any reason - say access to the wired LAN) than there are many more things you can do with it.

It can aid in producing minimum delay communication between hub controllers to deal with the extended service area.

Registration, a dynamically maintained data base, is inherently a central function.

Of course, the infrastructure also provides the way on and off of the wired LAN.

In the centralized infra structure model, the AP is just the radio front end. To improve coverage use more APs. Don't use more power. Don't use more antenna. After the AP, each other element in the hierarchy is less numerous, the wiring closet, intermediate cross connect, and equipment room.

The access manager must be as close to the station as possible based on simple propagation delay arguments.

It is now 3:00. The meeting will break until 3:27. A video tape showing work with wireless LANs can be shown. All are interested, so arrangements are made for video equipment.

Chandos Rypinski continues: IEEE 802.3 (CSMA/CD) is the most widely used LAN access method. The problem for radio though is that carrier sense is not a good way of telling much of anything in radio

In a multichannel system it is possible to contend on an access channel rather than on the data channel, this is potentially less painful. One of the papers is based on this assumption. Expectation is that contention on a set up channel is much more acceptable than contention on the data transfer channel.

All of my access methods assume a packet that has a header then payload. I've called these message based protocols, mostly to distinguish this from the periodic fixed timing method(s). Mine has no fixed timing. Regular fixed timing has problems.

Continuing with a discussion of Part II:

Many are concerned with functional requirements. I am more concerned with what is possible. As far as functional requirements go I foresee two groups (classes). The portable computer group - and the high functionality group. As soon as you say you have a few classes, constraints tend to group choices into families.

I will pass on the discussion of modulation in this paper. [Table II in this paper present modulation types and their good and bad points in the manner of an IBIS list. Sec.]

To provide channelization, if that is the choice, we may use spread spectrum code division or other classical methods. For now we should give more consideration to spread spectrum code division and how it may be useful.

If you have many access points reuse can be obtained by using them sequentially [TDMA for example], or by a method that allows simultaneous use [FDMA or CDMA for example]. If pursued to perfection both achieve about the same result. These are just different ways to slice frequency (time) and geography.

The external constraints:

What is the allocated spectrum?

We haven't seen too much recently on guard bands. The different bits per Hertz (types of modulation) talked of are sensitive to guard bands. The guard bands can be small if adjacent signals are equal level signals, else the guard bands must be bigger.

Choice of access method:

The access methods, that I present, use, as much as is possible, that which is common between them. This way the choice between access methods can be minimally biased. The difference in complexity between these access methods is small and should not be a consideration either. All of these access methods use packets that have start synchronization, overhead, payload, and end delimiters. To compare the access methods they must be each fully developed so that the unfamiliar understand each method well. Given all of that, what of the access methods?

There are four, based on the choices of channelized or not channelized, infrastructure or no infrastructure. (It is possible to have a two mode structure on infrastructure with criteria for when you shift between them.)

For the unchannalized system both choices, infrastructure or no infrastructure, are described together (document 91-95).

The distributed logic paper is my best effort to address the problem that has been defined by others as spontaneous groups - ad hoc networks (document 91-96).

When it is not distributed, the infrastructure becomes a paper in it's own right (document 91-97).

At the end of this paper there is a summary listing of the messages (packet types) used in these access methods. The messages are described in greater detail in document 91-80. There are more transmit messages now.

12.3 Introduction of contribution by Chandos Rypinski, ***Access Method for Channelized System Using Distributed Logic and Not Requiring Infrastructure.*** September 4, 1991. Document IEEE 802.11/91-96.

In a radio system there is always a probability of a lost message or transmission due to path obstruction and multipath. Contention may be allowed within the access method as long as the relative probability of message loss due to contention is less than or of the same order of magnitude as other message loss mechanisms. I hope that other people consider this point: If you think a deterministic access protocol is possible - well radio is too unpredictable - the most you can hope for is loss containment.

The basic suppositions and objectives are as follows:

Provide an access method that keeps as much in common as prudent with access methods that use infrastructure. [So that comparisons can be based on fundamental rather than superficial differences. Sec.]

The length of (time, bits) in which contention can occur should be minimized.

Channelization is possible using FDMA or CDMA. As a working assumption nine channel CDMA is used based on Dr. Jonathon Cheah's twelve codes. Use of channelization should be optimized.

The loss due to not transmitting when you can is greater than the loss due to listening when you don't have too.

The method:

A setup (S) channel is known a priori. Request/Grant is done on the S channel without regard for signals present. If the grant process works the channel is useable. The receiving station - the grantor - assigns the data channel to be used based on information learned listening to previous grants. The higher throughput data transfer channel is distributed over perhaps 9 channels.

Assume that failure is possible at each step. A recovery method must be provided for each step.

Contention Detection:

For this plan the primary means of detecting impaired transmission due to contention, or any other cause, is lack of positive acknowledgment. No attempt is made to avoid contention by listening (since that doesn't tell you much that is useful anyway). The time wasted by contention, even under heavy load, may not waste that much in this type of system.

The probability of reception as a function of distance does not have cliffs, the interference range of radio is many times the useful service range, and of course the carrier sense range is larger still. The few percent improvement in success rate (in not interfering with another's transmission) using carrier sense leaves you victim of allot of interference.

Richard Allen asks what are the signal strengths for the 95% (probability of success) levels. Chandos Rypinski replies that the answer can be derived, but there are rules of thumb: moving up 10 dB from 90% success surface improves performance to 99%. Move down 10 dB from 90% decreases performance to 50%. Success improves an order of magnitude per 10 dB - 90%, 99%, 99.9%.

Richard Allen claims that this is more precisely true in a Gaussian channel. Chandos Rypinski responds that there are cluttered paths, obstacles. It is not the best model, but it is unarguable that the interference range is much larger than the service range.

Chandos Rypinski concludes that a well designed distributed logic channelized access method without infrastructure can be built - but it has many limitations, and can be much improved using infrastructure. If a common message set is used the distributed logic channelized access method may become a subset of an on demand infrastructure system. Infrastructure is not that bad, more is gained than is lost.

Richard Allen asks about channelization. Chandos Rypinski responds that rejection (of adjacent channels) is sensitive to how channelization is done. Frequency division gives better rejection of channels far removed in frequency - it give less rejection of channels not so far removed in frequency. Code division tends to have the same channel rejection between any pair of codes, they are usually all the same distance apart.

Peter Cripps asks about the probability of hearing (carrier sense) versus interfering. Isn't there some correlation? Chandos Rypinski responds that blind firing in the setup (S) channel works better.

Bruce Tuch asks: How efficient is this? What is the bite that the S channel takes out of the data channel? Isn't the wait to get the data channel wasteful? Chandos: There are parallel data channels that can be used at the same time. Taken together, the data channels have 9 times the capacity of the S channel. The capacity of either S or D channels can be exhausted for a given model, there is an optimum ratio of S to D capacity for a given model. Nine is used here for illustration, but it could be that a different number is optimum - it is just easier to work with specific numbers.

12.4 Introduction of contribution by Chandos Rypinski, ***Channelized System Access Method Using Infrastructure Control.*** September 4, 1991. Document IEEE 802.11/91-97.

This is the second of three access method papers. The previous one used distributed logic in a channelized system. This one uses infrastructure control.

You can fix allot of the problems with distributed logic if you have some centralized control. I always assume lots of coverage and access points - but an indefinitely large system will always cause trouble - so how do you get a carpet technique?

Assume once again (as in the previous paper) a contention (S) channel and data channel(s), but this time no one gets to transmit without a grant. It is amazing how many functions are the same. (At the last meeting I alluded that I would not have a paper on this. . . This paper is about all the little functions that aren't so little if they aren't done right.)

The registration poll is the invitation to request. The reason for the poll? One of the problems that the poll solves is to find out who has left without saying goodbye. The poll doesn't have to be frequent, once each 10 seconds would be nice. That doesn't take much time for 100 stations. If the poll is low duty cycle, say less than one percent of network capacity, things (injurious things) can be learned before a message is at stake.

Part of what is desired, that direct station to station transfer be possible, requires that both the sender and receiver be in good communication, and that the receiver can copy as fast as the AP (access point). To facilitate direct communication the AP will allow the receiver to acknowledge before the AP can acknowledge. The infrastructure does remain informed however. The timing is worked out in this paper. A rather small number of microseconds of delay will do it. Enough information about channels needs to be sent so that the addressed station knows how to respond. (Remember that the acknowledge contains information on what channel to use for the data transfer). Care must be taken so that needed information is where it is needed so that use of the contention channel is minimized.

Question: Is this connection oriented? Chandos Rypinski answers that if you can do a virtual circuit, it may be no more than one on a 1 Mb/s network. For the virtual circuit there is a worst case delay and the scan time through all stations becomes an important part of that.

Channel Allocation

The obvious thing to do is give each AP an assigned data channel, this does allow simultaneous data transfer on all channels, but if there are more than nine APs the adjacent areas become a problem, they are not wholly independent. If instead the channels are committed as needed a few channels will go further. It is not likely that many in a field of 25 APs will be in service at the same time - so dynamically reassigned channels is a good thing.

Channels can be dynamically assigned by the hub management system. All that the station needs to know at the start - at time zero - is to listen on channel S and then go where told. The station needs no brain. The hub takes care of the details.

To provide virtual circuit capability (whether it should be used or not is a separate issue) - this is how it would have to be done: There are 6 milliseconds of uncertainty that can be tolerated. Don't do a request

grant for each segment (since there are going to be a lot of them). The first segment does a full setup (request, grant, and channel assignment), but subsequent segments take less - there is an autogrant procedure described here. There will be numbers per segment - first - last - there are multiple connections so a connection number is needed. These are the costs for segmentation.

It is required that neither the connection oriented service, nor the LAN service, can consume all the network capacity and block the other. Whatever the amount of capacity available it can be overloaded. When that happens it is desirable to offer invitations but no grants so that traffic stacks up at the originator.

When the load exceeds capacity it must be stopped [throttled]. If the system is 1.5 Mb/s, then one 64 kb/s virtual circuit is about all that would be wise.

Segmentation Compatibility with B-ISDN

It would be nice if this [segmentation of isochronous traffic - Sec.] had some compatibility with the ATM cells so that it can be fit to the public network without adding a second quantizing delay.

Contiguous LANs and the Two Tower Model

There are interfering stations that can't be separated by channels or distance, so what is the probability that stations will interfere given that they are in radio range? What does one station carry? It might do 9 M bytes in one hour, say perhaps in small chunks? What is the duty cycle of one station? They don't all download every 10 minutes after all. Given that reality, the intersections become pretty small. Many things work to keep separate networks from interfering all that much (we are assuming AP paths are pretty good here).

There are many configurable parameters. They are not arbitrary, nor are they to be determined by a vote of this committee. They fit the network to the user requirements. These are part of station management, not fixed design. Some are part of the infrastructure of the AP station, it has to be worked out.

Conclusions

It is possible to use a single protocol for both minimum and medium functionality stations, over short and medium distances, for systems with few to many hundreds of stations. It is possible for an infra structure to be inactive when it is not needed.

The most important reasons for favoring a channelized system are (separation of contention from data transfer, and to provide reuse). Given spread spectrum with code division, it would be nice if 10 codes gave 10 times the capacity - constructive use is important. It is possible to make channelization logical, not analog. (With downloaded correlation codes, rather than tuned circuits).

It is possible to have more than one channel allocation algorithm. The referenced one is the default choice. Given spread spectrum and low data rate, there is saving in not needing to have an accurate narrow filter. A messy spread spectrum system is likely to be cheaper.

Dr. Anthony Shober asks: Does this protocol require spread spectrum. Chandos Rypinski answers no, but it will work using it. Many here like spread spectrum. I wish to try to use its good points.

Is the scheme blind to channel widths? Chandos Rypinski answers yes, but I do like to work with real numbers so that I can make comparisons, and 1 Mb/s is a nice round number.

What if a network is needed a 10 Mb/s, or 30 or 50? Chandos Rypinski answers that in that case you should use sequential access with no contention. The fast stuff needs to be sequential use.

Isn't it necessary to have many chips per bit (say 500) to get this spread spectrum stuff? Chandos Rypinski answers: Don't take Qualcom verbatim for this. In our case 31 bit codes have some merit. However, for 31 bit codes to be effective detection synchronization is needed at the transmitter and receiver. The codes are "orthogonal" only at one phase. Bit one on all nine transmitters must start at the same time - this requires synchronization.

Chandos Rypinski says to remember - though I propose something, I don't necessarily approve of something.

John Corey asks how you accommodate different speed requirements? What do you vary? Chandos Rypinski answers: (in respect to the speed requirements of asynchronous versus isochronous services) For

the LAN there is capacity requirement - but payload varies - if response is prompt enough it is ok. For the virtual circuit response time and consistence is important.

Dieter Susset asks: Will the software / protocol / administrations effect the cost of the total system? Chandos Rypinski answers: The cost of (designing for) infrastructure should not to be swept under the rug, but that is an issue for the designer, we can't assess its impact. We can compare complexity. Even the cost of wire can be pennies, or thousands, depending on where it runs. The cost of infrastructure will depend on front end development and tooling - hence perceived market demand. Each of you will reach your own opinion about costs.

This ends the presentation of agenda item 12.4. The meeting will break for the evening after the VCR presentation by Dr. K. S. Natarajan of work being done at Columbia University. The following is a short sketch of the VCR presentation:

A book size wireless computer is shown. It runs X windows over spread spectrum wireless. There is no physical keyboard, a stylus is used. The last window touched has the keyboard focus. (You use the stylus to touch pictures of keys.)

There are profound differences using wireless: Say to boot. Multiple boots are done from the same broadcast - stations that missed part request transmission of only the part they missed. The radio is noisy and some packets are lost, so these get retransmitted as needed.

