Tentative Minutes of the IEEE P802.11 Working Group

Plenary Meeting
La Jolla, CA
November 12-16, 1990

Monday, November 12, 1990

The meeting was called to order at 3:45 PM, Vic Hayes, acting chairman IEEE P802.11, being in the chair. Thirty-five (35) people were present, the total attendance for the Monday afternoon meeting was forty-five (45).

1. Opening

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

1.2 Voting rights: Voting rights are obtained in 802.11 by attending two plenary meeting out of 4 consecutive plenary meetings, rights are granted at the third meeting. One interim meeting may replace one of the required plenary meetings. The Oshawa meeting was the first officially announced meeting of 802.11 and those participating (at least 75% attendance) there obtained membership. Because that was interim meeting, the chairman grants charter membership to any who have attended 75% of this first plenary meeting of 802.11.

1.3 The attendance list was distributed. The chairman drew attention to the obligation to register for the meetings.

1.4 Logistics. Meetings start at 8:30 each day. Breaks are normally at 10:30 a.m. and 3:00 p.m. Lunch break is flexible, normally started between 12 and 1 pm and lasting for 1.5 hours.

2. Approval of the minutes of the previous meeting

2.1 Approval of the minutes of the Oshawa meeting, Document IEEE P802.11/90-10.

Alan Flatman commended the detail of the minutes, but asked that Christian and surname be include until we get to know each other better.

In response to Bob Crowder's query: We affirm that we only approve the accurate reporting of statements and events, not the accuracy of the technical content.

Since there was no objection, ***the minutes were approved by general consent***.

2.2 Matters arising from the minutes.

Dave Buchholz pointed out that use of classes within a PHY was supported by only a simple majority, not the needed 75% of votes for and against; therefore this remains a preferred but open issue.

3. Report from the executive committee.

The chairman reported the following subjects of interest to 802.11:

Problems with the press release procedure within IEEE have been correct to reduce latency time and to widen distribution. Attention was drawn to the requirement that any official press release must be with the approval of the executive committee. You may express a personal opinion to the press, but you can not presume to represent the committee.

The executive committee is also working on revision to the operating rules and the functional requirements. The executive committee is preparing a negative vote with comments on MAC Service as defined in ISO 10039 for review Thursday at 8 a.m..

We have requested input from the executive committee on our PAR so that we can respond to their position.

Tutorials Tuesday on management information in 802 layer standards, and on Token Tree MAC were recommended to the interest of 802.11.

We must consider creating a liaison to 802.1, bridging and routers. We must be aware of decisions being made there on subgroup management, bridging, and managed objects. Later, Jim Neeley and Paul Eastman were appointed as liaison.

4. Confirmation of officers elected at Oshawa meeting.

4.1 Confirmation of the chairman. Vic Hayes yielded the chair to Jim Neeley.

Chandos Rypinski ***moved*** **to confirm the election of Vic Hayes as chair of 802.11.** Seconded by Dave Buchholz.

Comments: Chandos - "Vic Hayes has worked hard skillfully and with some insight, it would be hard to find one better. I commend him to you."

Jim Neeley - "As a corporate archrival of NCR I also recommend him."

Vic Hayes was affirmed as chairman. (39, 0, 0)

4.2 - 4.4 Confirmation of the vice chairman, secretary and editors Vic Hayes assumed the chair.

Paul Eastman ***moved*** **to confirm the election of the remaining officers at the Oshawa meeting: Jim Neeley as vice chair, Michael Masleid as secretary, and Michael Masleid, Jonathon Cheah, and Chandos Rypinski as editors.** Seconded by Nathan Silberman. (38, 0, 0) ***passed unanimously.***

5. Registration of contributions:

Chandos Rypinski registered a paper (11/LJ/2) titled "Wireless System Architecture, major choices and considerations" on the topic IEEE 802.11 802 LAN Access Method for Wireless Physical Medium.

Vic Hayes requests more use of submissions so that the meeting direction can be driven by the submissions.

6. Adoption of the agenda.

In agenda item 12 the NIST identification for the January 7-11, 1991 Gaithersburg, Maryland interim meeting was changed to the Compri Hotel.

Rick Albrow will report on what ETSI (the European Telecommunications Standard Institute) is doing that relates to this work under agenda item "6A, Liaison reports". Liaison for other P802 Working Groups will be assigned under "6A1, Assignment of Liaison Officers". Chandos will report on WIN LAB conference under agenda item "8A, WINLAB Conference report".

With these changes the agenda was approved by general consent.

6A Liaison reports:

Rick Albrow on the technical content of what is going on in the **European Telecommunications Standards Institute, ETSI.**

ETSI has a paid up membership of, for example manufactures, users, and operators. They must have a European base or must have presence in Europe, for instance, be a manufacturer or contributor in the European economy. The technical assembly of ETSI has subcommittees. One of these is **Radio Equipment and Systems (RES)**, which is supported by a number of Sub Technical Committees. Both RES3 and RES6 are relevant. Membership of a Technical or Sub Technical Committee is open to any ETSI member. Detailed drafting of new standards is often accomplished by working groups reporting to a Sub Technical Committee and supported by a full time project team whose members are drawn from participating ETSI members.

RES6 sets standards for digital trunked mobile radio for voice and data.

RES3 has been active for 18 months working on Digital European Cordless Telephone **(DECT)**. This was recently changed to **Digital European Cordless Telecommunications**. This is an obvious change in scope. The original emphasis was low cost high capacity telephony.

The drafting of the DECT specification is being done by the following working groups: Network and System (RES-3N), Services and Facilities (RES-3S), PHY and MAC (RES-3R), Speech Expert Groups (RES-3SEG), and Security (RES-3DAS). These groups report to RES3 and are supported by a full time project team (PT10) based near Nice.

RES3 is drafting a cordless PHY, MAC (with DLC and Network Layer above the MAC) but with a different brief to IEEE P802.11. None the less, radio has peculiar characteristics that may lead to common architectural aspects. It may be wise to watch what they do. Their schedule is to have firm documents for all the protocol layers by the end of this year, validated by the middle of next year, with approval at the end of 1991 as ETSI documents.

There is a Memorandum of Understanding (MOU) among European Community (EC) members to provide for common frequency band allocation so that there will be spectrum available across all members with common assignment. This provides a common market for advanced telecommunication products. New services that have not been coordinated with this effort will find it very difficult to get additional spectrum.

Discussion:

The word Local Area Network is not in the ETSI brief, it is a cordless network. Though it will be able to do LAN services, cordless phone is the optimized subset.

The DECT layers are Network (N), Data Link (DLC), Media Access (MAC), and Physical (PHY), all with a common management (LLME). Interworking occurs at the network level. At this time PHY is firm, as is MAC and DLC for voice. The network layer is not as advanced - and the LLME is not advanced.

The PHY uses a combination of methods. FDMA is used to provide 11 frequency channels. Then time division duplex is used on each single frequency to provide a transmit window and a receive window. Each window is in turn split into 12 bearers using TDMA. Each bearer provides 32 kbit/s of user throughput, 1152 kbit/s on the aggregate Tx/Rx channel, with a spatial cell capacity -payload- near 5 Mbit/s (single direction). It is unlikely that a portable station will incorporate more than one radio. A single portable station is limited to using no more than 30% of the total bearers. Current rules on bearer use allow 100% use of bearers on average on a single FDMA channel. This rule may need clarification for bursty users.

DECT is fully self trunking. If two cells are coincident they share capacity. If two cells overlap, they share capacity in the overlap.

DECT frequencies are 1880 MHz to 1900 MHz. Modulation is Gaussian Frequency Shase Shift Keying (GFSK, note: GMSK was mentioned in the presentation, however, GFSK is a better term) with a 0.5 Bandwidth Time product (BT) using 250 mW transmit power (10 mW per bearer). Cell size is 100 meters inside buildings, greater outside. All frequency may be used in a single cell.

DECT equipment is to be regulated but unlicensed. It is certified by type approval where the test requirements are to be published as a European Telecommunication Standard (NET). All equipment that uses the DECT frequency allocation must conform to the DECT standards.