NFS allows transparent data to many hosts. For those who move service is seamless from support to support. When the station looses one it goes to the next. Ownership passes from one to the next support with on wire control handoff.

Two CRTs side by side log network activity at two supports. As the wireless station moves from one to the other there is a burst of activity as ownership moves also.

The "private eye is shown" - a tiny CRT and optical system that makes the screen appear to float before the user.

Study continues in regard to work allocation between portable and infrastructure machines to optimally use the resources. Work is also ongoing at Columbia University.

Tuesday, September 10, 1991, Morning

The meeting resumes at 8:50 AM. There is a somewhat abortive attempt at fixed seating to aid the officers learning the names of all the new faces. There are new faces today. Everyone introduces themselves. Dr Kwang-Cheng Chen points out that Wireless LANs are a topic at the ICC conference in Chicago, 1992.

11. External Liaison

11.1 ETSI Simon Black reports on the third meeting, August 24, 1991. This was hosted by Apple Computer in Paris. There were twenty five or more in attendance, including Mr. Vissa (SP?) of CEPT FM.

Actions include

Request for: Project team support in 1992,
Services and facilities requirements specification,
IEEE 802.11 liaison.

Letter drafted to CEPT FM requesting allocation below
3 GHz for RLANs - ISM band not preferred,
Additional 30 MHz for DECT.

Joint RES RLAN/RES3N (DECT) meeting to provide comments
to public enquiry.

We are working to provide a mutually closer liaison with IEEE 802.11 - though the ISM band is not preferred by ETSI. We are looking for an increase of 30 MHz for the DECT medium rate portable service. The fear is that someone else may take the spectrum if DECT doesn't go for it now.

We are also working to make sure that data related comments regarding DECT are properly fed back to the public enquiry. [Data related here means especially the asynchronous bursty traffic that is the hallmark of the LANs. Sec.]

November 1991 is the target date for publication of DECT. The document has been available for public inquiry. Contact an ETSI representative. There doesn't seem possible to get the document by way of the (USA) State Department.

Bruce Tuch asks if the 30 MHz is for use with the DECT protocol only. Simon Black responds: Yes.

11.2 T1 Liaison Dr. Rifaat Dayem reports that T1 is the ANSI committee developing standards for communication such as ISDN. T1 is working towards PCS (Personal Communication Systems) through T1P1. They request liaison with IEEE 802.11 (see document 91-93).

11.2a Introduction of contribution by Dr. Rifaat Dayem, ***Proposed Liaison Statement from 802.11 to T1P1.*** September, 1991. Document IEEE 802.11/91-93.

This is a T1P1 contribution. The second page shows the T1P1 cover. This is followed by an explanation of what IEEE 802.11 does. This is followed by the IEEE Standards Project Authorization Request (PAR) for 802.11, then finally the letter from IEEE 802.11 to T1P1. These should help to show the intent.

The explanation of what IEEE 802.11 does is taken largely from the PAR. Dr. Rifaat Dayem shows a series of slides with excerpts from the PAR - which opens old wounds.

To provide wireless connectivity to machines, portable . . . initial focus on the ISM radio bands.

Dale Buchholz asks: What about the 18 MHz (licensed) bands. Victor Hayes replies that we are preferred - focused - on the ISM band. Dale Buchholz remarks that if your focus is your own little campus, and that is the total range of your portability, then licensing is a non issue. Jim Neeley comments that the issue (at least in how it is presented to T1P1) is important to this committee and should be voted on - but we do not have quorum. Note that the 18 MHz band is consumed in some areas already. Dale Buchholz contests this. Jim Neeley argues that there needs to be at least two providers in each area, modeled after cellular telephone.

After it becomes clear that the precise wording in the PAR is critical to its meaning, Dr. Rifaat Dayem agree to change the wording of: ". . . ISM radio bands, but will apply to possible new dedicated bands" in his presentation to agree verbatim with the statement regarding the use of additional bands as given in the PAR.

Other document changes include moving the first draft standard ready date from March 1992 to November 1992, and moving submission to ISO of the standard and conformance standard from December 1992 to December 1993.

The required coordinations, shown as in the PAR, will be updated as needed after talking to Vic Hayes. Note ECMA TC 32.

The question is raised: **Is there a need to approve the Liaison letter (contribution)?** (And how can you do it without a quorum?)

Dr. Anthony Shober points out that we will never achieve quorum at an intermediate meeting again. **It is not acceptable to have working groups not able to make decisions.** Nathan Silberman notes that 10BASET voted issues for later ratification. The voters and observers present, forming a task group, did make decisions.

The plenary does need to ratify the task group's work. Without blank check approval it is not possible to complete work before the next meeting. Quorum requires 37 voting members. There are less than 30 here. Proxies are not allowed.

The discussion is conclude with a statement by the Chairman: **Dr. Rifaat Dayem is our official Liaison and so is empowered to say whatever he chooses.** Dr. Rifaat Dayem states, non the less, that he will still discuss major points with us.

11.3 CCIR Task Group 8/1

Michael Callender, Chairman of CCIR Task group 8/1 explains that within the ITU structure there are two technical task groups: CCITT and CCIR. These make non binding technical recommendations. Though non binding, people take note because of the membership - who CCIR represents. This has an impact on WARC 1992.

WARC 1992 is restricted in scope, but it does deal with things dear to our hearts: FPLMTS. FPLMTS (pronounced fplumpts, or fluplmumps in American?) is: Future Public Land Mobile Telecommunication Systems.

CCIR 8/1 has provided a spectrum estimate of need for the several categories. We don't do satellites. We haven't done the LAN for lack of enough input. The goal? Realistic allocations are needed.

The data PCS request came after our technical advice had been delivered, a 10 month lead time was needed. We can't work directly anymore, but we can expand the scope of the January meeting to get there another way - not in the regulatory loop directly, but we can do it off line.

Dr. Rifaat Dayem ask when? Michael Callender responds: WARC, the request for spectrum - four weeks in Spain in February. WARC is the high level recommendation.

Dr. Rifaat Dayem asks what about CEPT? Victor Hayes answers that CEPT is fixed (in place) service. CCIR is mobile. Group 9 does LANs, and so is part of CEPT, but now with portable computers it is more mobile, so now CCIR has taken an interest, it is part of 1.9 to 2.1. CEPT is a regional activity, CEPT influences European opinion. CEPT is looking for fixed service spectrum, CCIR (is looking for mobile service spectrum).

Is FPLMTS a licensed service? - an improper question: CCIR doesn't do regulatory issues.

Dr. Rifaat Dayem asks what is a good time for us to make our request for harmonization, and who should we make the request to? Michael Callender answers that joining the FPLMTS lobby is the best thing to do. Go for more spectrum for generic mobile equipment. Don't get hung up too much on how it is divided up - first get contiguous spectrum.

Vic Hayes explains that Chandos Rypinski is our Liaison. The real decision makers are the administrations. Regarding the IEEE Executive Committee letter ballot, 6 votes are in - near simple majority, we will get it out as soon as possible. I am to draft a cover letter. We are mandated to liaise with CCIR anyway.

What about higher data rates? Reply: That is being pushed by ISDN services.

Impatience is expressed at the slow process. Chandos Rypinski explains that there is no alternative. The computer industry is not powerful enough to short circuit the inertia of the historical methods, you must first join the US delegation, then read the documents, figure out the changes needed, convince the US delegation , then get permission to go to the international meeting - maybe, and then to succeed at it you need to gain historical respect. Corporation X can't do it by awe, no one is awed at these meetings.

Michael Callender explains that this came in because a number of people understand that the portable computer has a place in these things. The services committee has a subcommittee meeting in two weeks - we need to add maybe ten words to the service definition to include the scope. - joint with CCITT study group 1. Of course sometimes 10 words must be dearly won. We need to make allies in the telecom industry, not opponents.

There are issues: Service provider or no service provider? The computer industry doesn't want to accept a service provider that cannot be controlled by a department head. There is the public or private dichotomy, but this is not in the CCITT purview. Don't raise this flag until after WARC and the spectrum is there to haggle over. Chandos Rypinski can get the Alexandria output document here this meeting.

The key seems too be in the scope of the services document. That is somehow a joint activity of CCIR and CCITT. Michael Callender points out again that CCIR hasn't had enough involvement from the computer industry. To get information about involvement in the US Delegation contact:

Bill Stevens
Phone: (408) 974-6307
E-mail: stevens.bill@applelink.apple.com

The meeting resumes at 10:49 AM after break. Ken Biba will continue the ad hoc group at lunch. At the Chairmans discretion Mil Ovan, because of contributions, is elevated to membership - assuming continued contributions. The Chair explains that contributions are considered 49% attendance.

The meeting attendance fee is $60.00, payable to Bill Stevens. The hotel can not accept this fee (as part of room charges or otherwise). Please pay cash, check, or travelers check, Bill will create receipts for all.

11.3 CEPT

CEPT met last week Tuesday and Wednesday. Victor Hayes was sick and not able to go, he sent a colleague instead with the paper. Thursday he reported back, but not with the real output. CEPT received Dr. Rifaat Dayem's report. WARC is working to get the fixed services out of the spectrum below 3 GHz. This is very hard. They are looking very carefully at the region between 3 and 6 GHz. The ISM bands are not perfect - not suitable for radio LANs - so it is removed from consideration. Instead, below 500 mW can be done with site license, below 25 mW with no license. ETSI will make the technical standards.

RES 8 is doing low power devices. They are surprised to find that RLANs are now put in their area. They are not familiar with RLANs. DECT's 30 MHz is not in this (CEPT's) purview.

Question: Is the 500 mW and 25 mW for spread spectrum. Answer: There are many bands under consideration.

The meeting now moves back to Monday's work.

9.2 Introduction of contribution by Bob Rosenbaum, ***Wireless Market Observations.*** September 1991. Document IEEE 802.11/91-103.

We are looking at some potential users of wireless LANs, from the user's perspective, not from a technical perspective. This is seen first as an enabling technology, not a replacement. It allows inclusion of a new class of users that could not otherwise be accommodated. The analogy is with 10BASET and Ethernet. Twisted pair allows a larger class of users. Wireless will also increase the market for LANs.

The important points are mobility, flexibility, ease of installation, and cost recovery. The scope is temporary offices, retail stores, factory floors, schools, satellite offices, - and a solution to construction obstacles.

Since this is an early stage in development, size of these markets is fuzzy. But we will do it anyway. Looking at the NON replacement market, there are unconnected PCs, New LAN PCs, and Moved PCs, (all information is culled from IDC). These figures run 14.3, 4.4, 10.3 million units respectively in 1991.

Regarding the portable PC Market there are .95 and .08 million units of portables and LAN connected portables in 1990. (From InfoCorp and WINDATA). This is projected to reach 3.6 million portables and 2.1 million LAN connected in 1994.

Portable PC Issues:

The portable PC networking market breaks down into sub markets: In building connections and wide area connections.

The in building connections are hand held devices with small amounts of bursty small packet traffic where high speed is not important, and stationary devices similar to desktop PCs. The assumption is that the PC applications will not be running while the person is walking.

Dr. Anthony Shober asks about the peripheral connections versus peer connections for the wireless PCs - ignoring the host and E-mail. Bob Rosenbaum responds: I have not explored that particular aspect, and will not comment off the top of my head. O-Neil communication has done this for printers at 38.4 kb/s spread spectrum. In Germany there is an infrared printer. Printers are medium data rate. Mice and keyboards are different. Disks and the client server model are different - I don't have the numbers on that.

Bob Rosenbaum continues: What are the typical configurations? There aren't any. If you try to make sense of it there is always a counter example, still - we try. Large offices are 20,000 square feet. In the large office connectivity with all other media, operation and management is a must.

In the small office and retail size up to 10,000 square feet has a 90% confidence factor. Pure and only wireless is a possible solution, but it is still wise to be compatible with a wired system. For retail a range of 150 feet seems adequate.

Mill Ovan asks what is the density in each of these areas. Bob Rosenbaum responds: A workstation per each 150 to 200 square foot area. that is in the United States in a large environment. In the small environment density will be higher. The checkouts in grocery stores are clustered, in department stores they are distributed. This leads to 100 people per segment. The technology to segment this is a technical problem, not a market statement. The system must be smart enough to manage multiple subnets and avoid conflict among them. It is tough to keep radio in a well defined space. At least with infrared you can put up walls in the open areas. The system must have the smart to manage and control conflict within itself.

Network management is an absolute requirement. There has to be a way - a well defined way - to manage this LAN. A lot has been done in 802.5 and 802.3 on management. We might be able to latch onto that activity. Wireless should build on the structures that are already out there.

To be successful we need to be complimentary to the existing wired and fiber world that is out there. Look how 802.4 ended up: It is excellent technology, but it is not there in the marketplace. The reality is 802.3 and 802.5. Unless we fit those seamlessly, the application space is doomed to small, questionably defined niches out there. I prefer that wireless be a significant force in the marketplace. - So it must work with 802.3, 802.5.

Remember the effort that FDDI is making with station management. We should not have to do something totally new and different. Victor Hayes asks what are the abstract requirements for management? Bob Rosenbaum answers that he has an extensive list of things that need to be managed but is not prepared now to talk about it in any way that makes sense.

Bob Rosenbaum continues: The keys are the management and the integration. Compatibility with 802.3 and 802.5 are the most important issues that I see.

Victor Hayes points out: We must provide the MAC service definition, is there a danger that we then miss Compatibility? Bob Rosenbaum replies: There is always the danger, but if we keep the need in focus, we will likely not falter. Larry Van Der Jagt asks, does it need to be bridgeless? Reply: No, but it must not require hardware or software changes. If you are using an existing hard wired 802.3 network, then you should be able to put in wireless so that the end users have no need to change anything.

[Comment: Be wary of the trap that you are walking into here. The need is obvious, but how to achieve it is not. Applications use characteristics of implementations of Ethernet that are not guaranteed by networks conformant to IEEE 802.3 ("snappy response" is not guaranteed). Improper use of broadcast address "works" - sometimes, but can cause problems to others in a bridged network. "Real" software sometimes uses and depends on physical characteristics of the platform on which it runs. That is a no-no, but it happens. Sec.]

Jim Neeley comments: Expect drivers from venders to go with different stacks. The standard (802.X) is ignorant of the protocol stack. The customer is aware of the stack. (Be that DECNET, NOVEL, ELAN, LAT - Masleid). We will conform if we meet IEEE 802.2 - we can support NOVEL on an enhanced basis, and should not preclude the vendor from doing that.

Bob Rosenbaum continues: The PAR should also address making the bridge as painless as possible. Can 802.11 do the wireless without a view to how the bridging will work - to make bridging and routing as nice as possible? Jim Neeley replies: Not independently. Yes will do it, specifically to 802.11, but not to impact the customer.

Karl Auerbach points out that a lot of things in networking are inimical to the paradigm of wireless. Direct bridging to wireless may be bad, routing is better.

Jim Neeley comments that 60% of the networks use NOVEL. NOVEL is above the MAC layer connection, but NOVEL does not conform to the 802.2 logical link layer. We should be aware of NOVEL as a de facto standard and try not to screw it up. TCP/IP is not standard either. TCP/IP is also a de facto standard. We should also support the management protocols, (but via a MIB, a management information base).

John Corey reacts: NOVEL does a lot of things wrong that can really collapse, destroy, the radio network - the broadcast stuff for instance. Dale Buchholz points out that with the infrastructure they can filter it out, it is not to be used as a relay between wireless LANs. [I spite of the words used, I think the intent of the statement is that the wireless LAN is not meant to be a relay between wired LANs - the wireless is a leaf, never a branch or trunk. Sec.] John Corey concurs: This is a very very limited resource, many of the things normal to wired networks become flooding traffic to wireless.

Jim Neeley comments: This needs a contribution, say from Motorola, on how Altair sanitizes the network. It is a significant piece of work, and can't be expounded in this meeting. A number of us are aware of this problem, we are going to support these things of course - but we must confine ourselves to the piece of work that is a bridge specification specific to 802.11.

Question: If it is (hypothetically) impossible to meet 802.3 or 802.5, then does the wireless market evaporate? What is the time frame for the market to recover - how long? Bob Rosenbaum: I don't believe it (802.3 or 802.5) to be impossible, there are instance proofs - the BICC and the Motorola product. If, in spite of that, this group says it can't be done - then for the next 3 to 5 years the market will look very uninteresting from my point of view.

[The wireless market will develop, even if it cannot bootstrap off of existing applications, but that will take time. Sec.]

As to the other application, warehouse, pen computers, driving the market in other ways - these are new and unknown factors that my mind can not deal with. The existing market growth I can understand, the totally abstract I can't deal with. Since the premiss is that 802.3 and 802.5 can be done, then we should do it. Look at the failure of 802.4 compared to 10BASE36 for instance. 10BASE36 allowed exiting applications on existing CATV networks. (But then again there weren't too many private CATV networks).

Larry Van Der Jagt points out that there is a lot of 802.4 used in process control application. Bob Rosenbaum says that he is not aware of that. Larry Van Der Jagt says most of it is embedded, and so you just don't see it.

John Corey asks: Does it increase the market if the existing controller cards can function as is, with something new at the AUI interface? Bob Rosenbaum replies: Yes. [This is the 802.X spoofer scenario explored in great detail by 802.4L. It was unloved. Sec.]

IBM is looking at the desktop replacement marketplace. The portable computer market is in the unmeasurably small range. In this room there are only a few portable computers, but in 5 years the room should be full. The product must be compressed to fit into the portable market. The driving force will be the personal computer memory card interface association - the things that plug into portables that looks like the microchannel pcimia (?) feature. It will need something thicker to hold a radio though.

You need to make it (the radio interface) slide into the interface suitable for the network and the geography in which you are resident. The true market is what will work in a portable computer.

John Corey states: This assumes that the portable is the true wireless market. What about the 802.3 802.5 AUI hook.

Jim Neeley: If I have to put something in that is needed to talk to something that needs to attach?? [This is what Occam's Razor is used for. Sec.]

A [Janus] black box that talks 802.11 on one side and 802.3 one the other side.

Chandos Rypinski says you take the existing interface, say AUI, and substitute radio for cable - but to do that you must wrap the AUI in a new interface. The true interface is the backplane, to do it with minimum complexity and power, you must go to the true interface. Working from an existing adapter, though possible, is not wise, since it adds parts without functionality. Communication must be seamless of course, but replacement of the adapter card is ok.

Bob Rosenbaum concurs. It must be seamless, but how it is done is not important to the market.

Victor Hayes: We have been down this road. We must have compatibility above the MAC, but not to the MAC PHY boundaries of the 802.5 and 802.3 MACs.

Dr. Rifaat Dayem points out that there is much thinking that must be done, how can we coordinate the schedulers, we need to get contributions. We need an architectural for characteristics of bridging specific to 802.11 attaching to 802.3 and 802.5 and other things. This may result in work being done in 802.11 or it may require work done under 802.1 (Dot One).

Chandos Rypinski will study source routing and spanning tree for the January meeting, he has access to people who have the knowledge to do this.

John Corey asks: Are we are looking at voice and imaging? How are we going to do this?

Jim Neeley this needs not only throughput, but also timeliness, this implies the use of the isochronous channel and compatibility (requirements) with FDDI II. Think of the telephone glued to you PC, operating independent of the session current on you PC. This is in progress in 802.6 and 802.9 - plan on using it, or explicitly ignoring it and losing the market.

John Corey notes that each thing that is incremental will add to the market over and above what is offered by 802.3 and 802.5, which do not offer voice and video.

Karl Auerbach strongly disagrees: Adding pieces makes an elephant that is trying to fly.

Tuesday, September 10, 1991, Afternoon

The meeting breaks for lunch, and resumes at 2:01 PM, continuing with agenda item 12.

12.5 Introduction of contribution by Chandos Rypinski, ***Sequentially-Used Common Channel Access Method.*** September 4, 1991. Document IEEE 802.11/91-95.

A chart is shown, page 14 of document 91-94. It is a matrix chart of possible access methods. The chart breaks into 16 cells based on no infrastructure/with infrastructure, low rate/high rate, single channel/multi channel, spread spectrum/narrow band. (Some of these won't happen, such as high rate and spread spectrum and multichannel.) This paper covers all of the likely possibilities using a single channel.

Now we'll talk about non channelized access methods, where use of the channel must be done sequentially. It can be done with or without infrastructure.

This is an asynchronous system. It starts with an invite, then request, then grant, then data, (then ack). The next cycle then starts immediately (as apposed to waiting for a time sequential window).

The topology assumes a group of 9 to 16 access points (defined as those likely to mutually interfere) among them invitation-to-transmit appears sequentially.

A list of functional objectives, not unlike the other protocols, is shown - the differences relative to other 802 protocols are:

In general the number of stations served by a single high speed access point is a small number, this implies that if stations density is 1 per 100 square feet, then 12 stations occupy 1,200 square feet: This is an implied short range. [18 feet! - and the nine access points may be only 40 feet apart. Sec.]

Another difference is this: The 802.X LANs started out assuming a large number of stations in one unbroken LAN, but this turned out to be a bad decision, in practice local bridges are quite common.

The PHY layer of radio is just not as reliable as even telephone pairs (non data grade unshielded twisted pairs), to say nothing of quad shielded cable or fiber. We have the burden of making ours look just as good as those. More power and ECC is not going to do it for us. The physical layer is going to have to do additional things - say acknowledgement and repetition. Short messages give less exposure to error. Long messages are not likely to get through.

It is important to know why we have an infrastructure. Any piece can be no better than the knowledge it is trying to control [each part's performance will be limited by imperfect knowledge of its environment] a distributed control can hardly know what an adjacent station is doing. We may improve that by taking advantage of knowledge gained from contiguous radio spaces.

The access control function or scheduler is one of the vital functions of the infrastructure. The infrastructure is indispensable to communicate off network or out of range. The need for infrastructure is not a religion, it is about the things that need to be done.

Put the decision where the information is. Don't make it so you have to send information about the state of the network over the network as messages.

LAN structure has evolved to imply long addresses. Inside the system short addresses are nice, they are used to save air time. The short address it is not meant to be carried out of the network. Included also is CRC, an error detection mechanism - this is nothing new. The Hamming distance consideration exists, but I will not go into detail.

There is an access point identifier that is important to the station and the infrastructure. There is another subtle question. In a pure peer to peer network there is an attachment to (a preference for) a symmetrical protocol. I have no particular attachment to symmetry between peers and from peer to access point - for instance: The infrastructure doesn't need to ask permission to send to the station. It (the station) must be always ready per 802 functionality.

A polling function detects stations that shut off without deregisterring. The list of available stations needs to be reasonably accurate. Poll rate is configurable.

[Slides are shown, excerpts from the paper, only some highlights can be presented here. Sec.]

If ACK is not heard, the message will be repeated.

There are fine points about interleaving of invitation messages. There is some detail about segmentation of the message since the air packet is short compared to long messages.

In no place in the does the station scan for frequency space. The station responds to a sufficient invitation. The infrastructure takes care of all that and tells the station what to do. This allows more commonality at the station - say three APs hear something? The infrastructure must sort it out.

If the packet is long compared to some upper limit it must be segmented. 288 octets as a good number. It is not good to make it larger than an ATM cell, smaller is OK. If the packet is very long [or infinite] a simpler protocol using auto grants will be used [after the circuit is set up].

The mixing of packet and isochronous data was much argued in 802.11. In 802.6 the same arguments - in 802.9 the integrated interface - the subject is exhausted in those forums. Connection oriented and connectionless services have different stacks above the MAC. For packet virtual circuits, timely delivery is needed, for this an infrastructure is always needed.

There is (in this protocol) computability to ATM cells as used in 802.6.

There are intersystem overlap problems. I use probability arguments for independent management systems at their borders.

The major point is that invitation to request goes sequentially about the group of 9 or so access points, in theory one AP station could get all the bandwidth if it is not needed elsewhere so capacity is demand driven. Analog frequency channels, or code division separation is without regard to demand. This is a good feature of sequential access.

Now for **Autonomous Groups Not Using Infrastructure** using distributed logic instead.

This resembles some other things proposed using CSMA. In this case the station that has to transfer sends a request. If the target station hears, the target sends grant, then the sender sends, if all goes well, the target sends back ACK.

This might seems poor, but it is a very fast channel, exposure time is short, there are a small number of contending stations. The procedure itself is written up, refer to the papers.

The next point: If you can use the same message set with and without infrastructure than the systems should be mixable. It works like this: With the infrastructure quiescent, access is contention based, with infrastructure activating criteria. It is possible to have the best of both worlds when and if needed.

Conclusions - Reasons for favoring:

This will work over wires - without radio at all. It can use many types of media.

In the common channel access method with infrastructure unused capacity is in a common pool available to any Access Point in a reuse group.

The plan is highly resistant to anomalous signal levels from contiguous Access Points as compare to channelized spread spectrum systems.

The plan avoids the overhead necessary for managing channel selection and for placing this function in the ISO layer and management structure. This is the simplest system to adapt to dual mode (with and without infrastructure).

(On the down side, maybe:) Though this may access method may imply short range, it is not a proven fact. You can spend bandwidth and power to get higher rate. It is true in practice, not proven in theory. The cellular story is reviewed: Cellular was long on cost of infrastructure, short on cliental, so they worked to increase the size of cells. Now they are cutting up their 100 foot antenna and 100 watt transmitters so that they can reduce the size of the cells - too many clients per cell!

Chandos Rypinski: This finishes the presentation of access methods. Three families of access methods. What is the feedback, critique. Where are the assumptions incorrect?

Simon Black responds: To consider this in detail we need more thought. To make instructive comments most will have to go back and study.

Larry van der Jagt remarks that in comparing Ken Biba's and Chandos Rypinski's access methods, one of the things that speaks for completeness is that Ken's is identical to one of the access methods in Chandos Rypinski's work except for a change of names. (Specifically, the sequentially-used common channel access method, without infrastructure, operating in distributed contention mode.) It is encouraging that these are so much the same.

Jim Neeley comments: I commend Chandos Rypinski on merging so much that was divergent. I did find parallels to a frequency management or channelization that parallels cellular. The bidder is under control of a third entity - that management controls a set of access points. It is ok if you own them all. It is ok, but is a problem if the reach of the third party manager can not get to all that needs control, also a problem if the switching rate is too high. It could be awkward. Note that the end station not measuring power level is an optional thing. To understand the problem, assume access to basic service and access service area by virtue of the large store system. What of the small shop in the system that is denied access to the backbone?

Chandos Rypinski responds to the cellular analogy: I am familiar with, but do not follow it at this time. There is an interesting comparison: The access is done in a local switch - it is done in San Francisco by a single machine as much as 50 miles away. The round trip propagation time is a key factor in high speed systems, the decisions must be done as close to the information as possible. There is not likely to be a single common controller.

With respect to the shopping mall, we will have to work more on the models, taking things that we know will happen by the probability that they will happen. If we can push the failures from these mechanism to no worse than failures due to the other mechanisms it is good enough.

Jim Neeley comments that the access manager has good knowledge, but doesn't own all the area. This causes problems. The workstation may also know things that are not associated with the radio per se.

Ken Biba asks about simulations? Chandos Rypinski replies that the description is precise enough for a third party to analyze, it will need a third party to help, say a university. The simulation is too complex for my personal resources.