Frequency assignment: The EC agrees to allocate 20 MHz per the Memorandum of Understanding, however, ETSI covers more than just the EC countries. An ETSI member can choose not to do DECT and not allocate frequency. France and Italy has some problems with frequency allocation.

Given the genealogy of DECT (optimized for voice transmission), it appears that P802.11 is the principle forum for data over radio. DECT provides enough for voice, but not enough for voice and data. (At least not for data rates within the scope of IEEE 802.)

There is a need to form a union of voice and data - more than voice mail between computers - interactive voice. The two need to be melded cleanly - there is a need for integrated voice and data. Jim Neeley: "A significant group of bankers in New York do look at this as needed, all one function".

0. Announcements ECMA TR/44 was distributed. This is "An Architectural Framework for Private Networks", it is meant to provide a reference model that covers real aspects of networks beyond the scope of the OSI Reference Model including ISDNs and multidrop configurations. TR/44 can be help to determine how best to apply various functions within a protocol. This technical report was used extensively in DECT, it is a good methodology.

Free copies of this document are available from

ECMA, European Computer Manufacturers Association,
114 Rue du Rhône,
CH - 1204 Geneva (Switzerland).
Phone: +41 22 735 36 34, Fax: +41 22 786 52 31.

6A1. Assignment of Liaison Officers The chair appointed Jim Neeley as the liaison officer to P802.1. Later, Paul Eastman is assigned by the chair as additional liaison officer to P802.1.

Having no other business in the Orders of the Day, the meeting was adjourned.

Tuesday, November 13, 1990, Morning meeting

The meeting was called to order at 8:51 AM, the chairman of IEEE P802.11 being in the chair. Forty-nine (49) people signed the attendance list.

0. Announcements The chair announced the receipt of two fax messages:

Douglas Postlethwaite, an independent consultant is preparing a background report on European Strategy for Radio LANs for the European Commission. He would like information on what is being done in America. The next draft is due Thursday, November 22, 1990. (Temporary document 11/JL/3) His address follows:

Douglas Postlethwaite
High Clere, Oak Way, Reigate
Surrey RH 27ES, England
Phone +44 736 763 645

Larry van der Jagt, KII, submitted his report of the study he undertook to provide a document ordering service. Part of his message was that the viability of accepting such a service was very low. The chair undertook to look at the Alphagraphics service. (Temporary Document 11/LJ/5)

7. Final review of Project Authorization Request (PAR), Document IEEE P802.11/90-17.

The result of the session held in Oshawa is provided in document IEEE P802.11/90-11. Vic Hayes had prepared document IEEE P802.11/90-17 which is comprised of the mandatory text on the PAR form plus the text from /90-11, grouped together under various headings. The chair requested whether there were objections to use doc /90-17 as the base document for the present discussions. Since there was no objection, ***document /90-17 was accepted as the base document by general consent***.

We are creating a new PAR. It is independent of the 802.4L PAR which is similar in scope. Once the 802.11 PAR is approved, it may be assumed that 802.4, which now has authority to do work on wireless, will withdraw its PAR.

Discussions of issues on pages 2 and 3:

Do we wish to elaborate on what is meant by moving - especially on speed? What is meant by vehicular speeds? Most of this discussion was deferred, but it is clear that vehicular speed is meant to be faster than normal pedestrian speed. Discusions are deferred.

Changes were made to clarify the relationship between standards and regulatory bodies (such as the FCC). We provide an application model. Since there is a relationship between band choice and how it is used, we can not now presume to know how things will be done. We changed the second sentence into "**To offer a standard for use by regulatory bodies to standardize access to one or more radio frequency bands for the purpose of local area communication.**".

Richard Lane points out that page 4 of the PAR confuses the issue of licensed vs unlicensed use. Chandos Rypinski points out that if we make unlicensed use a requirement it puts many constraints on the standard. Co-use of the ISM bands will be fraught with problems that will be presented later. Chandos claims that such a requirement is beyond the scope of the standard - should not preclude licensed use and we should not preclude unlicensed use. It was agreed that the scope statement remain silent on the issue of licensed vs unlicensed use. It is clear that this remains an important issue.

Kiwi Smit points out that the PAR as written does not restrict itself to packet data only. Isochronous voice data may be included. Dave Buchholz argues that if that is done, we are not distinct from DECT. Steve Wilkus points out that we do not have to differentiate ourselves, we could in the limit endorse DECT as the standard.

Lucian Dang points out that if we include voice there may be stiff resistance from those who think of voice as strictly their domain. Tom Phinney points out that we could design for voice as a secondary user, similar to how voice can be carried in a Ethernet packet. It was argued that if voice is carried in store and forward it may avoid competition with the real time folk.

Jim Neeley points out that we must provide a limited amount of real time voice since that is a market requirement. Chandos suggest that packet data for LLC is required, other things (voice) can be enhancements, but should not be required services in the PAR. Leave the PAR general, referring to local area communications, not to local area data networks.

It was pointed out that there are many patents on radio communication, some of which may apply to methods that may be used by 802.11. The PAR was changed to indicate possible patent issues.

After completion of pages 2 and 3, Paul Eastman ***moved*** **that pages 2 and 3 of document '90-17 as amended be submitted to the Executive Committee for further processing.** This was seconded by Tom Phinney. Objections were raised based on possible interaction with pages 4 - 7 not yet worked over. Tom moved to postpone, Daniel Lewis Second. (34-2-0) ***the motion was postponed.***

Discussion of pages 4 - 7 of the PAR: (Note: Refer to annex 1 for page 4 including the line numbers used during the meeting)

There was a discussion under "Type of medium" on the use of the term "through the air" as apposed to "untethered" or "cordless". Many anticipated applications for wireless communications will not be battery powered, and so there will be a cord. This makes use of words like untethered or cordless confusing to the Americans at least. The real goal is to develop a MAC and PHYs that use electromagnetic waves (i.e. radio waves as well as infra-red or visible light). Such electromagnetic radiation can be expected to work "through the air" or in vacuum equally well, and to a lesser extent through water. While it is true that cabled media, such as twisted pair, coax, and fiber optics use guided electromagnetic radiation, "through the air" differs in not depending on a reliable low loss conveyance. The "through air channel" may take advantage of ground wave or structural wave guide effects, but does not depend on them.

Motion by Jan Vancraeynest: Replace "through the air" with "untethered". Seconded by Dr. Kaveh Pahlavan. (2-30-2) Motion ***fails***.

Motion by Daniel Lewis: **Accept the sentence as stated.** Seconded by T. Mitsutomi. (Question called by Bob Crowder, seconded by Chandos Rypinski. (32-0-1) Question is called.) (29-2-2) Motion to accept the sentence as stated ***passes***.

There was a discussion under "Type of medium" on "use with unlicensed RF equipment". Don Johnson believes the intent to be that the end user need not have a license. Chandos warns that we should not take a step that precludes use of licenses, there are easy licenses and hard licenses, don't make that decision now. Rick Albrow points out that there is a difference between unlicensed equipment and unlicensed operation. Tom Phinney suggests that licensing, say for a premises license, may be desirable, however, don't try to anticipate what the FCC may do. Nathan Tobol says not to preclude licensed use or equipment, but if that precludes multivendor equipment it is no good.

Motion by Chandos Rypinski: Change "... unlicensed RF equipment ..." to "... radio spectrum defined in the following section ...". Seconded by Robert Buaas. (After the preceding discussion Dan Lewis moved to call the question, Bob Crowder seconds. (29-1-7) The question is called.) The motion **to change "... unlicensed RF equipment ..." amended to "... the electromagnetic frequency spectrum as described in the following paragraph ..."** ***passes.*** (30-4-3)

In radio spectrum in third paragraph add:

Don Johnson made a ***motion*** (with amendments) to **add to the third paragraph under "Radio spectrum" as follows:**

"Therefore, in order to further development of the standard, the 802.11 committee should participate in the development of changed or new regulations for short distance radio services in which all authorized users of any new frequency allocation shall be permitted to radiate only a defined maximum power density. The goal is to provide regulations which allow for an easy approval process for the end user." (29-3-6) ***Passed***

Dan Lewis made a ***motion***, seconded by Robert Buaas, to replace the lines 6,7 and 8: "Currently the only ... for the ISM bands" with "The initial work of this committee will be to define standards that allow maximum utilization of a shared spectrum with minimal interference among users and ease of regulatory approval."