Vic Hayes complements Chandos on the size of his contributions, that being inverse of the size of his company.

The meeting breaks, and is called again to order at 3:37 PM.

12.6 Introduction of contribution by K.S. Natarajan and Chia Chi Huang, ***Battery Efficient Operation of Radio MAC Protocol.*** September 1991. Document IEEE 802.11/91-102.

We recognize that reduction of battery power to support communication is important.

Assume an 802 LAN distribution system with three overlapping area access points. Use the frame structure from the previous contribution, broken into periods. Assume an infrastructure of the time slotted type. [Something similar to Dr. Jonathon Cheah's. Sec.] Use power only when actively receiving data or transmitting data, the rest of the time be in sleep or idle mode.

During period AH, the time the AP is transmitting receiver allocation lists, all receivers are active. AH (the A Header) contains information on who is to receive. If it is not included in the list the mobile will power down its receiver until the end of this particular period. All others (those included in the list) will do additional calculation to determine when they need to be active. For example, if 1 through 4 have been allocated with 3 first up: After 3 has heard its thing, it can go to sleep, each of the others can wake up as their slot is coming up, then go back to sleep - say sleep the first 8 slots, then wake up for 1 slot, then go to sleep again.

The traffic may be in full broadcast mode, but only intended receivers need be awake to here it.

All receivers will power up again so that at the next header time BH, they will learn what slots are assigned to whom for transmit. At CH the channel is open for contention (aloha slot), mobiles may transmit contending for service to the access point. The cycle repeats.

David Leeson asks: Is it precluded that all be in one slot. Answer: (No.) We are trying to follow the access method of a previous contribution.

Richard Allen asks: Is the time it takes to power up a limitation on this scheme. Answer: No, since the stations know in advance when they have to have been powered up by.

If the smallest (what is the smallest slot size? A 100 byte packet on a 10 Mb/s LAN) 80 microseconds slot is the time to wake up? You need enough time to wake up. [Lets say the utility goes down as the time left to sleep is eaten into by power on time. Sec.]

Dr. K.S. Natarajan continues with an example of the power savings.

Assume the micro controller uses 385 mW, and idles at 55 mW.
Transmitting uses 325 mW; receiving 400 mW; standby 1 mW.
The micro controller is on when transmitting or receiving.
A low power timer measures sleep time.

If the station transmits 1% of the time, and receives 5% of the time, power conserving uses 98.99 mW, as apposed to 784.25 mW without power conserving. This improves as the on time is reduced. On time of the transmitter, of course - but the main saving is in the receiver.

Larry Van Der Jagt wonders if the micro controller is necessary if the sleep mode is not needed? [The controller is needed to keep track of Dr. Jonathon Cheah's protocol, sleep is done by idle timers. Perhaps a simpler protocol could get by without a controller? Sec.]

At some increasing traffic load, you are wasting computation calculating the load. [This might matter to the station that is the focus of all the traffic, but not to the others. Sec.]

Question: What of the multiple access points? If in range of several access points how does it coordinate? Answer: That is not part of this contribution, it might be don with frequency hopping schemes.

Dieter Susset asks: Is contention for registration? Dr. K.S. Natarajan answers yes, and also for single packets.

Question: The controller has a constant sense of time? Yes, timers remain active when the controller is idle. The headers contain information about when the next header is coming.

13. Miscellaneous

13.1 PHY This completes the contributions on architectural. We will continue now with Miscellaneous PHY issues, documents 91-100, 91-98, and 91-99.

13.1a Introduction of contribution by Michael A. Masleid, ***Bandwidth and Capture Using the Multiray Model.*** September 7, 1991. Document IEEE 802.11/91-100.

[The following material is transcribed from tape with minor alterations. Sec.]

This work is based on a computer model for a rectangular box room with several antennas in it. The point of that was to get a feel for the applicability of cellular techniques inside buildings. The assumption was that given the standing waves off walls and floors and people that the cells were going to be these little tiny things about a quarter of a wavelength long and it really wasn't going to work out well unless you think in terms of having handoff algorithms that are relatively fast. A couple of question arose out of that having to do with, one, a model assuming a single frequency, whereas any practical transmission is spread over several frequencies, so precise standing wave patterns aren't going to be so precise. The first question is what is the effect of bandwidth on standing wave patterns?

The second question is once you have captured the signal, say a code division type, I would hope (with any decent receiver design) that you would become much less sensitive to other transmissions in the area. You have locked onto it and follow it all the way down to . . . So more realistically, rather than show you signal intensity, whichever comes strongest, I should have been showing you intensity for whichever one you have captured, and the area over which it is still a useable signal.

I have tried to do those two things with the computer model, and present the results to you.

The first: The effect of bandwidth on standing wave ratio. If you imagine that there is a wall or reflector of some sort, and an impinging signal on it of some wavelength. The reflected signal, depending on what the dielectric constant and conductivity of the wall is, will have nulls where the signal coming this way will cancel the signal going that way. The power profile coming from the wall is some sort of sinusoidal thing. If it is a conductive wall the voltage field at the wall is zero, then peaks, then zero. . . How perfectly the nulls are created depends on how perfect a reflector the wall is. Where the nulls occur depends on the wavelength of the signal. If you are sending a group of frequencies, exactly where the null is will be different for each one - and so the width and sharpness of the nulls will be something to do with the signal used.

Slides showing power as bright green, blue, red, or white, areas depending on source antenna are presented. Standing waves are evident around the edges, and throughout the slides. The standing waves grow less distinct towards the middle of the slides, particularly as bandwidth increases.

This drawing shows the four antenna, that which is strongest, at any given point. In this area we are seeing the power density for an antenna over there on the right. There is a null near the wall, another null a half wavelength out, and so on and so on. As I increase the bandwidth of the signal, the nulls will get less sharp until they virtually disappear. As they gets further and further from the wall other nulls that had appeared become dramatically less sharp.

Larry Van Der Jagt asks: What does the brightness of the color represent? Michael Masleid answers: Brightness of the color indicates field strength, as it gets darker and darker the field is weaker and weaker, but not in any dB scale: Its just a linear power scale, but not calibrated in any decent way. The different colors indicate which antenna is used. Whichever one has the highest field strength is the one you can see. Where green disappears, it has only disappeared because the red (or blue or white) signal strength is greater.

Richard Allen asks where the antennas are located? Michael Masleid: If you imagine for yourself a box shaped room, perhaps six meters across, 8 feet high, the antennas are located at various heights in this room, the white one kind of high and very close to the wall, the blue one not so high and very very close to the wall, the green one very nearly centered, the red one off in the corner - a rather completely random dropping in of the antennas, not intended to be pathological or nice.

These are meant to represent the access points? Yes - and a presumed code division multiplex with all the access points trying to do their own area at some kind of high data rate.

There are some other very important things to recognize about the antenna that give the peculiar shapes of the patterns: They are vertically polarized, so they tend to give an even power profile over the area under them, with a dead null directly underneath them, which is a sort of peculiar choice. One might chose to have a down firing antenna. You have to remember I'm from a factory orientation where we are thinking in terms of range I suppose, so side firing makes more sense there - also I am trying to make the point that cellular design is not necessarily the best - making the gross assumption that you have large cells, they are completely independent, and they don't interact.

The figure, showing the effect of 20 MHz bandwidth, at 1 GHz carrier, is virtually identical to the CW figure except for tiny details. The other drawings assume 100 MHz bandwidth and 500 MHz bandwidth at 1 GHz carrier. Now, no one is going to give you that. What is interesting is that cohering event, the collision off the wall or a table or a chair, creates a standing wave that is durable. It exists for several wavelengths out from the wall, it exists for a fraction of your bandwidth. If I have 500 MHz of bandwidth, then some part of what 500 MHz represents away from the wall I can still have structure. If I have 20 MHz bandwidth, I have to go a significantly greater distance to get out of the structure. In normal size rooms you're never going to get there, you'll hit the other wall again.

There are entertaining things, where large scale structures at huge bandwidths exist, because the multiple paths that lead to a place differ only slightly in their path lengths, so even at huge bandwidths there is structure far out into the room.

The moral of the story is that bandwidth, very large bandwidths, do reduce the effect of VSWR, does reduce the size of the nulls, but doesn't make them so that they can be ignored. They still exist. You can still get relatively fine structure. The size of bandwidths we need to be able to avoid it are much larger than the bandwidths that we have available to us. So we still have to think in terms of micro micro cellular if we have multiple antenna on the same frequency with multiple codes. It doesn't mean that one should despair, it just means that you have to be prepared to deal with it. This leads nicely to the next question:

If you have to deal with several codes in one area, and you have captured one of them, don't you have some advantages? Why don't you just hang on to one? It doesn't have to be the strongest signal, as long as you can still use it.

The next set of four drawings are what happens if we assume that once we have captured a signal we hang on to it. We don't immediately switch to the strongest signal as you move about - you only switch when you find that the one you have is unusable.

The original drawings showed the power profile of that which is strongest. Period. The new drawings - I told the computer to plot the other three antennas 9 dB lower than the green one. In similar fashion for the blue one, white one, red one.

Larry Van Der Jagt asks: Doesn't mean plot the other three antennas 9 dB down from what they are? Attenuate the other three antennas by 9 dB?

Right. Faking out that the receiver isn't tuned to them, its been captured by one, and so the others are not interfering.

We'll have to talk a bit latter about why pick 9 dB as apposed to any other number - it seemed to make sense when I was writing the simulation. I remember that we had decided to do it, Dave Bagby and I had talked at some length - I've forgotten how we came to that conclusion. Having thought about it some more, I think I can motivate how you can get there. Anyway -

Lets say a station powers up and looks for the best signal, and decides it's GREEN. Ordinarily if it moved over three inches it would all of a sudden decide that it had to be RED, and move another three inches and GREEN again, then RED - something of a nuisance.

So what we can do is assume that it locks in (to GREEN). Once locked in it can stay with it and move around quite a bit before it has to leave (moving around on the green captured figure). It will still have to leave. Once it gets here, this little splotch of red, its going to get in a situation where red (remember that I artificially suppressed red 9 dB) red is now 9 dB hotter than the green signal and may be causing undue - unmanageable interference. It's time to switch over to red.

(Moving over to the red captured figure). So now he's here, captured by red. He finds himself surrounded by decent redness. With any luck he can stay with it for awhile - if he happens to move in this precise direction he's back into the green one though.

So, because of the standing wave, and the population of reds hear and greens there, you could still find yourself having to switch pretty fast.

Simon Black points out that surely if the stations also had antenna diversity then you could avoid switching, at least between the antennas (APs) in the room? Michael Masleid responds that each of those antenna on the station would have to be doing its own thing (active phasing combiner or receiver front ends) - the one

that you have selected could be the one that moved into the null and so said switch to the other antenna. Bruce Tuch responds that it would have to be dynamic, and wide band like this - spread spectrum. If it wasn't you'd need not -9 dB, instead you'd need +20 dB. You are assuming that once you lock in your interferer could be stronger than yourself and you'd still be ok due to spread spectrum. In a non spread system you'd be back to the first pictures that you've had that show that it doesn't work. Michael Masleid: Any way - the idea is correct - if you have diversity (on the station) then you can switch on the diversity instead of switching on your (code). It is perfectly correct, but you do have to switch.

The point of it all is: Do we have to worry about switching? - and the first answer is: (With huge bandwidth) YES because you get this thing (large scale structure - deep fades in spite of bandwidth because of large scale symmetries and coincidence). And the second question is, given capture do you still have to worry about switching? - and the answer is: Yes, you still do, and you may have to be pretty agile - but it's not as bad.

Here its ridiculous (without capture), the number of switches per Bruce: inch. Michael: its per foot, right? Bruce: at what frequency? Michael: At 18 GHz its unmanageable unless you have directional antenna. Which is interesting I think. At Worchester they (Motorola) actually showed what the profiles for this stuff was. Any way, you can play the game with these figures, sliding around, to see how many switches you have to make. It is also entertaining to think what would happen if you got three pieces of spectrum - not contiguous - and related by prime numbers for instance.

This is still a simple room model - just walls floor and ceiling. You can program any wall material you want, but no furniture. In real life you will have reflections from the furniture - and you can't get out of the standing wave pattern from that.

Now, what about the choice of 9 dB capture. Lets pretend a code length of 255. Then assuming a correlator the voltage of the correlator is 255 times the chip. The power output will be the square of that (255*255). The cross correlation - not knowing the other code - is likely to be the power summed over 255 bits - just the sum of the power of each chip, or 255. The signal to interference ratio is 10*log((255*255)/(255)), or 24 dB. For a 255 bit code against a 255 bit code that has been reasonably well selected, I'd expect a 24 dB signal to interference ratio. Presumably I don't need near that much to receive successfully, so lets say I need 15 dB - then I can follow the one that I have selected 9 dB below the one that is interfering in absolute power.

If there is a field of three other antenna out there, all radiating, I have to deal with power from each one of them. Allowing somewhere between 10 and 15 dB of signal to interference ratio, but there are several interferers so I have to throw away another 4 or 5 dB. . . so anyway, what's left is 9 - this isn't science, its more like engineering.

That's the reason for the plots - something like 255 bit codes, 8 codes, 9 dB. Larry Van Der Jagt points out that you can definitely get up to 16 codes - the square root of the code length. Michael Masleid comments: And can handle only so many, as the sum of all the cross correlation of the other codes is eventually equal to your own signal. - At any rate, the motivation is a fairly long code, quite a few of them out there, given quite a bit of coding gain how far can you follow it down, and to what extent have you avoided the cellular too many cells problem? The answer is you still haven't avoided it, you still have to deal with it.

Questions?

Larry Van Der Jagt asks: This is assuming that you have a standing wave - which is assuming that the room has come to equilibrium, right? Michael Masleid: It comes to equilibrium rather quickly. Larry: In whatever the delay spread of the network is, right? Michael: Yes.

Larry: So during delay spread the nulls are whipping about? There is always a period of time when there is power arriving? Michael: Yes, but that only buys you something if you have the bandwidth - if you are quick enough to resolve all of what's happening. If your receiver takes as long as the room does to reach equilibrium then of course you've had it. If the receiver and transmitter has 100 MHz bandwidth and you're 10 ns from a reflecting object, then you can resolve the reflecting object. Larry: During the delay spread? Michael: Right.

Larry: So the thing is, this is the way it is at steady state. The receiver is likely to be making decisions other than at steady state.

Michael: (Uncomfortably) - This is steady state - but it is (steady state) assuming the receiver is as fast as 20 MHz. It is the 20 MHz bandwidth sized null. Its a peculiar thing . . . It seems to be impossible to avoid complete signal cancellation. Each of the frequencies fail. What's happening is you do have a delay spread, but at some places in the room there is a null - even with huge bandwidth. The reason is that at some places in the room the geometry is such that all paired paths have virtually the same path length. For the large null you have bilateral symmetry into the room that causes every possible path pair to cancel. Its just an accident, the other side of the wave guide effect.

Larry: What's on my mind is during this time when the room is coming to steady state - Michael: It's possible that the room comes to steady state without ever showing a signal, because each arrival. . . Larry: That is very pathological. Michael: Pathology happens a lot if you have a lot of people. Larry: I don't buy it. If the signal is bouncing off of all of these things, then at some point in time when the rays are arriving there just won't be a null. Michael: It could well be that there is signal, but not above the interference level. Larry: But the interferers are whipping around also. The receiver doesn't make decisions based on steady state conditions, it does it during the delay spread. This is all very interesting, but I'm not sure that it applies. Michael: It must: The program goes frequency by frequency and computes the E-field for each frequency for every place, and then sums that E-field in as power, and so at all frequencies there is no power - and the implication is that at no time could any power be transmitted because all frequencies that could have been used by the Fourier transforms of any possible modulated signals don't propagate. Its saying that it's in a non selective null.

Bruce Tuch asks: If the room is more complicated than this, what is the probability of a flat fade? Michael Masleid answers that they would be in different places.

Larry Van Der Jagt: Given that the signal is coming on and going of - changing? Michael Masleid answers that you have to do it with a finite bandwidth, that yields only so many frequencies that the signal can be represented by. A null at all possible frequencies means that in the time domain all possible paths have cancelled. The frequency domain has nothing to do with steady state - it is in frequency, not time.

This discussion goes on for some time. Both parties are correct to some extent. Even wide band signals can cause standing waves, otherwise there wouldn't be colors in butterfly wings, puddles, and bubbles. But there is a limit on how deep the null can be - the cancellation of line of sight due to floor (and ceiling) bounce, if perfect in steady state, is imperfect during signal change to the extent that the signals differ in the time between arrival of the line of sight and floor bounce signal. This is related to the time derivative of the signal which is limited by bandwidth - but it is not zero. This could be very useful, but perhaps not for code division multiplexing.

Bruce Tuch asks what happens if you didn't use a spreading code modulation technique to get the bandwidth, say you used frequency hopping? Michael Masleid answers: You would occasionally land an a frequency that you should have avoided, it will blow away your front end for that hop - but I don't know enough about it to say. I don't think you can get something for nothing.

Have you done anything with directional antenna? Michael Masleid answers that it would be very interesting to do. I must depend on the good graces of all the parties involved that I will have a chance. One thing I can say right now: The standing waves in my figures are due to waves traveling toward and bouncing back from walls. If the antenna is ignoring the reflection from the wall then there is no standing wave - or not so many, just the ones from nearly identical paths. Those lengths don't change so fast relative to each other with motion. To hazard a guess, at 18 GHz with directional antenna the patterns will look much the same (in texture) as they do at 1 GHz without directional antenna.

Chandos Rypinski asks: Could you do this work very easily for a different specification of the antenna - with a directional antenna. Michael Masleid answers: if its radiation pattern can be expressed mathematically in some reasonably simple way - the ones in the program are infinitesimal vertical elements and vertically polarized receivers. Chandos: So the vertical pattern has shape and the horizontal pattern is omni? Michael: Yes, a regular donut. Chandos: Torus. Michael: Torus? - right. Chandos: Lets not get sloppy here.

Michael Masleid: Actually, I do need to change to a regular dipole radiator anyway, the two element model: That will double the compute time - it will take 10 minutes - I'm impatient. What do you imagine as a directional antenna. Chandos Rypinski: I would like to see the antenna retreat into the corner so that it

becomes a corner reflector antenna. That does things to the horizontal pattern. Yours differs in that it has the antenna many wavelength away, and the walls are only 60% reflecting. Michael Masleid that can be changed. Chandos Rypinski - for the first wavelength around the antenna? Michael Masleid - No, well, that is more interesting. I worked out how to do it for diffraction, but you have to do a Fourier Transform. Chandos Rypinski OK, so maybe instead of having a change in conductivity of the walls, simply project the pattern that would result, the pattern is an arbitrary mathematical function no matter how you get to it. [And that may be good enough. Sec] Michael Masleid: Can you do it with three radiators? - How about dipoles? Chandos Rypinski comments that you have to be very careful then. If you do it with two dipole antenna to represent the (reflecting) ground plane, then you have assumed the ground plane is infinite. Michael Masleid comments: I could make the receiver directional, that is a special case.

What about a collinear array - the nulls will be different, the close in nulls will go away.

Dr Kwang-Cheng Chen points out that you can only observe the time average, you can't ever see real phase, only relative phase. [True - the time domain signals I have presented in the past have shown phase - the twists and turns are important, but the rotation of the total figure is arbitrary. Sec.]

Larry and Michael continue their discussion of space and time. The meeting breaks at 5:14 PM to adjourn for 8:30 AM tomorrow. Work will continue on PHY issues, then service definitions for CCIR, then break to work on requirements.

Wednesday, September 11, 1991, Morning

The meeting resumes at 8:50 AM. Those interested in the VCR tape shown by Dr. K. S. Natarajan of the work at Columbia University please give their business cards to Dr. K. S. Natarajan. The estimated cost for the tape is $10.00 or less. The attendance list is passed around. Remember to pay your meeting fee to William Stevens of Apple Computer, cash, check or traveler's check. Agenda adjustments: The requirements group is waiting on Ken Biba, we will continue with the PHY.

13.1b Introduction of contribution by Chandos Rypinski, ***Power-Drain Considerations for Full Time and Sleep Mode Radio Receivers.*** September 4, 1991. Document IEEE 802.11/91-99.

This paper address the underground rumbling about sleep mode to conserve power. Obviously this will be pursued in the battery powered computers. This is in two parts. Keeping the radio receiver turned on may be necessary. Oscillators. It may take many millisecond for an oscillator to stabilize. Part of my effort is to avoid the need for power off circuitry for (the receiver front end) if that is possible.

Looking at the radio block diagram shows the front end mixer with local oscillator, then a quadrature detector (baseband) using a second local oscillator at 150 MHz, with two mixer/low pass filter paths, and then the receive signal processor.

First thing in the reference paper: Is there something better than 7 dBm? - something better than diode ring mixers? Life begins at 7 dBm (7 mW) for diode rings. What about active mixers and resistor mode FETs? There are many circuits that will work at 0 dBm, and even lower for bipolar mixers. I am sensitive to the need to use monolithic microwave integrated circuits (MMIC). The key parts to keep low power (so they can be left on) are the mixer and local oscillator. I make the assertion that receivers should be on all the time. Yes, putting them to sleep will come up, but I'd rather associate that with registration and deregistration. I do have a few sets of these documents, I will give these to practicing RF designers. There are some conclusions regarding quadrature PSK, two signals occupying the same space. BPSK (binary phase shift key) may also have merit.

I did not do this to three significant figures, the precision is not justified. The following is a skilled guess: 3.5 volts is best for lowest power but more speed is had 5 volts, so the power total may be better at 5 volts.

1st mixer	10 mW
1st LO and buffer amp	20 mW
1st IF amp	20 mW
2nd mixer	20 mW
2nd mixer LO	20 mW
2nd video amp	20 mW

The block parts - gain bandwidth, the older ones understand, tuned circuits rather than video amps will do a less wasteful job. A hallmark is the absence of resistors. The power drain may be 22 mA at 5 V. That is 110 mW.

Given a portable computer battery: 9.6 volts, 2.4 amp hours, about 24000 mW hours - the 110 mW is a small fraction of this.

Ken Biba asks what is the cost of the continuous use of the correlator? Chandos Rypinski answers: I have not done this analysis at this time. The conventional approach gives high power consumption, but this is not the skilled or careful design.

Bruce Tuch comments - for the radio part, you show no preamplifier? Many assumptions are made. Chandos Rypinski answers: (Yes) - this is system design, the system design overall must be carefully tuned. It is a skilled guess. Use of a prescaler? This assumes use of a frequency hopper, but not all of us subscribe to that religion.

Michael Masleid comments that the correlator, implemented on a Sawtek filter, even with insertion loss, is going to draw less power than a super-computer correlator.

Chandos Rypinski comments that the point is to get to baseband without powerdown. [Get to baseband with low power analog circuits that don't need to be powered down. The baseband circuits can be powered on as needed. Sec.]

Not that the resistive FET mixer doesn't draw ANY power. Signetics has a 900 MHz first mixer. It runs at 3.3 mA at 3.X volts. Now this may not work out for 50 MHz bandwidth, but it is an indication. There was an RCA CA39??, a 100 mA design. If you are weighed down with too much knowledge (some that has changed) then you are perhaps in trouble making quick estimates.

Conclusion: You don't want or need to power down the receiver (front end).

13.1c Introduction of contribution by Chandos Rypinski, ***RF Modulation Proposal: Quadrature Double Sideband Reduced Carrier With Two NRZST Baseband Channels.*** September 4, 1991. Document IEEE 802.11/91-98.

Mell Dotz (spelling?) did much of the conceptual work when we were at Collins radio, he had a very deep insight into how these things work, since 1955 most of this has been put into textbooks. Those who say they have found new things may be assumed to not have studied the literature.

I will show some older references on the issue that I am addressing, a 1971 memorandum on Relative Spectral Density for PSK and MSK - MSK is two superimposed PSK. More modern modulations like K and Gaussian shift keyed, fiddle the pulse shape to bring down the out of band frequency components.

There has been enormous effort to take out the (out of band) lobes without producing intersymbol interference (ISI), but that is not the right statement of the problem. One should generate the correct signal in the first place, rather than trying to fix it after the fact.

From Parsippany [January 15th, 1990 meeting. Sec.], the trouble starts with baseband, a bunch of half sine waves with plus or minus excursions. The problem is the discontinuity in the cusps, it is hardly worse had you used square waves. You must remove the discontinuities in the baseband curves. If you just reverse phase between "bubbles" you will get the spurs.

Now the fondness for this (BPSK type signal) is the zero threshold (at the receiver), it is easier to set. There is an attachment to IF strips that are limiters, this avoids the AGC problem - the Pandora's box of problems of fast attach, slow decay, symmetry. . . I want linearity - but it's not the AGC issue - I want the transmitter to be linear. The receiver carries information in the phase, so you may limit it (the signal in the receiver without losing phase information).

Bruce Tuch comments: If the receiver is non linear it will regenerate the spurs. Chandos Rypinski replies: Yes.

There has always been an argument and advocates of constant envelope. If you distort in the receiver you make crosstalk between the I and Q channel. You can, through the interstage, pass higher bandwidths then you would be allowed in any physical media.

If the desired signal is within 20 dB of the lower detectable limit, linearity may be desirable. If the power (at the receiver) is very high, the self induced (due to nonlinearity) distortion may not be important since media impairments (noise and interferers) have been masked.

All the action occurs in the front end (of the transmitter). We design the baseband signal, define it, then say that the transmitter is a linear transducer. We get the mirror image at the transmitter frequency. I think this is all feasible. This becomes the radio system access point and station.

So what is the waveform (baseband) if it is not a half sine?

A narrower band waveform in the first place. Look to a Gaussian shaped pulse - that is not necessarily the best. This is said in the earliest work. The best shape could be argued, but not argued too much.

NRZ is the best at baseband. But NRZ has problems with the DC component and clock recovery. Those problems are fixed with block coding.

The pulse that is necessary (for minimum spectrum - near zero beyond the first zero) is compressed duobinary. [This looks like sin(x)/x, but squeezed more into a triangle. Sec.] This implies partial response - you must deal with bits before and behind the bit being sent.

The duobinary pulse is compressed to 2/3rds time, and offset from zero time. The required shape is shown in figure 4 (of 91-98). Look at combining 7 consecutive pulses: This makes a rather nice flat top symmetrically ringing square wave (page 9). This is done on Mathcad - I will give disks to those who can use them. The transmit waveform can be predistorted so that the eye pattern is optimum at the receiver. This has been built for twisted pair. It is not too grim, a 3.15" x 2.5" circuit board with some surface mount. This was for an NRZST modem in 802.9. The situation was different, financial considerations didn't warrant continuing.

The point though: Fix things at the transmitter. Their you have perfect knowledge of history both ways in time, and can fix the distortions that will follow a priori. For twisted pair, 3 bits of history is enough - an ASIC with 1000 gates did the trick nicely then. If we could do it then, you can do it now. You have to bite the nut sooner or latter. "Do and easy transmitter, then clean up the receiver to distinguish yourself in marketplace" seemed to be the standard philosophy then. I assert that we should do it in the transmitter this time.