Discussion of the motion: Dan Lewis claims that any new frequency allocation should allow a maximum number of co-users with minimal interference. Rick Albrow points out that ISM is peculiar to US, we should delete emphasis on ISM bands. As of April the 18 GHz band was opened for licensed use with data. Chandos points out that we can not eliminate ISM from consideration, there is no other frequency space available now. Ultimately the ISM is probably a dead end, however, 18 GHz is not an answer without problems. Dave Bagdy also points out that the ISM band is the only thing that the committee can do, it is the focus for the short term. Don Johnson points out that the 1 and 18 GHz bands are so different that different PHYs may be required (different modulation and technique).

Dan Lewis is afraid that this initial emphasis will lead to using spread spectrum techniques, this will lead in turn to things in the MAC that will preclude narrow band techniques.

A motion by Tom Phinney, seconded by Dan Lewis, to refer the motion to a subcommittee (taking into account the work in Oshawa) failed. (0-34-6)

Bob Crowder called the question (35-0-3). The vote to replace lines 6,7, and 8 was (7-22-7), ***the motion failed***.

Bob Crowder made a ***motion*** seconded by Don Johnson (amended by a motion from Rick Albrow, seconded by Tom Phinney to remove "the committee intends" after "and" (17-3-16)), to **replace line 8: "Therefore the initial work of this committee will be for the ISM bands." with "Initial work will be for the ISM bands and to consider the use of additional bands beyond ISM"** (23-3-8) The amended motion ***passes***.

Rick points out that this leads to a primary focus on the ISM bands, then other bands later.

At 12:27 PM the group broke for lunch.

Tuesday, November 13, 1990, Afternoon meeting

The meeting was called to order at 2:09 PM, the chairman of IEEE P802.11 being in the chair. Forty-four (44) people signed the attendance list.

0. Announcements Please note that use of the copying service requires clearance from the chairman.

7. Final review of Project Authorization Request (PAR) continuation.

Hiroshi Tomizawa ***moves***, seconded by Chandos Rypinski, to add a sentence following line 13 "... for international standardization where possible." that reads as follows: "It is possible that the fundamental technology for the initial work may be different from that of the final work."

Don Johnson points out that the final work may be in addition to the initial work. Michael Masleid points out that several PHYs may be required in this standard - that is OK - the only danger is that the MAC may need additions that we fail to anticipate to support the new PHYs. Tom Phinney warns that we may be badly underestimating the size of the market - there may be a tremendous amount of radio - we may not be willing to undertake that level of design. The chair warns that we do not want to inherit the ills of ISM later.

Tom Phinney questions: Should we allow this level of ambiguity in the PAR?

Dan Lewis believes the PAR should be rather general, we are missing the larger context. William Stevens warns that we don't want to sound like we don't know what we are going to do.

Hiroshi Tomizawa attempted to call the question, this ***failed***. (3-22-10)

Dan Lewis ***moved***, seconded by Alan Flatman, that the section involving radio spectrum in general be written such that it does not imply a particular technology or frequency band.

This is not something that can be moved. Michael Masleid objected that such a move ignores considerable previous work on through air media done by 802.4L. Nathan Silberman points out that we need to provide a workable solution, this (the ISM band) is one. The chair handled this ***motion as out of order***.

This led to a discussion on how to obtain "buy in". To progress a standard there must be balance and understanding. For this reason we will be using the IBIS list to try to preserve an audit trail of the logic and decisions that take us where we may go. After this meeting we will also depend on a voting membership that has had the time to learn the issues before discussing them.

Jan Vancraeynest points out that spread spectrum is not required in the ISM band. Reply: The power level allowed for non spread spectrum in the ISM band is too low to be interesting.

Are we to use spread spectrum only? The PAR is dancing around the issue, it does not mandate only spread spectrum. Chandos: There is a strong case for spread spectrum, however, the situation (at the FCC) is changed. There may be other candidates.

The chair advises: Before July, it looked like the ISM bands were the only way to go. With the notice of inquiry, more spectrum may become available. Perhaps we can proceed independent of modulation, and use the ISM band as a backup. Please understand that we are looking for good spectrum - but if we do not have it, we could use the ISM band.

Jim Neeley says imagine that we need (eventually) to provide services to Netbios, Proprenet, TCP, OSF, MGMF, and voice phone stations, PSN, and PBX with an Isochronous MAC, doing this using direct sequence, frequency hoping, and infra-red. This implies multiple PMDs (PHYs) that attach but do not prejudice. Our first objective must be to get the one bucket that we can catch.

Tom Phinney asks why we are ignoring the MAC and Isochronous service?

Dr. Eugene Yen wonders about the apparent bias toward (providing simplicity to) the end user, is that intentional? Reply: Yes, that is typical of the 802 standards.

After the 3:08 PM break the meeting resumed (at 3:34) with important advice from Nathan Tobol, one of the original writers of the 802 standards:

Don't restrict the PAR in any direction that you want to go in the future, others will take unclaimed territory away from you, be it BSR or ANSI or whatever. Do not put things in that specifically limit you. This (radio) is very much the future, expect it (802.11) to become a series of standards.

Randall Jones points out that lines 12 and 13, "To further enhance the standard ... international standardization where possible." is not reasonable. Of course we are making a standard, this must refer to spectrum standardization, perhaps in the CCIR?

Don Johnson ***moved***, Robert Buaas seconds, **that line 13 be changed from "... standardization ..." to "... spectrum allocation and use ..."** (27-0-6). The change is ***approved***.

Discussion of lines 14 and 15: "The standard shall support stationary ... and mobile stations... at vehicular speeds ... with one PHY ...".

There are some who want to limit vehicular speeds to pedestrian speed. There seems to be some fear that we will infringe on the present domain of the cellular phone companies. Others argue that vehicular speeds within a campus or factory must be supported. To them the obvious need for radio is communication with mobile equipment (inventory control, overhead traveling cranes, stacker reclaimers, lorry cars and so on). Chandos suggests limiting to pedestrian speeds, Jim Neeley to private vehicular speeds or campus vehicular speeds. Chandos points out that the real limit on speed will be determined by the (technical) work of the committee. If the implementation is to be with one PHY, then it must be such that the bulk of the service can be done inexpensively. If special service (high velocity) is needed then it is reasonable to achieve that with higher complexity and cost.

Michael Masleid ***moves***, seconded by Chandos Rypinski, **to leave lines 14 and 15 as written (reaffirm).** (29-3-3) ***The lines stay the same***.

Discussion of the supported environments.

Environment:

Robert Buaas ***moved***, seconded by Tom Phinney, **to add "residence" after "... hospitals." in line 19, and "residential areas" after "... plants and storages." in line 20.**

Chandos wonders if we dare claim home distribution, that is the domain of the phone companies? Jim Neeley says that we should restrict the service to span no more than a single residence. Tom Phinney advises that we should use the word premises - that can be taken to include a bus or plane.

Robert Buaas would like to be able to include near neighbors, or all within an apartment complex. What about premisses and the local areas between them? Bob Crowder fears communicating across a public right of way.

Chandos advises that there is no single control of a residential area, and so ***moves*** **to remove "residential areas" from line 20.** Jim Neeley seconds, advising that the signals cross boundaries, we don't want that fight. (20-3-10) ***amendment passes***

Bob Crowder ***moves amendment*** that "... buildings ..." be replaced by "... premises ..." in line 19. (6-9-14) ***Amendment fails***. Question is called (29-0-1)

The vote on ***the main motion*** now reading **add to buildings in line 19 "... and other premises ...", and add "... residences." at the end of line 19** is (26-5-1) ***The amended motion passes***.