[A demonstration of Chandos Rypinski's software is shown on the hotel LCD projector. The display doesn't work out well on the black and white screen, but you can make it out ok. Sec.]

This works a bit more briskly on a '386 with math co processor. The compressed duobinary shows a good eye pattern (fully open). For PR4, the NEC proposal, the maximum opening of the eye pattern is well below signal maximum.

I also take the position that binary modulation is preferred to quadrature.

The meeting breaks, an reconvenes at 10:30, allowing time for the program to run.

Returning to Chandos Rypinski's demo, the (two high) eye pattern for PR4 shows eyes that are open for 1/4 the amplitude of the signal, and 1/4 the bit time. The slicer must be set to less than 1/2 of peak signal. Now, the good place for decision thresholds is zero, not a fraction of signal amplitude. The general observation is: A big eye helps more than bandwidth compression. (The pattern shown is as it comes out of the transmitter.)

Bruce Tuch comments that the use of this in the ISM band is not viable. Chandos Rypinski replies: If there are one watt transmitters on the same premises, of course that is a limitation, but not a preclusion. At 5.9 GHz the interference is less.

[Question is lost.] Chandos Rypinski replies: Yes, mixers with starved oscillators and no AGC can overload.

Yes, 1 Watt is the ISM band limit - but the ISM band per say is not our target. We can change the rules anyway. You may be committed to an immediate product. I am not. It is wrong to ask the committee to take too short a term view.

Constant envelope modulation is still on the table - but some of us believe (differently) on the power issue, perhaps only me and my mother. [Chandos Rypinski supports use of remarkably low transmit power levels.

This lends itself well to linear amplifiers, constant envelope becomes important for non linear amplifiers at higher power. Sec.]

Michael Masleid points out that the public perception of safety is that microwave radiation is bad for you. A system that works at very low power will meet with less hostility.

Chandos Rypinski talks about spectrum allocation of the high UHF television channels: The advisory committee for land mobile services accomplished this (creation of mobile telephone out of the ex-TV channels). I was part of this. There were arguments for how to use the frequency space. I was in trunk systems, if assigned as needed you get better utilization. The counter argument is the Chicago cab drivers - there are 5 or 10 thousand cabs per channel in Chicago - and this is normal. The cabs work the channel. It is never free of interaction - never silent. If the taxi is close enough to base it has the largest signal, the coverage area is interference defined. The manufacturers started selling more powerful transmitters and mobiles - 50 Watt mobiles and 200 Watt base stations, but it just escalates - it is a trap. The game is to figure out how to solve the problem with the least power and least interference, it is not to try to get the largest coverage. You don't put one (100 kW) light bulb in a building.

Make the AP as simple as the light bulb and then put in enough so there are no shadows!

[Some undecipherable comments here, the gist of which is that megabucks are being spent on the development of mobile phone - now. - and that the 900 MHz band has already become unusable. Sec.]

(Power) is a fundamental question. The most basic driver is the cost of the system to the subscriber. Some think reducing the number of access points will reduce the system cost because of their past conditioning on other systems. Minimization of access points is thought to be the key. Actually, with the cordless phone and the regular phone it was the cost of the station that was key to acceptance. More and simpler APs and lower power stations is what will make it succeed economically, and succeed technically. What are you worried about? The key is customer density (remember cellular phone), customers per access point. The pervading philosophy was that the high cost of base stations must be amortized over no customers (so range was maximized). Since then customer density became too high. They had to get rid of the towers, the 100 watt transmitters, the antennas. It was a disaster since the one cell covered the whole city. Are you trying to maximize the number of customers per site? Or get a system in with one AP? The real money is in the first. The second is a short term profit dead end. Do nothing to thwart the one, but also do not thwart the other. (So that you can get your foot in the door.)

Bruce Tuch agrees on station density and power - but in the ISM bands the bad guys will renege, and then it's back to the races.

Chandos Rypinski replies: I have lived long enough to see it change in seven years. If your time frame is one year maybe not - you will retire. I never will.

Question: What are the ground rules, what we are designing for. Chandos Rypinski replies: The art may surprise you. Overload is not as simple as I let on.

Michael Masleid makes a plea, from the point of view of the customer - what is needed is a product that is not obsolete before it is delivered. Please design once, and carefully.

Larry van der Jagt comments that low power is better. The 1 kW interferer will nail the 1 Watt transmitter as quickly as the 100 mW transmitter.

Dave Leeson points out that the ISM band is unique, we can exist with interference. The data PCS, that works against most of the applications. I think that's not in the purview. 10 watts or 1 mW is not so important. We can't outsmart Darwin. Products will supersede us - just as thin wire cable was obsoleted by twisted pair in Ethernet. In racing when the green flag drops the bullshit stops. The flag has dropped. Let's stop arguing about how many angels can dance on the head of a pin. We can't fix the PHY. Lets do the MAC instead. If Darwin gets us, so be it. Lets move ahead, use the current collective genius to get on with it.

Chandos Rypinski finishes: Let's say what is on the table now is what should be on the table - and go for resolution.

14. Ad-hoc groups.

14.1 Ad-hoc group on wireless LAN requirements, Ken Biba presenting:

Develop an integrated set of wireless LAN MAC and PHY requirements, and document them in a living 802.11 document. This set of requirements will be used to guide and evaluate our development of wireless LAN MAC and PHY standards after subsequent review, comment and approval by the complete committee.

The requirement list includes:

MSDU Size Distribution
MSDU Arrival Distribution
Nominal Transfer Delay
Transfer Delay Variance
MSDU Loss Rate
Service Initiation Time
Station Speed
Destination Distribution

Use the Delphi method to come to a reasonable conclusion for these numbers. [Read ***Shock Wave Rider***. Sec.]

This afternoon we will break into ad-hoc groups to work on this.

The ad-hoc group on PHY requirements will be chaired by Larry van der Jagt.

Mil Ovan / Dale Buchholz will do office requirements, timing to get results back by next plenary.

In the questionnaire, address the market size represented. How many stations per year will be shipped? As long as we're doing a Delphi poll lets do it right.

Put the questionnaire on the public forums. James Neeley will send it out to the known IBM world. Put it on the Sun E-mail distribution and on the BBS. Be sure to include your E-mail address.

Leaders for ad-hoc groups on education, meetings, financial, office, medical, industrial, retail, and warehousing, are sorted out: Dick Allen, Simon Black, Dr. K. S. Natarajan, Dale Buchholz, Roger Pandanda, James Geier among others.

Wednesday, September 11, 1991, Afternoon

The meeting resumes at 1:28 PM with discussion of the service definition of FPLMTS lead by Chandos Rypinski.

See ***Preliminary Draft Recommendation FPLMTS.SRVC (Rev 3) Services Supported on Future Public Land Mobile Telecommunication Systems (FPLMTS) (Question 39/8)*** Document 8-1/50-E, IEEE 802.11/91-105, and the new document: ***Modifications to Report 1153 on "Future Public Land Mobile Telecommunication Systems" (Question 39/8)*** - Document US TG 8/1-nn, IEEE 802.11/91-106, which gives the real meat of our discussion relative to FPLMTS, in which a frequency block might be allocated for personal services, and may include telephones and hopefully computers.

Document 91-105 is the entire services recommendation section as it is going into the report, or at least what it will be based on. We at least have the R5 interface which looks like a radio LAN thing.

It is proposed that 802.11 (represented by Dick Allen and Vic Hayes) attend the UK and Dallas meetings regarding the services definition drafting of FPLMTS. Assuming attendance, what is their mission?

I now propose for examination at this meeting doc 106, carried to Washington by Bill Stevens (and myself). We attended the meeting of TG 8/1 at Washington in the offices of Motorola. In that context we put this document 8-1/50-E for consideration. To provide for the high speed networking needs of portable computer users. I (Chandos Rypinski) recommend that we authorize our representatives (to CCIR) (Vic Hayes and Richard Allen) to recommend to the editing committee (of the CCIR Services Document) to add the words as described: (provide for the high ... computer users.)

The motion by Chandos Rypinski, seconded by Dick Allen:

That the representatives of 802.11 standards working group be authorized to participate in the editing meetings on document 8-1/50-E and to recommend that the text changes in 802.11/91-106 be made and that the ISO/IEC participation be reflected in the output 8-1/50-E document.

This passes: 23-0-0

Does this need to be ratified by the plenary meeting? Victor Hayes answers: It is of this meeting.

Introduction of contribution by Jan Kruys, presented by Bruce Tuch, ***DECT and LAN use, an Analysis.*** September, 1991. Document IEEE 802.11/91-104.

Our conclusion is that a radio LAN is a stochastic process as a rule. The DECT allocation does not work because of the set up time (of the connection oriented service). In summary, DECT is not necessarily useful to this forum.

The DECT seems fuzzy, we have one person working full time trying to get it unfuzzy.

The protocol of DECT doesn't support our service so we propose that the 30 MHz earmarked for DECT should instead be used for RLAN.

The history of connection oriented service is the telephone. It is correct for that, the set up and release time is insignificant compared to the length of the connection time itself - the whole phone call.

Now - a asynchronous (packet) that is shared can carry voice efficiently if you observe that voice is bursty. The channel can be used for something else during voice pauses.

Dr. Rifaat Dayem asks: What is your feeling on getting the 30 MHz? Bruce Tuch answers: I don't know, but DECT doesn't meet radio LAN needs. there is an ad-hoc group in RES 3 that notes the limitations.

Simon Black points out that it is a commendable analysis but not the whole of the issue. I could present a reply but this is not the correct forum. There is a joint meeting in Cambridge RES 3N and RES RLAN, the ETSI ad-hoc group meets October 17th to consider such comments.

Dr. Rifaat Dayem asks: Do radio LANs need additional spectrum? Answers: If data is to be as successful as voice more spectrum is of course needed. No, just be sure comments in the public enquiry get placed constructively.

It is time now (2:00 PM) to form the ad-hoc groups. The ad-hoc groups may work till midnight. . . The meeting adjourns for 8:30 tomorrow.

Thursday, September 12, 1991, Morning

The meeting resumes at 8:47 AM. The attendance list is distributed.

16. Tentative Meeting Schedule

Date	Month	Year	Place	Type	Location
11-15	November	1991	Fort Lauderdale, FL	Plenary	Embassy Suites
13-16	January	1992	Rayleigh, NC (IBM)	Interim	TBD
9-13	March	1992	Irvine, CA	Plenary	Irvine Marriot Hotel
11-14	May	1992	Netherlands (NCR)	Interim	
6-10	July	1992	Minnesota	Plenary	TBD
14-17	September	1992	TBD	Interim	
9-13	November	1992	La Jolla, CA	Plenary	Hyatt Regency Hotel
TBD	January	1993	TBD	Interim	TBD
8-12	March	1993	?New Orleans/Hilton Head?	Plenary	
TBD	May	1993	Baltimore area (Ship Star)	Interim	
12-16	July	1993	Denver, CO?/Kauai, HI?	Plenary	Sheraton Denver Tech Center
TBD	September	1993	TBD	Interim	Sheraton Denver Tech Center
9-13	November	1993	Ft. Lauderdale, FL	Plenary	Embassy Suites

The May 11-14 1992 meeting (sponsored by AT&T) may be near (but not in) New York City. - or (sponsored by NCR) the Netherlands. This is very important for our work in Europe, since we are perceived there as an American only standards group. Michael Masleid argues that it would be well to distance ourselves from the current recession before scheduling meetings outside the US. The rebuttal is that it needs to be done soon since the rapid work in WARC, CCIR, CEPT, and regulatory agencies on spectrum allocation.

The May 1993 meeting is planed for the Baltimore area - snow is possible, but it would not be difficult to get around, it would be damp, not frozen. Bob Crowder is in Europe at the Field Buss meeting at the moment, however.

Hawaii is rejected for the July 1993 meeting: It is a good place to play but not to work.

16.1 Confirmation of Ft. Lauderdale, Florida meeting.

The November 11-15th meeting is in Ft. Lauderdale, Florida. Vic Hayes shipped the venue in the last mailing. If you have not received it get in touch with Victor Hayes.

16.2 Objectives for the Ft. Lauderdale meeting.

To establish the WLAN Requirements (closure vote).

To establish the design goals.

Chandos Rypinski obtains the floor: I am anxious to have a mechanism to begin closure on the access method. A proposal for candidate mechanism, with a mechanism for closure on acceptance of new candidates.

[This begins a complex discussion. No apology for the mess - it is important to capture the ideas so that someday they will be dealt with. Sec.]

What about Ken Biba's schedule? The November meeting will be dealing with architectural (MAC services?).

Larry van der Jagt asks: What about the design goals? Why go through another round of debate of design goals, we should accept nominations for complete solutions, look to the end, not the beginning again.

Ken Biba: We should leap to the architectural discussion, the design goals are implicit in the market, the system requirements.

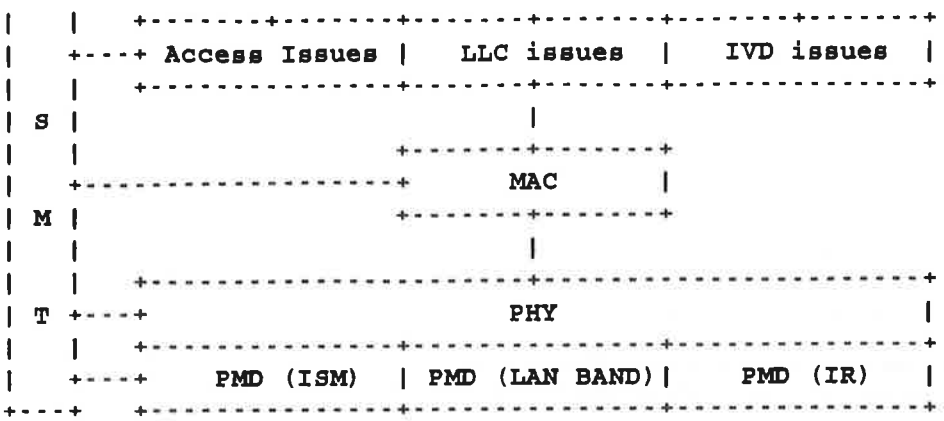
Jim Neeley: We should have a system design. This calls for a functional decomposition.