Dave Bagdy points out that if we take on public areas we get into turf battles. Richard Buaas says that we may want the turf war, we may want the issue resolved.

There is some concern that this is a required coverage list, Dave Bagdy ***moves***, seconded by Nathan Silberman, **that lines 18, 19, 20 and 21 be struck.**

Michael Masleid objects: these lines were meant to be explicit inclusions.

Tom Phiney says move the lines to after the service areas. Dr. Jonathon Cheah suggests changing "Supported environments include:" to "Possible targeted environments include:" Dave Bagdy accepts. The question is called (27-1-0). The amended motion is **to replace lines 18, 19, 10 and 21 to after line 26 and to change in line (original) 18 "Supported environments include:" to "Possible targeted environments include:"** and voted (26-3-2). The ***amended motion passes***.

Michael Masleid ***moves* that the word "possible" be removed from "possible targeted environments"** since this is not an assertive statement, and can be taken to exclude environments not included in the list. Tom Phinney seconds.

Bob Crowder is apposed wishes to remove residences. Tom Phinney points out that is out of order, it was just voted in. Jonathon likes the wording as is even if it doesn't fit with assertiveness training.

Dave Bagdy points out that a residence may be a boat and calls the question without relinquishing the floor. (30-0-1) On the motion to remove "possible" (10-13-7). The ***word possible is retained***.

Dave Bagdy having not relinquished the floor moves to adjourn the meeting.

Wednesday, November 14, 1990, Morning meeting

The meeting was called to order at 2:09 PM, the chairman of IEEE P802.11 being in the chair. Forty-nine (49) people signed the attendance list.

7. Final review of Project Authorization Request (PAR) continuation, the chair distributed a revision of doc IEEE P802.11/90-17, annotated 17r. This document is provided in annex 5.

Dr. Eugene Yen wished to increase the supported data rate to 100 Mbit/s. This can not be done (without approval from ANSI) within the charter of IEEE 802.

Tom Tsoulogiannis ***moves* to remove the words "... at rates between 1 and 20 Mbit/s..." from "Supported service."** Seconded by Louis Pandula.

Dr Paul Eastman points out that this is not relevant, since the IEEE 802 functional requirements of 1 and 20 Mbit/s then rule. Jonathon calls the question, seconded by Paul. No objections. Vote to remove (17-15-7) ***fails 75% rule***.

Richard Lane ***moves* to leave lines 1 and 2 on page 5 as stated.** Michael Masleid seconds. (30-2-6) ***Passes***.

Rick Albrow points out that this violates an agreement in Oshawa to support 100 kbit/s service. (This can not be done in the scope of IEEE 802, but it can certainly be a required service of the MAC.) Jim Neeley points out that we must work well above 64 kbit/s to stay out of the high quality voice service.

Jan Vancraeynest asked about the biological hazards. Tom Phinney replies:

There is scientific epideminological (based on distribution of disease) evidence that low frequency electromagnetic radiation has an effect on mitosis (chromosome separation, replication, and cell division) and on cell wall transport (movement of material into and out of the cell). The evidence indicates that each effect is very frequency specific. Some frequencies are more hazardous than others. There are now very tight restrictions in Sweden and the USSR. IBM is placing more restrictions on their monitors. Expect more restrictions. It may be argued that since this is a low frequency effect, it is not important to microwave. It seems however that high harmonic content in the pulsed field is most important, and so it may well be a problem. Jim Neeley points out that this should be on the work list.

Chandos Rypinski points out that we should also mention the 10 dBm/cm^2 maximum field requirement. Tom Phinney argues that is a well known requirement. The pulse requirement is a flag to the unaware. We should randomize our timing. It would be a shame to write a standard only to have it outlawed world wide.

Jim Neeley ***moves* to change "The MAC design ... due to biological hazards." to: "The standard shall anticipate restrictions on EM fields and pulsing of EM fields due to potential biological hazards."** Seconded by Tom Phinney. (36-0-3) ***Passed***.

Chandos Rypinski ***moves*** **to change "... which are portable ..." to "... which may be portable ..." in the first sentence under "Purpose of proposed Standard", and to change "To provide a standard for use ..." to "To offer a standard for use ..." in the second sentence.** Dr. Jonathon Cheah seconds. (37-0-1) ***passes***.

The chair advises that "Proposed Coordination" will be enforced - we must provide proof of coordination. For this reason the list is pruned to what is necessary. The patent issue is worded by "Patents relevant to the work of IEEE P802.11 are known to exist"

Tom Phinney ***moves*** **to accept this page**, seconded by Dan Lewis. (35-0-0) ***Page 7 is accepted***.

Bob Crowder expressed concerns that we may take the scope of the standard to include something more than a Local Area Network, perhaps entering the arena of voice and integrated voice and data. Bob Crowder ***moves***, seconded by Tom Phinney, to change the first sentence under Scope of proposed standard to: "To develop a Medium Access Control(MAC) and Physical Layer(PHY_ specification for wireless local area network connectivity for fixed, portable and moving stations." (8-25-5) ***Motion fails***.

Robert Buaas ***moves*** **to accept page 2**, seconded by Tom Phiney. (36-0-0) ***Page 2 is accepted***.

A subcommittee was formed to reword the exceptions to IEEE P802 Functional Requirements so that it can be understood by the casual reader. The only change made to the apparent intent of the exception is that no exception to the MSDU undetected error rate requirement (frames reported correct but in error at the MAC service interface) shall be allowed at any time or place.

The coffee break started. The chairman will edit the results of the draft PAR discussion into a new document for distribution to the Executive committee and the Working Group itself.

The Vice-Chairman was in the chair.

8. FCC GEN Docket 9-314: Dates are October 30th for submission of comments, November 30th for reply to the comments.

Chandos Rypinski reporting on what has happened since October 30th:

"The docket is about personal service, telephone in the shirt pocket, DECT, zone phone, telepoint. Telepoint is originate only, not two way dialing, other services do more. These are not LANs, but it is important when they decide to use certain frequency ranges - in particular what is used in 1 to 3 GHz IWP 8/13 (CCIR) mapping of frequency. This is a common world wide frequency limited to public telephone service. It is clear that the only agreement is on spectral requirement, range and service. The US has no position at all, US members won't take a position in until the US takes a position. The 1.7 to 2.3 GHz frequency region taken by FCC is very news worthy. Chandos asserts that the interest is short distance radio voice, but the issue is actually short reach radio services - data services. Chandos quotes Ben Cobb 'The future of telephone may lie in the 100 comments to FCC' This is big.

Chandos continues. "Our service will not get off the ground without spectrum. Stuart Lipoff analyzed the 900 MHz ISM band. There are too many other transmitters there to assure that the radio will work. I urge those who want 900 MHz to read that paper. Does the same applies at 1.9? Not yet but... The utilities use spectrum for point to point microwave and claim the replacement cost is 2 billion. Of course they are replacing this with fiber now, but they still want to be paid for the use of the spectrum. We need to define a service so we can get frequency space to use for it. We must then reduce the amount of interference that it creates.

"By November 30th we must make reply comments, rebuttals to the October 30th comments. (Chandos) will take on the point to point microwave services (Temporary document 11/LJ/9). The argument is they will not have to spend 500 million dollars, since our co-use won't interfere with the service that they do not make extensive use of. Those companies that have an interest should write (to the FCC) that they can build networks that do not interfere and (that such networks) will increase the total value of services.

"Obviously there is competition for frequencies. Apple is supporting high speed PCS at 1.7 to 2.3 GHz - data PCS up to 10 Mbit/s. There are competitors. The United States part of IEEE 802 needs to develop its position of how to use the spectrum. Only positions that take into account existing users can possibly prevail.

Jan Vancraeynest points out that you can (must) reply to a comment, but you do not have to have made a comment yourself in order to do so.

Jim Neeley points out the IEEE 802 executive committee should be one of the repliers, wireless data should be on par with for voice. This does not address how much spectrum we need, who we should live with, and who we should move out. Some of us should get together and draft a reply for November 11, 1990. (This was done by Jim Neeley, Chandos Rypinski, and others and presented later.)

8.2 Identify subjects for reply comments. Chandos opened the floor for comments. The comments resolve into several broad issues summarized as follows.

Frequency? Cost of equipment begins to go up after 2.5 GHz - above this frequency expect to use gallium arsenide instead of silicon. Since the aperture of an omni directional antenna is smaller at higher frequency, path loss is said to increase 6 dB per octave frequency increase. This may be a significant problem for battery powered services. On the other hand, only the front end needs to operates at RF - Motorola makes low cost 18 GHz radios. A good estimate of cost versus frequency requires a good network model.

Bandwidth? How much is needed for 20 Mbit/s? How much can we hope to get? Again this depends on the network model, but assume that spectrum is a very precious commodity - ask for too much and we may get laughed out of the house. The following models are not accurate, but are indicative, each has an application space that may eventually be supported, possibly in the same band allocation:

A cluster of high-rise glass offices. Need high data rate, but distribution systems cannot coordinate, so 4 color map frequency reuse is attempted. Use coherent QPSK at 1.5 Hz/bit, 10 Mbit/s, 4 channels. Requires 60 - 120 MHz.

Battery powered portable workstations on a campus, single frequency coordinated distribution system. Need high data rate, sacrifice modulation efficiency to save power. Use incoherent MSK or FSK at 4 Hz/bit, 10 Mbit/s, 1 channel. Requires 40 - 80 MHz.

Retail environments within a shopping mall, with moderate delay spread. Need moderate data rate, but also independent distribution systems, so 4 color map frequency reuse is attempted. Use coherent QPSK with 11 or 13 chip Barker spreading, 1.5 Hz/chip, 13 chip, 1 Mbit/s, 4 channels. Requires 78 - 156 MHz.

Heavy industrial environments with large delay spread and limited access points (and access point is transceiver node on a distribution system). Use coherent QPSK with 127 chip spreading codes, 1.5 Hz/chip, 127 chip, 230.4 kbit/s, 1 channel + .5 voice. Requires 66 - 132 MHz.

Heavy industrial environments with large delay spread and fast relative motion. Use FSK with 127 chip spreading codes, 4 Hz/chip, 127 chip, 100 kbit/s, 1 channel. Requires 51 to 102 MHz.

If a rate 3/4 forward error correction code is added to any of the above models - to solve mobile or noise problems - the required bandwidth increases by another 33%. A request for 70 - 140 MHz bandwidth is reasonable. Chandos Rypinski points out that 140 MHz is the size of a molecule at the FCC (the largest bandwidth we can expect to get for an indivisible service).

Licensed? Tom Phinney doesn't want to design a standard that hands a monopoly to a company that controls a band. The FCC avoids creating monopolies or franchises.

Political. To steal frequency, pick a patsy. There is no way to decide what space to ask for. Instead, choose an enemy. Don't choose the federal government or the maximum service telecasters. 1710 to 1850 MHz is the federal government. 1850 to 1990 MHz is the private user band, or maybe the other way around? These are point to point, narrow beam, long hop users. A fixed enemy is a good enemy. The point to point users are allowed 25 kW watts effective power. If the LAN service is so channelize, we could have the option to move to other frequencies to avoid inband interferers. It is true that going against all the railroads, utilities, and sheriff's department is bad - but there are worse things.

The Chairman distributes an update of the draft PAR as document IEEE P802.11/90-17Rr for review by the members. This version is also distributed to the Executive Committee for pre-information. The document will be reviewed in agenda item 11.1. The chairman resumes the chair.

8A. Report Win Lab Conference.

Chandos Rypinski provided the following report:

There was a conference held in East Brunswick by Dave Goodman, Computer Science, Rutgers University. In the past this conference has be oriented to voice systems. Now it is oriented to high technology. Most of the presentations are not relevant to 802.11, but 4 papers should have attention called to them.

One paper has already been mentioned - the paper by Stuart J. Lipoff, an analysis of the 900 MHz ISM band. (Temporary document 11/LJ/2) The paper uses examples that include full spread spectrum and approximations there of in the presence of interferers that include licensed systems using kilowatt transmitters - things used for instance as theft detectors for cars running in transponder mode. Those who think they see a long future in the ISM band should read this paper with some care.

Another paper, by a lawyer (L. J. Movshin of Thelen, Marrin, Johnson & Bridges (Attorneys at Law) is called "Navigating the Regulatory Morass". (Temporary document 11/LJ/13) This is the best tutorial on paper about how Washington works with respect to the FCC. Those who wish to be more familiar with that process should read this paper.

The third paper is by AT&T on a micro-cellular urban network. The network uses 900 MHz antennas at street intersections, with propagation analysis to the cross streets, through the intersection, and along line of sight paths. (Temporary document 11/LJ/14)

The final paper to call to your attention is interesting. It is by R. W. Brodersen, e.a., University of California at Berkeley. (Temporary document 11/LJ/15) It describes a year 2000 network with much video processing for live motion using a 1 Gbit/s backbone. Live motion video is possible through reduction of feature size using realizable complexity. The assumption is that electronics continues to improve. It has become better each year. We have more speed and less current drain each year. There are limits - it is assumed that at 0.7 microns (device geometry) electron velocity causes diminishing returns. But what really causes speed to be limited is interconnect wiring and capacitance. That is the most important. Some of the gains will have come from reducing the length of the interconnects. So expect further speed/power improvements down to at least 0.7 microns.

One of the upcoming WIN Lab meetings is next September at King's College, London.

The meeting broke for lunch.

Wednesday, November 14, 1990, Afternoon meeting

The meeting was called to order at 2:09 PM, the chairman of IEEE P802.11 being in the chair. Fifty two (52) people signed the attendance list, two (2) were excused for acting as liaison officer in P802.1.

10. Architecture.

10.1 Presentation of contributions. Chandos Rypinski made a presentation of a radio LAN that he has been designing. The following is a transcript of the verbal report, see also document IEEE 802.11/90-18.

A key feature of this network is that NO transmitter shall be on unless it is in use (in use implies that there must be an receiver in range of the transmitter that is addressed by the transmission). This is a simple statement but in some places that is argumentative.

The wireless system architecture makes the following major functional choices:

a) LAN capacity and speed capability must approach or equal that of existing wired LANs. "Anything less than 10 Mbit/s in a LAN is unmarketable"

b) Inclusion of some of the subsets of digital connection-oriented services. - to support Masleid's real time voice. There is a difference between capability and assurance.

c) Scalable medium signaling rates; so that reach-rate tradeoffs may be made within the Standard. Go for 1, 2, 4, 8, and 16 Mbit/s data rates. Pick one or all to start with - see what happens. Use 4 Mbit/s to start with (or 4.096 Mbit/s if you wish, it makes no significant difference in radio).

d) Access points, affixed to walls or towers, such that each station is within (preferably line of sight) range of an access point. Remember that to assure coverage, always increase the number of access points. Improving modulation or increasing power is not nearly as effective as increasing the number of access points.

In the case of a moving station, a bridge crane or a robot for instance, the problem is that of moving from one coverage area to the next. Such motion should be invisible to traffic handling. The object is not to hand off to the next coverage area. The object is to give continuous coverage. Perhaps the switching can be done between packets, however, rather than as a hiccup inside of an individual packet.

Should we be designing a commodity or a premium niche product? We must attempt to design a commodity. This goal need not be incompatible with premium industrial equipment. Commercial products needs to be reliable as much as any thing else does. Complaints will induce correction to bad products in commercial environments also.

Is a radio system a replacement for wired systems? No. Twisted pair will not be replaced by wireless. Go for something that is simple and reliable - something that works. Market penetration is for the world to decide. There will still be wire if there are many access points (it is needed to connect the access points together). What should be used - coax? Look at EIA TIA 568 for suggestions: twisted pair is to be provided as standard from the wiring closet to the terminal. This 4 pair vinyl or plenum grade 100 meter maximum length cable can be used for the access point control cable.

The model presented is simplistic so that we can argue about it. Access points are on a square grid. Pitch is the distance between grid lines. For an access point to work it must have a range of SQRT(2) of the pitch/2. This implies that the coverage area of access points overlap. Plan on it.