Chandos Rypinski: Those who have candidates to nominate should do the decomposition. The committee as a whole should judge the effectiveness of the candidate proposal based on the break down.

Ken Biba: It is natural to break to subgroups. Natural subgroups are suggested, and the interactions with 802.1 and 802.2.

Jim Neeley agrees with Chandos and Ken, the next round of papers on architectural should provide the breakouts.

Lay out the proposal architectural into the four major work items, the MAC Service (upper layer) interface, the MAC, the PHY, and the SMT side layer. SMT is station management, that may go to 802.1 [YES BUT - the managed objects are YOURS. Sec.]



There have been some rather hysterical statements in the magazines about health related issues that have little solid foundation. We would like to help them understand what it is that we have here, and have them tell us their concerns and fears.

Lets accept proposals broken out into the FDDI II architectural model to avoid paradigm shifting.

Ken Biba comments: I would like simulation results or experimental results as to how the proposal works to help evaluate the proposals. I encourage people who have done systems to disclose their results.

Chandos Rypinski: That is a sensitive subject before a draft standard (exists). Acceptance of a nomination (for consideration by the committee) may be the trigger for experimentation.

Ken Biba agrees, experimental results are not required for nomination.

Bruce Tuch comments: We have done experimental work in the past regarding 802.4L, and are willing to bring that to the table - but I don't want to turn it into a selling game with boxing gloves. I don't want to be doing a sell job here anyway. It is dangerous territory!

Jim Neeley comments that simulations are useful to discussions of MAC proposals, experimental results based on the current RF environment will not be useful for evaluation of the MAC layer by the time we adopt the isochronous MAC function. I agree that at this stage we can do the PMD functions in the ISM band - but we must be careful that we don't look at those in an isolated contemporary environment. We must not do it in an anechoic chamber.

Victor Hayes argues that a bottom up approach to architectural is a danger. [There is some discussion about the chair speaking out of turn in the queue? Sec.] James Neeley believes that the chairman has discretion in how he wishes to achieve his goal - delivery of the standard. [Not all present will give carte blanche on how to achieve that goal to the chairman. Sec.]

Ken Biba argues that decoupled analysis is not productive. Analysis must be in the context of all layers.

Michael Masleid argues that development, particularly of new things, is interactive, using top down, bottom up, critical element, big picture, - whatever it takes to move iteratively to the goal.

Peter Cripps favors interactive development.

Larry van der Jagt moves, second by Chandos Rypinski, that:

(We) Accept nominations as complete solutions based on the MAC-PHY-SMT model, as apposed to working on the MAC-PHY-SMT model in abstract.

Discussion

Richard Allen feels that this places a burden on a proposer of just a PHY to design the whole system - that is ungood.

Bruce Tuch believes that if the proposal is only for the PHY, you can give it. Larry van der Jagt says you can do it, but not as a nomination to the standard, only in support of work moving to standard.

Clarification? Are we talking only about and architectural with three PHYs (or PMDs?), we can't work that out. Larry van der Jagt says it is complete if it makes a whole (includes at least one MAC-PHY-SMT).

Nathan Silberman what is a complete, concrete solution? We need to have a frame work. (Without that) how can we go for the target? Go for strawman proposals.

Dave Bagby comments: I understand the desire for details. A wise presenter will give it (details, however), I am against the proposal. It (the motion) asks for value judgement. How do you know it is complete, what defines complete - (for instance,) here's mine - can we accept it? The purpose is to develop the standard, it is not to introduce single quantum. [Atomic - indivisible proposals. Sec.] Is this a power play? I urgently suggest that we vote against it.

Jim Neeley agrees that we should vote against the motion since it is too much work, we (only) need the shell of an architecture so that we can define the interfaces between the boxes on the picture.

Michael Masleid supports the motion: The work should be complete in the sense of addressing the model - but these proposals and models should not be the only front (line of attack) that we must work from.

Dr. Kwang-Cheng Chen agrees with the motion. Complete? - no, we have a box that works, but need to understand it more. It's ok if anyone has a complete solution, but just a system demo (of a working unit) will not accomplish a lot. There are so many things not well defined, each (of us) has something in mind - if nothing is defined clearly we are in a dangerous position.

Dave Leeson comments that a direction without a way to judge it is not good. I am against this motion, rather, we should do the foundation, then build on it - and if the foundation is wrong to bad. Live with it.

There is only one characteristic of PHY radio that is characteristic: The "i j" probabilities. P(ij) is not one. (P(ij) taken as the probability of communication success given emission). What are the characteristics of radio and infrared that are fundamental. (Once this is firmly established), then (we can deal with) how do we do the MAC.

I like the PHY definitions that Michael Masleid and Larry van der Jagt did yesterday better, that is the PHY that we will build the standard upon.

Build from bottom (PHY) up.

Chandos Rypinski responding to Dave Leeson: There are linkages between MAC and PHY. To Dave Bagby: There is no way to do a power play here - a 75% vote is required - with no unresolved NO votes. With a group this large only logic, reason, and persuasion works. I have watched big companies try to use bigness, but it always or nearly always doesn't work. It isn't the intent (of the motion). The nomination is not a decision, it is a starting point. It is easier to iterate from a starting point than a non starting point. Non would propose that that does not have broad appeal, (yet) must go with the preponderance of opinion. Each will pick from the concepts now on the floor to go for a consistent whole. We may change the motion to allow "partial" solutions, a nomination is not a standard, just a proposal, a starting point - but things must be well enough described to be understood and analyzed. Anything that comes in close will be iterated. I am for the motion.

Larry van der Jagt: I agree with much of Chandos Rypinski's comments, any one who has been in standards for a while knows you don't ramrod. Yes, someday we will vote to close the nominations. Someday we will settle, but don't dream it is some time in September or November. Regarding the role of chairman - I think he is a facilitator. Regarding an isolated PHY - it does us little good, it needs to address a consistent MAC.

Michael Masleid contrasts real proposals and abstract constructs. A real proposal can be decomposed into its abstract elements, shedding light on possible ways of building the abstract construct. This can give us needed insight on where functions should be put in the model, where the interfaces should be, and what must go across them.

Ken Biba comments that working on high layer interactions independent of MAC-PHY interaction turns out to be extraordinarily difficult. The success at Service depends much on optimism about the success at the PHY layer. [Success of transmission - the P(ij). Sec.] Independent consideration is fruitless.

Ken Biba: What does the PHY service export to the MAC? One of the keys (to knowing this) is how good is the media. How much can I trust local information? If the probability of success is high it leads to distributed networks , if low then centralized control follows. We need to know what is true in our case.

Ken Biba: I don't necessarily agree with wording of motion, but agree to simultaneous consideration

Dr. Tony Shober: I yearn for what Larry van der Jagt yearns for philosophically, but the wording of motion concerns me.

The breakup of group into parts (MAC, PHY. . .) in Worchester was shouted down. Ken Biba has a very good point. there should be a common MAC. [People voted in favor of that with one interesting exception. SEC.] I want the committee to specifically structure how it goes about accomplishing its task. The lack of " " may thus be explained. I fear the motion. It is well intended. I agree the philosophy. - but the 2nd and 3rd quarter mile are being left out. I am against the motion, but it is a tough call.

Bruce Tuch: I have a problem, though philosophically I agree. Dave Leeson's P(ij) is still assuming a definition of the PHY, but where is the line between MAC and PHY? What are really the MAC and PHY functions? You must define your expectations. If one PHY solves the problems, the MAC is simple, otherwise, the PHY is simple and the MAC is not. The isolated solutions need to be put together. We really need to understand (the whole picture). But we shouldn't knock out other contributions. The PHY enhanced to look like wire is different from the naked PHY.

Dick Allen: I am apposed to the motion as written, but proposals need enough in them to evaluate. Someone who has worked with a particular medium may have a MAC that works, but is not optimum. Don't do the PHY for lack of finished MAC? Should they be ignored?

James Neeley: It is my intent to vote NO. - reasons: I can't create a proposal in time and so I am intimidated from contribution. We need to know the interaction between MAC and PHY in detail. Yes. We need to be able to break into groups eventually. This motion, though, prejudges a contribution. Who is qualified to judge (completeness)? What we should discuss is that which allows us to divide the work.

The meeting breaks at 10:33 AM, and resumes at 11:00 AM.

Larry van der Jagt: My intent was to underscore the class on contributions called nominations, the starting line of the second and third quarter miles. It does not mean that there will not be other things coming in, or other processes, but at some point perhaps long in the future nominations will be closed and we will move on to a standard. I would like to withdraw the motion at the chairmans discretion.

Chandos Rypinski: Can we get on to the question?

Dave Bagby: I understand the intent, but am against the motion. I call the question, second by Jim Neeley.

On calling the question 16-0-0. On the questions 2-12-2. The motion to "**Accept nominations as complete solutions based on the MAC-PHY-SMT model, as apposed to working on the MAC-PHY-SMT model in abstract.**" fails.

Chandos Rypinski comments: We have been working on piecemeal solutions. Having seen it in other committees. . . Having seen it in other committees I see that issues are too interlocked here for the approach to be successful. The areas of interlock are the reliability of the radio media, which is subjective, it depends on context and experience. There is a trade-off between logical (digital) and analog tools, some of the logical tools are in the MAC, for instance ACK is in the MAC. Another thing that causes interaction,: the MAC in the general case is more complex and has more baggage than is needed for spontaneous (ad-hoc network) groups. So for some thing the general MAC is more elaborate. Maybe.

Jim Neeley points out that there are existing networks. There is source routing, spanning tree algorithms, NOVEL netware, - we must meet these with no skinning places (poor fits). This may result in exclusion of something far down the pike.

Chandos Rypinski observes that those who work - or can work do have an advantage. I now show some instructive motions, but do not place them on the table now.

[Paraphrased. Sec.]

Proposal for a nomination plan with specified closing date necessary for a proposal to become a candidate for adoption by 802.11:

All the essential structural definitions of a possible basis for the Standard be defined and nominated by a sponsor by the time specified below -

Nominations require 25% approval.

The form of the nomination, say for the sequentially used single channel high rate system plan shall include key points. Say RF modulation type, rate, bandwidth, access method, distribution strategy, service definitions.

I see this as a productive way of making constructive progress at getting on with the process.

We may proceed with pieces parts, or combine for viable solutions. The combine and iterate method is productive.

Dave Bagby, expressing despair regarding procedure: We don't follow it. [We have adopted new procedures at almost every meeting. - perhaps we have not found one that is productive. Sec.]

Dr. Tony Shober: The method changes from meeting to meeting? The way Chandos Rypinski proposes we do it has us picking from nominees. Dave Bagby says we should develop (from foundations, from issues). I thought we develop, not chose. What is the relationship?

Dale Buchholz points out that there is an informal way of taking contributions to form a synergistic synthesis. It is productive.

Larry van der Jagt: By forcing nominations, we can make some of them go away.

Chandos Rypinski replies: I think Dale has described 802.9. In 802.6 the multiplex of Dan Z (spelling?) and the DQDB of the Australians was a famous vote. The committee had to choose. It happens. There is here the concepts of market and . . . - some are cost sensitive. The group can design a standard, but not one that is ambivalent to fundamental assumptions. - for instance the enterprise wide and the spontaneous group dichotomy. I rather guess that the competition is not on fine points.

Dave Bagby: It is a matter of the cart and horse. We have different views as to what nominations may imply. This is in the purview of the chair.

Peter Cripps: Perhaps we can call these nominations contributions that latter coalesce into formal nominations.

Returning to the agenda item: Objectives for the Ft. Lauderdale meeting.

To receive contributions for architectural proposals breaking into for example PHY, MAC, SMT and MAC Service interface. Implemented proposals will be entertained.

To establish a procedure for. . .

Dave Bagby comments: Yet another procedure? Our past history has not been good. Victor Hayes apologizes for the ibis list. . . [In the sense that the officers did not pursue this approach with more fanaticism. Sec.]

Larry van der Jagt: When we have an effective procedure we will use it. You can't ramrod a procedure any more than you can a standard.

Vic Hayes wishes to open the issue of procedure for operation at the next meeting.

Nathan Silberman believes that procedures are too confining: I am afraid they limit freedom of creativity. We need to achieve, to establish a road map for achieving our goal.

16.3 Last Mailing Date.

The last mailing date is October 14, 1991. Contributions must be in my office at that date so they can go to printer and stuffer.

16.4 Any other intermediate meetings needed?

Do we need and additional intermediate meeting? A pre-meeting Sunday, so that Ken Biba can edit or something? Ken offers a suggestion: Following up on related thoughts, we have the ad-hoc group that is largely MAC services, it would be useful to also have the PHY experience, lets form an ad-hoc for the sanitized experience on the PHYs. It would be nice to have that too at the next meeting. Lets form such another committee, invite some who have measures to contribute to join, so we may work to. . . - call it a correspondence group?

Dale Buchholz comments that it could be a very useful exercise. We could go for a Monday meeting.

Nathan Silberman, Dale Buchholz, volunteers, get your addresses to Ken Biba. Plan for a consolidation meeting Monday at Ft Lauderdale? The E-mailer is too broad. Use E-mail just between interested parties so that it can be sanitized before Ken Biba leads the consolidation meeting Monday morning.