Do we increase power to avoid shadows? No. Get an alternative radio path. Deliberate overlap is a very important factor. Reliability comes from having more than one receiver that can copy the message when the station transmits.

Does this scheme seem to reject co-channels (FDM tesselation)? Yes. This is a single radio channel. Given a square distribution system, the non overlap area disappears rapidly with only a slight increase in power.

The reach of each access points should be minimized. This is counter intuitive, however, economy in the number of access points is not the only economy that must be addressed.

The frequencies used will be in use already, so there will be interference issues. Reducing access point pitch reduces the required transmit power and reduces the required dynamic range. This helps reduce interference both to and from other services. In a system such as this transmit power could be less than 1 mW. If a small pitch distribution system transmits only in the area estimated to contain the recipient of the message, then other parts of the distribution system can be in use at the same time handling other traffic. Because of this the aggregate throughput in a fixed coverage area goes up as pitch is reduced. Properly done (say the distribution system hesitates before kicking in) direct peer to peer communication could exist in the area of coverage without intervention by the distribution system.

A key assertion is the reach/rate tradeoff. Is time dispersion a function of distance? (Rate is normally limited by time dispersion.) The assertion - that time dispersion decreases as distance decreases, at least in line of sight - needs to be proven. Some measurements indicate that time dispersion is not a function of distance. With proper art that may be a different story. Downward directed antenna and antenna diversity may be effective here.

Tom Phiney points out that the access point interconnection could also be wireless using directional antenna. Chandos thinks there would be a problem with power.

The following is a correction to the last paragraph on page 3 of document 802.11/90-18, 802 LAN Access Method for Wireless Physical Medium:

For a constant capacity system, the data rate would quadruple each time D is halved. Then the transmitter power would go as (reach)^4, and there would be 1/4th as many transmitters, and interfering effect would vary as (reach)^2.

After a 30 minute break (till 3:32) Chandos Rypinski continues:

The punchline? There needs to be central controller for the access points. The station only transmits to a certain number of messages to which it responds in a predefined way. A form of system operation using the above described topology and dependent on a central controller is defined and assumed.

Discussion of Chandos Rypinski's architecture:

Peer to peer is available, the stations use it when it works. If not, then in a few milliseconds they revert to bridging (the distribution system can be thought of as a bridge). How this works is a long discussion in itself.

Chandos states that given the reach/rate trade off, it is possible, by reducing the distance between access points and the power per access point, to handle twice the traffic in half the time with the interference to external services constant.

Tom Phinney objects that this constant is true only if protocol overhead is ignored. Chandos agrees, in the final analysis this has to be included.

Dr. Jonathan Cheah questions why path loss is assumed to be second order, why not higher. Chandos replies that a line of sight path is assumed.

Michael Masleid points out that the power advantage (gained by decreasing access point pitch) is much greater than achieved with square law assumptions when working in a cluttered environment. Chandos points out that in a fading channel you must transmit 30 dB over what is required for line of sight to achieve 99.9% coverage.

Will the guidelines for building wiring followed? Chandos' reply: There will be significant penetration of the EIA wiring in the next ten years, it is taking off now. However, this may not be found in industrial sights. In

In Japan there are no wiring closets, they use run lengths of as much as two thousand feet. Wiring guidelines are being implemented even in old buildings where the wiring is being pulled out and replaced. There are two powerful reasons for this, the first is that the old wiring is undocumented. It cost less to rewire than to document. The second reason is that if the wiring is in the air space it must be plenum grade. (If the wiring was installed before the code, you can leave it, new wiring must meet code.) Don Johnson indicates that a mini survey 5 years ago indicated that the old wiring would do up to 70% of the distance that the new wiring would support.

Tom Phinney wonders if the dynamic aspect of direct peer to peer communications within the coverage area of a distribution system is the correct approach. Perhaps this should be done as a static rather than dynamic decision. If a station hears a distribution system it uses it, otherwise it does the protocol on its own. The square law assumption does not hold for point to point in large areas, say with 100 meters reach. Most useful areas are cluttered, with loss that can approach the 4th power of distance. In this case there is no hope for direct peer to peer communications. Dave Bagdy points out that at the extreme, a 5 foot pitch on the access point grid, the peer to peer range is to short to be useful.

Chandos wonders if mandatory direct peer to peer is a hasty decision. (In a very high data rate, micro powered, single ray line of sight near field system - I am inclined to agree. Sec.)

Tom Phinney observes that the nice thing about a small pitch system is that it conserves power and can use a limited power approach. Think of a restaurant were people talk louder and louder to be heard. That approach doesn't work out so well. Another real advantage is that if a customers system doesn't work, it can be fixed by adding a little more hardware.

The manufacturer has the option - at his own cost if need be - to fix the customer's installation and retain that customer, rather than telling him too bad, look elsewhere.

What about spread spectrum? Reply: Chandos is not an advocate of one versus the other. Tom points out that in a short line of site system multipath may not be a problem and so spread spectrum may not be needed. Chandos points out that there may be two solutions, one with very short range and high access point count (and low cost per access point), another with very long range and low access point count (and high cost per access point). This architecture may provide a method for comparison.

Tom Phinney: Think of an access point as a repeater. This access point provides a path from station to central controller. The access point maps from the power level of the laptop computer to the power level needed to traverse the distance to the central controller. A repeater - not a bridge - is a very simple device. It may be doing only an RF to baseband conversion. This allows later evolution to bridges. Chandos comments that there are all RF examples. The police us repeaters in their cars to relay from their walky talkies to base stations, the airlines use repeaters in the aircraft to relay the hand phones to ground stations. That is getting to much into the architecture when the system design is the important thing.

10.2 Discussion to make a matrix of proposals.

Chairman: Since there is only one proposal there is not much need for a matrix yet. Refer to document 90-15 page 10. These are the questions that we should answer to get a clearer picture of the architecture that we need. This may be used as a guide for IBIS (Issue Based Information System) as described on page 11 and 12 of the same document. This completes the orders of the day.

Thursday, November 15, 1990, Morning meeting

The meeting was called to order at 8:35 AM, the chairman of IEEE P802.11 being in the chair. Fifty one (51) people signed the attendance list.

0. Announcements. The chair re-iterated that people must register for this meeting. The funds are needed to defray costs. Failure to register will result in loss of voting rights, which then have to be regained from scratch.

11. Reports from ad-hoc groups

11.1 PAR. The most recent revision of the PAR was reviewed (17Rr). The document isprovided in annex 6. It was observed that the rewrite of "Compatibility requirements" was wrong. The phrase ", as defined below." for 5.6.1 had not been transcribed from the ad-hoc group's notes. Bob Crowder suggested that the word "defined" be changed to "redefined" since the definition presented for 5.6.1 is different than that shown in the function requirements for 802. Michael Masleid objected to such a change on the grounds that the definition in the functional requirements is incorrect, and also because Michael doesn't like to use extra syllables. (A later discussion with Nathan Tobol indicates that the definition of 5.6.1 now includes the 10E-8 detected and 10E-9 undetected error rates as one sum equal to 10E-8 errors. The 10E-9 undetected error rate is encrypted into 5.6.2. This leaves discovery of the correct detected error rate and hence frame loss rate as an exercise for the reader. I conclude that technically 5.6.1 is correct in the functional, however... Sec.)

Chandos Rypinski ***moves*** **to accept the revision as edited (use defined, not redefined).** Tom Phinney seconds. (16-2-10) ***The section on compatibilty requirements is approved***.

Chandos Rypinski ***moves***, seconded by Dr. Jonathan Cheah, **to approve Doc: IEEE P802.11/90-17 Rr, as amended, and to submit the revised document to the Executive Committee with the motion stated on page 1 of the document.** (32-0-1) ***The motion passes***. The document as approved by IEEE P802.11 is distributed as doc: IEEE P802.11/90-19.

(The Executive Committee approved both the 802.11's PAR (with some minor changes) for forwarding to NESCOM and the reply comments to the FCC. The document approved by the Executive Committee is distributed as doc: IEEE P802.11/90-20. Secr.)

11.2 Reply comments to FCC Lets say 73 individuals from 65 organization make replies to the FCC advocating short range data service in accord with the work of 802. This would surely be an indication of interest in short range data service. A reply doesn't have to be long, but it does have to be from an expert on this.

Bob Crowder ***moves***, seconded by Dan Lewis **that a committee work to draft an appropriate reply comment to Docket 90-314** (This is to be the official position of the IEEE 802 executive committee.) (35-0-3) ***The ad-hoc committee was established***.

A question was raised on possible overlap with T1P1. Are they just a management group? Chandos Rypinski replies no personal expertise on T1P1.

They are sponsored by the exchange carriers. We are unique in that we are not enabling franchises, we are enabling multi vendor equipment. Chandos will work off-line so that he can report on the status of T1P1.

With regard to the proposal on document distribution from Larry Vanderjagt:

Document distribution would not be profitable for his business. He would need to charge 16 ¢ per page (plus postage). The Chair will pursue this issue with Alpha Graphics.

The group needs access to the work done over the last few years. Dr. Jonathan Cheah, Michael Masleid and Vic Hayes will be the compiling editors.

12. Meeting schedule.

12.1 Confirmation Gaithersburg meeting

The next meeting will be held in Gaithersburg:

Compri Hotel
805 Russel Avenue,
Gaithersburg, MD
January 7-11, 1991.

Rooms are $75.00 per person, $10.00 for each addition person in room. Book at least two weeks prior to the meeting date. Breakfast (a good one) is free. Identify your affiliation with 802.11 to get a good rate. Regular room rate are much above $100 dollars.

Dr. Jonathon Cheah is the contact.
Phone (619) 453-7007, Fax (619) 546-1953, Telex 910 321 02241,
E-Mail jcheah@oscar.hns.hac.com

12.2 Objectives for the Gaithersburg meeting are:

Define markets to be addressed.
Identify the users and their needs.
Estimate the spectrum needs
for the establishment of the architecture.

There is the opportunity for FCC staff to participate in our studies.

Monday night will be 802.4L technology transfer.

Channel measurements at GM
Propagation analysis at GM
Microwave oven measurements
Rappaport report
DQPSK implementation
Code Division Multiplex proposal
Near/far problem
Ping Pong Protocol
FEC related issues
Spread spectrum versus other things.

Contributions are solicited on:

Transmission technology to estimate transmission needs,
interference into other systems.
users and their needs
architecture
T1P1 Liasion

Timing plan:

	Mon 7	Tue 8	Wed 9	Thu 10	Fri 11
AM	admin spectr	arch interf	FCC spectr	arch	
PM	spectr markets	spectr users	FCC interf	admin output	

evening of Monday: Review of 4L work

12,3 Last mailing date No date was established

12,4 Any other Intermediate meeting needed? It was agreed that no second intermediate meeting was required.

For a proposal for the May meeting, Dr. Kaveh Pahlavan made a presentation on Workshop symposiums. The schedule:

- International Workshop on Portable and Mobile Communication, King's College, London, September 1989.
- International Symposium on Spread Spectrum Applications, King's College, London, September 1990.
- Workshop on Wireless Local Area Networks, Worcester Polytechnic Institute, Worcester, MA, May 1991.
- International Symposium on Portable, Indoor and Mobile Radio Communications, King's College, London, September 1991. (Temporary document 11/LJ/10, refer to annex 2)
- International Symposium on Portable, Indoor and Mobile Radio Communications Worcester Polytechnic Institute, Worcester, MA: Sep 1992
- Tokyo, Japan: Sep 1993

The meeting in London had 100 people, the next - Wireless Local Area Network Workshop, May 1991 - is expected to have 100 - 200 people. The first day will be tutorials. The second day overview of LANs past and future. Topics are:

* FCC regulation
* Portable and Mobile View of Local Communications
* Indoor Radio Propagations
* Spread Spectrum
* Adaptive Antenna Array
* Adaptive Equalization
* Users Panel.

To coordinate with the tutorial and symposium the ***May interim meeting will be planned for Worcester, May 6-9, 1991. Location to be determined***. Information of the Wireless Information Network group at the Worcester Polytechnic Institute (Temporary document 11/LJ/7) is annexed (3).

Nathan Silbernam requests that meetings alternate east and west coast. The following is the current tentative meeting schedule:

Date	Month	Year	Place	type of meeting	Location
7-10	January	1991	Gaithersburg, MD	Intermediate	Compri Hotel
11-15	March	1991	Hilton Head Island, SC	Plenary	Westin Resort
6- 9	May	1991	Worcester, MA	Intermediate	Worcester Tech
8-12	July	1991	Kauai, HI	Plenary	Hyatt Regency Kauai
Hotel					
TBD	September	1991	Westcoast?	Intermediate	TBD
11-15	November	1991	Fort Lauderdale, FL	Plenary	Embassy Suites
TBD	January	1992	Westcoast?	Intermediate	TBD
9-13	March	1992	Irvine, CA	Plenary	Irvine Marriott Hotel
TBD	May	1992	TBD	Intermediate	
6-10	July	1992	Minnesota	Plenary	TBD
TBD	September	1992	TBD	Intermediate	
9-13	November	1992	La Jolla, CA	Plenary	Hyatt Regency Hotel

The meeting broke at 10:54 to allow time for a subcommittee to draft the IEEE 802 Local Area Network Standards Committee reply comments to the FCC Docket for Executive Committee approval.

Thursday, November 15, 1990, Afternoon meeting

The meeting was called to order at 2:00 PM, the chairman of IEEE P802.11 being in the chair. Thirty eight (38) people signed the attendance list.

13. Review of document list

13.1 Approval of output documents The ad-hoc committee introduced the result of their work (Temporary document 11/LJ/18). Bandwidth was an issue. The initial bid was for 40 MHz. This is a bit tight to do 20 Mbit/s - and yes, there is an 802 standard at 20 Mbit/s, it is the fiber optic token bus described in ANSI/IEEE 8802.4 1990. Some think that 40 MHz is too narrow even for 10 Mbit/s. That depends on assumptions about modulation and filtering. Jim Neeley points out that 40 MHz bandwidth is correct for 10 Mbit/s. (Based on one set of assumptions, of course. The IBIS notation is effective for this kind of work. Rather than trying to present the rest of the convoluted discussion in prose, here it is in IBIS, names deleted: Secr.)

>I: What bandwidth should be requested of the FCC?

-P: We shouldn't talk to the FCC, this is an example of a few companies seeking endorsement of IEEE 802 to further their own ends.

*A-: You can't go through all the wickets unless your private agenda and the IEEE agenda are virtually identical.

-P: We shouldn't say how much bandwidth we want.

-A+: We don't know now what we really need.

>I: Is it important to know what we really need?

*P: We can't wait that long

*A+: We must make the request now.

*P: We don't need to know exactly what we will decide
*A+: Though we don't have concurrence, the range 70 - 140 MHz is representative of the range and variance of the numbers we would obtain if we polled the (experts in the) room.
*A-: If we don't ask for something we will get nothing.

-P: Request 40 MHz from the FCC.

*A-: This is not enough for 20 Mbit/s.

-I: Why bother? There are no existing 20 Mbit/s 802 LANs.

*A-: Yes there is: fiber optic token bus, ANSI/IEEE 8802.4 1990

-A-: This is not enough for 10 Mbit/s.

>I: Is 40 MHz enough for 10 Mbit/s?

*A+: It is enough using modulation from some of the QPSK family.

?A-: It is not enough if using spread spectrum with a reasonable length spreading code.

?I: Can you transmit 10 Mbit/s by increasing the code rate?

?P: No, symbol rate is limited by delay spread.

?A+: Spread spectrum's use will be limited to environments with large delay spread.

*A-: We need to ask for more so that we can bargain.

*P: Request 70 to 140 MHz from the FCC.

*A+: We may need frequency division for extended service areas.

*A+: We may need frequency agility to avoid interference with co-primary users.