16.5 Confirmation of the January meeting.

James Neeley reports on the upcoming January meeting. The hotel rate is good, in the Duram Chapel Hill suburban area, there are walk in restaurants within mile walk. The hotel has offered free transportation to the airport. If there are 50 or more people registered the meeting room is free, but it is a separate contract for the audio visual and copying Monday through Thursday 8.30 to 5 each day.

Break for lunch, 11:43 AM, returning 1:28 PM. It is decided not to accommodate those people with early flights home by working through lunch. Many other people have scheduled "Red Eye" flights to accommodate the published meeting schedule. We will have lost 4 people.

Thursday, September 12, 1991, Afternoon.

15. Ad-hoc group reports.

[Note: The following is constructed from an open loop (I don't often look at what I type) transcript from presentations and slides done on the fly (real time). While this is reasonably accurate for discourse, which is highly redundant, it is not accurate for numbers. Unlike the presentations above, I have no way to cross check these numbers - I don't have the source documents. Look on these numbers with some suspicion. Sec.]

Ken Biba reports that not all groups are ready, preliminary results as follows:

Education - Dick Allen

There are two types of environments. The class room and the campus internet. The campus is defined by and area 3 miles by 3 miles square.

The classroom seems to be the worst case, with transfer of large files from a server to several stations in the room. Anticipate 1 M byte broadcasts, using perhaps the IBM retry only of bad packets as shown on the video presented by Dr. K. S. Natarajan.

The MSDUs on internet are bimodal, 40% large, 60% small. In the classroom expect 90% large, 10% small - but that needs more Delphi work.

Speeds will be 8 miles per hour for stations on internet, 4 miles per hour for stations at class.

Connections will be 20% local (within the access point), 80% off local for internet. In the class room the order is reversed - 80% of the traffic is local to the AP in class.

The number of stations is 5,000 on the internet, 200 in range of a single access point in the class room. Station density is 2 stations per hectare (100 meters x 100 meters), and 2,200 per hectare in the classroom. This is a bit overstated for internet, since it is probably not a uniform distribution.

Financial

Many things were discussed. The financial market is largely the office market - so we concentrated instead on that which is unique - the trading environment: The CBOT.

They download, once a day. Then it is all transaction processing. It is not real time. There are 100,000 transactions per day. Each trader only 5% of the time, but almost always all are busy at once. For them 2 to 5 second turn around is instantaneous, since now it is done on 15 minute intervals. This is not at the wish of the traders - the FTC wants it done to tidy it up. The traders drop there transactions on the floor, runners pick them up.

Privacy is important but not critical, but there must not be a mistake in the data, authenticity is important but not vital because of the double check of buyer and seller. Fairness means equal degradation, no one may hog the channel. The order for trades must by timely and FAIR.

Data flow is all one way, from the handheld unit to the backbone. (A 1 pound handheld unit is shown.) What about immunity to jamming? It must have access to order trades. It must connect to exiting infrastructure, 802.5 and 802.3 are most common. Entry is pen based. Density is 40 people per 100 square feet. Units must be used while held over the head. - no short people.

The handheld unit must have rounded edges so as not to easily injure others. Rubber duckies (protruding antenna) are out. You may have to be able to address 4,000 people on the floor.

Chandos Rypinski asks what is the ceiling height? Answer: 45 feet. Downward pointing antenna may be practical.

Wireless is obviously the only solution, but power is very important. 8 hours on time is mandatory.

Dale Buchholz asks what is the size of the market? Answer: In terms of sockets? 1,000 per exchange - a total of 20,000 points. According to Ken Biba 40,000 units is the total world market - London, Tokyo. The Russians may become part of this if we convince them that traders are useful.

Office - Dale Buchholz

This is presented as a two page slide, and includes applications like CAD/CAM, real time voice, NOVEL Netware, TCP/IP, NFS, Apple Talk, LAN manager, SNA, DECNET (which has strange stuff embedded in it - LAT, MOP, and ELN). There are modem sharing devices, portable telephones and the stationary population.

Small to large in offices is hard to define. There are two extremes - bimodal? The average is 12. The range is 1 to 200. A caution - this is a historical number that future applications may change.

Density, for the oriental market is 30 to 40 square feet per person, a table, computer, phone, and chair per person. This is like our telemarketing. [The travel reservation company Rosenbluth for instance. SEC]

The WIN data has large offices at 25,000 sq feet.

What about moving? It is movable - work - move - work. - quasi stationary. That is different from phone. The walking terminal is more of an inventory thing - it is hard to walk and type at the same time. The environment itself is moving however, since there are people walking through it. - and if you start news, or e-mail, or print a document, it may not be done, but you may be moving: File transfer in motion.

For file access, MSDU distribution is bimodal, 60% are 80 octets, 40% are 600 octets, but growing. Throughput is media limited, duty cycle is 1%, delay is 2 msec..

Compared to video in the classroom environment, molecular design or view graphs - the office is not that much different. We have loosened up the error rates for voice and video: 1% for voice, 3% for video (one frame per second).

Seamless portability in relation to 802.3 and 802.5 and other office networks is required.

Ken Biba comments that there seems to be several classes of service, a partitioning.

Chandos Rypinski comments that traffic per station would e nice to know. Can you add a row to the slide, is there a way to come at that?

Dale Buchholz continues: There is a need for broadcast, E-mail, and distant database update, and real time voice, and video for teleconferencing and paging.

There are applications for security, - wearing a video monitor. It would be mice for the security guard to be able to look at his monitor board.

Maintenance of network connections as you move is important. If you are logged into a network connection, and you walk through and uncovered area, do you get back into your session?

The market size is HUGE, 6 million units per year maybe.

Medical - Roger Pandanda

I want to go back in quiet to review and form the description and framework.

PHY - Larry van der Jagt

What are the commons in several bands, infra-red, ISM, and 60 GHz? This is not to be considered the final output, opinions will be purged. [The presentation was done with LCD projection using the same computer recording minutes, which is a bit awkward. I include parts of the presentation that may be controversial, but are not a matter of opinion. Remember that this is not final output. Sec.]

The physical media over which the 802.11 MAC must operate is a broadcast media with properties that are somewhat different than those found in the traditional coax cable broadcast media. These differences impact the functional requirements for the IEEE 802.11 MAC. In particular the MAC must be designed taking into account the following characteristics of the PHY medium:

If a station transmits it can make no assumption that any station will detect anything.

If a station detects energy in band it can not assume that any station is transmitting.

Variable latency is a characteristic of this PHY and medium. There are different latency elements such as propagation time, presence of signal detection time, time to recover data, turn around time of tx/rx.

Signal strength is not a reliable indication of geographical position relative to the transmitter

Signal strength is not a reliable indication of signal quality.

Signal to Interference ratio at one station is not an indication of Signal to Interference ratio at another station.

Reciprocity is violated. If station A can talk to B, it is possible that B can not talk to A. Michael Masleid explains: This is true from the point of view of electromagnetics, due to drive point impedance - reciprocity has something to do with transconductance, not whip antennas in near field. - But that is not important, be it true or false. A simple example: If there is an interferer near B, it can prevent B from hearing A, and yet B can talk to A without impairment.

Will there be any discussion of separate of PMDs? Larry van der Jagt answers: I am not trying to do that. just give what is known true about the PHY.

Length of packets that PHY must transmit impacts loss rate, longer packets more likely to be lost.

Industrial - Tom Siep

We have also ignored the office applications, this then is a distillation of what is left.

File transfer: 1 M byte (downloads). Computer Aided Manufacturing at 500 octets per second, assuming a smart local entity, else if dumping full images then video bandwidth is required.

Loss is acceptable, but not more than one in a row. All flow seems to be to a backbone (unless there is a man with the mobile station).

There is a lot of noise (not mere EMI - some of it is computer killing).

There have always been LANs (predating 802), but not what you are used to. They have been used for control system. Larry van der Jagt points out that they are very good.

Platforms are somewhat mobile, handheld, arm held, machine mounted. (Sometimes big machines.)

Populations of 1 to 1500, with clusters of 32. (Work cells, for instance.)

Security and privacy are not as much of a thing, since everything is owned by the company. Buildings may be 1/2 mile long.

As with financial, wireless is only solution.

Most of the data is time critical. Some types of packets must be destroyed if delayed, other types must be preserved.

At an automobile plant there will be 2000 AGVs per building, 1/4 million per year. The other area of application is smart systems - the transducers, field buss applications. [The number of transducers is unthinkable, there are tens to hundreds per computer, and the wiring is very expensive. Sec.]

For AGVs and such things, the price per node and power is not important. - Knock you dead power for the mobile machines.

Warehouse - Ken Biba

The warehouse has modest sized MSDUs. Velocity to 30 km/hour - a forklift. Size and density is variable.

The environment is harsh, sometimes with airborne contaminants.

There is no general agreement on voice, some think that intercom is important.

Dick Allen comments that this is just as it is in the office - we speak about the applications that we understand, but the new ones? Multimedia? The future requirements? If we are done with the Standard in '93 and obsolete in '95 we have failed.

Ken Biba thanks all those involved.

Roger Pandanda asks: How many are interested in multimedia - can we form a group for this by next meeting? Richard Allen volunteers. Collect data by E-mail. Use Richard Allen as a common E-mail box.

17. Review of document list

Document 91-107 is the attendance list.

Can we have a list of names and E-mail addresses, it would be more compact?

Victor Hayes: I will try sending the agenda by E-mail, but please acknowledge to ensure the channel is ok. I will also distribute the alias file.

18. Other business

Mike Cheponis reports that the Hams, Amateur Radio Relay League, ARRL is meeting in San Jose, Friday, the 27 and 29 of September. After 10 years of this it is possible that their work and ours may be fertile ground to mix. Saturday is presentation of papers and diner in the evening. Sunday will show equipment, packet satellite and DCP. There is a $40 dollar charge. Friday is tutorials on packet satellite and DSP, spread spectrum Amateur, - 100 Watts in the ISM bands. **The Hams can run 100 watt Spread Spectrum in the ISM bands.!**

There will be a lot of high level technical discussions, the Hams do MAN, rather than LANs, but the knowledge may be transferable.

19. Closure

Thanks for the contributions. Ken Biba for his work, Michael of course, and Jim Neeley, and our host, Bill Stevens (as a token, bulbs from Holland). I wish all a safe trip home, the meeting is closed 2:51 PM.

20. Notes and Action items

20.1 Notes

The Pan-Asian Telecommunications Summit is meeting at the Marina Mandarin Hotel, Singapore, December 2-4, 1991.

Some of the speakers are Dr. Theodor Irmer, director, CCITT, Switzerland; the Director, international Cooperation Division and Communications Policy Bureau, Ministry of Posts and Telecommunications, Japan; Arthur Dunkel, the director general, General Agreement on Tariffs and Trade, (GATT) Switzerland.

20.2 Action items

Ralph Manfredo at California Microwave (1 408 720 6216) needs a list of members and access priority for the BBS. (Victor Hayes)

Put the instructions for obtaining the archives from Alpha Graphics onto the BBS.

Dr. Rifaat Dayem needs an update of the required coordinations as shown in the PAR. Note ECMA TC32. (Victor Hayes)

Chandos Rypinski will study source routing and spanning tree for the January meeting, he has access to people who have the knowledge to do this. (Chandos Rypinski)

There have been some rather hysterical statements in the magazines about health related issues that have little solid foundation. We would like to help them understand what it is that we have here, and have them tell us their concerns and fears. (Ad-hoc group?)

Appendix 1
Attendance list

Mr. RICHARD C. ALLEN	Apple Computer Inc	+1 408 974 2880
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Mr. TIM BLANEY	Texas Microsystems Inc	+1 408 446 9202
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Mr. CHARLES BRILL	AMP Inc	+1 717 561 6198
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Appendix 1
Attendance list (continuation)

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Chairman Standards Working Group
IEEE P802.11. Wireless LANs

Appendix 2
Document list

IEEE P802.11/91-91	Wireless Local Area Network Requirements: Office applications (Ken Biba)
IEEE P802.11/91-92	A Hybrid Wireless MAC Protocol Supporting Synchronous and Asynchronous MSDU Delivery Services (Ken Biba)
IEEE P802.11/91-93	Proposed Liaison statement to T1P1 (Rifaat Dayem)
IEEE P802.11/91-94	Selection basis for architectural, Modulation, Channelization and frequency reuse methods (Chandos Rypinski, LACE)
IEEE P802.11/91-95	Sequentially-used common channel access method (Chandos Rypinski, LACE)
IEEE P802.11/91-96	Access Method for Channelized System using distributed logic not requiring infra structure (Chandos Rypinski, LACE)
IEEE P802.11/91-97	Channelized System Access Method using infrastructure control (Chandos Rypinski, LACE)
IEEE P802.11/91-98	RF Modulation proposal: Quadrature double sideband reduced carrier with NRZST Baseband channels (Chandos Rypinski, LACE)
IEEE P802.11/91-99	Power drain considerations for full time and sleep mode radio receivers (Chandos Rypinski, LACE)
IEEE P802.11/91-100	Bandwidth and capture using the Multiray Model (Michael Masleid)
IEEE P802.11/91-101	Meetings ad-hoc group Initial report (Rick Albrow, Symbionix))
IEEE P802.11/91-102	Battery efficient operation of radio MAC protocol (K.S. Natarajan and Chia-Chi Huang)
IEEE P802.11/91-103	Wireless Market Observations (Robert Rosenbaum, WIN Data)
IEEE P802.11/91-104	DECT and LAN use, an Analysis (Jan Kruys, NCR)
IEEE P802.11/91-105	Preliminary Draft Recommendations: Services on Future Public Land Mobile Telecommunication Systems (FPLMTS) (CCIR 8-1/50)
IEEE P802.11/91-106	Contributions from USA to FPLMTS
IEEE P802.11/91-107	Tentative minutes of the September 1991 meeting