*A+: Bandwidth is needed for spread spectrum coding gain

*A+: Bandwidth is needed for spread spectrum path diversity

?A+: Spread spectrum isn't worth doing unless the spreading gain is much greater than 10.

-P: Request 600 MHz or more from the FCC.

-A+: Several people have re-iterated the need for 600 MHz.

*A-: The original mention of 600 MHz was placed on the floor in jest.

*A-: Given the limited nature of the resource, there is no point in asking for more that can be seriously considered.

The expert consensus is that typical 802 data rates are to be supported using 70 - 140 MHz bandwidth.

After a break, the meeting resumed at 3:31 PM. Tom Phinney proposed a change of wording to the reply comments. After some discussion of the kind of services that could share the channel, the proposal was amended.

Tom Phinney ***moves*** to change part of the reply comments, seconded by Chandos Rypinski, to the following:

" The radio LAN being defined by IEEE 802.11 will provide the same or equivalent capacity. Multiple geographically proximate LANs will be able to coexist and could coexist with certain categories of existing licensees.

While it is premature to specify the total bandwidth requirements for LAN data usage, 70 - 140 MHz is our educated guess."

The question was called by Dave Bagdy, seconded by Chandos Rypinski, the Ayes have it. Vote on motion: (27-0-2) Tom's ***changes are accepted***.

Tom Phinney ***moves***, seconded by Jan Vancraeynest, **to approve the reply comments for submission to FCC** (assuming 802 executive committee approval). (26-0-2) ***Passes***.

(This item was added to the Thursday Executive Committee agenda and was approved without discussion. The document as approved and reviewded by legal counsel is distributed as doc: IEEE P802.11/90-21 Secr.)

13.2 Destination of Input documents The input document list and their destination is given in appendix 2.

14. Any Other Business. In view of his work in CCIR Task Group 8/1 Mike Callendar asks if the IEEE P802.11 work is meant to be a public or private network. Jim Neeley responds that the service that we are providing is to an LLC and also to a yet to be defined voice, probably IVD, service. Tom Phinney responds that the principle interest is in private and building distribution. Chia-Chi Huang responds that both public and private is important, but private business use is problematic because of the need to coordinate with multiple cells (owned by other businesses).

Chandos Rypinski explains that we have access to the CCIR in general but to Taskgroup 8/1 in particular, as follows:

We have access through the US delegation, ask Frank Rose for acceptance and authorization to be a member of the US delegation. The US position is represented by the State Department. We need more representation from the computer community. For companies who wish to influence the CCIR community in these matters, the vehicle is Frank Rose.

15. Closure. Tom Phinney moves to adjourn. The Ayes have it. The chair thanks all participants for their contributions to the work, especially those working late in ad-hoc groups. The meeting is over at 4:25 PM, November 15, 1990.

Appendix 1
Attendance list

Mr. SVEN OLOF AKERLUND	ELLEMTEL	+46 8 727 30 44
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Mrs. HELEN E. BEVIS	British Telecom	+44 473 224 378
Mr. CHARLES BRILL	Amp Incorporated	717 561 6198
Miss. SUZY BROWN	Apple Computers Inc	408 974 6902
Mr. ROBERT E. BUAAS	The Buaas Corpotation	714 968 0070
Mr. DALE BUCHHOLZ	Motorola Inc.	708 632 5146
Mr. WILLIAM J. BUCKLEY	VERILINK Corporation	408 945 8156
Mr. MICHAEL H. CALLENDAR	MPR Teltech Ltd	604 293 6071
Dr. JONATHON CHEAH	HUGHES Network Systems	619 453 7007
Mr. TON CORADETTI	NCR Corporation	513 445 3068
Mr. ROBERT S. CROWDER	Ship Star Associates Inc	302 738 7782
Mr. LUCIAN DANG	Rockwell International	714 833 4352
Dr. PAUL EASTMAN	Fairchild Data Corporation	602 949 1155
Mr. BEHROOZ FARNOOMAND	OPTA Co. Ltd.	415 354 1137
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Mr. RICHARD FORMEISTER	Fairchild Data Corporation	602 949 1155
Mr. ANDREW GREEN	Sumitomo Electric USA	408 737 8517
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Mr. BOB HEILE	WIN Systems	508 689 3995
Mr. NABIL HINNAWI	Techn. Center	703 818 4508
Mr. CHIA-CHI HUANG	IBM Research	914 945 3286
Mr. RICHARD F. HUNTER	Comm/Scope Inc	704 323 4851
Mr. DONALD C. JOHNSON	NCR Corporation WHQ 5E	513 445 1452
Mr. RANDALL JONES	COMPAQ Computer Corp	214 985 4828
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Mr. JOHN MALIS	COMPAQ Computer Corp	214 985 4264
Mr. MICHAEL MASLEID	Inland Steel Co. MS2-465	219 399 2454
Mr. MARK MERRIK	Synoptic Communication	408 764 1538
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more.....

Appendix 1
Attendance list (continuation)

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Dr. KAVEH PAHLAVAN	Worcester Polytechnic Institute	508 831 5634
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Mr. BRIAN PERTY	Systech Corporation	619 453 8970
Mr. THOMAS L. PHINNEY	Honeywell	602 863 5989
Mr. STEVEN P. RUSSEL	TELEMARK Communications	415 322 2883
Mr. CHANDOS RYPINSKI	LACE Inc.	707 765 9627
Mr. HAIG A. SARKISSIAN	AT&T	201 771 4250
Mr. HAIM SHAFIR	Level one	916 985 3670
Mr. NATHAN SILBERMAN	Symbol Technologies Inc	408 446 2210
Mr. RICHARD SILLMAN	Sun Microsystems Inc	415 336 3670
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Mr. MARVIN SOJKA	Norand corporation	319 369 3564
Mr. LOUIS STANKAITIS	ANIXTER	708 677 2600
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Mr. VICTOR J. TARASSOV	AT&T Bell Labs	908 580 4218
Mr. NATHAN TOBOL	Future Concepts Inc	508 384 3696
Mr. CARLOS A. TOMASZEWSKI	Retix	213 399 1611
Mr. HIROSHI TOMIZAWA	OKI electric	915 723 9388
Mr. TOM TSOULOGIANNES	Telesystems	416 441 9966
Mr. JAN VANCRAEYNEST	NYNEX CORP.	914 287 5091
Mr. R.E. (DICK) WEADON	Southern Bell Comp Techn Resources Inc	314 529 7517
Mr. ALLAN WETZEL	Texas Instruments Inc	214 997 2370
Mr. STEVE WILKUS	AT&T Bell Laboratories	508 960 6033
Mr. GRAHAM WILLIAMS	British Telecom	+44 473 224 389
Mr. F. WILLIAMS SARLES	FWS Engineering	617 862 0607
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Mr. MARSHALL ZERBO		408 974 9116
Miss. MARY ZWIEBEL	IEEE	201 562 3804

Appendix 2
Temporary Document list

Ref No	Source	Title	Destination
11/LJ/01	Hayes	Temporary document list	annex minutes
11/LJ/02	Rypinski	Arthur D Little paper re Practical aspects of system design and Circuit realization of spread spectrum data communication links for use in License free applications	11/90-26
11/LJ/03	Postlethwaite	Request for product description for RLAN study by European Commission	obsolete
11/LJ/04	Hayes	New Technical Committee ASC T1P1	obsolete
11/LJ/05	Van der Jagt	Proposal for document ordering service	obsolete
11/LJ/06	Callendar	CCIR 8/1014 - Study report on Future Land Mobile Telecommunication systems (FPLMTS)	annex 4
11/LJ/07	Pahlavan	Wireless Information Network Group at the Worcester Polytechnic Institute	annex 3
11/LJ/08	Callendar	CCIR IWP 8/13, CAN 2 - Radio Parameters for frequency sharing considerations in the personal communications segment of the FPLMTSs.	obsolete
11/LJ/09	Rypinski	Comments of C.A. Rypinski on GEN Docket 90-314	obsolete
11/LJ/10		Call for papers International symposium on personal, indoor and mobile radio communications	annex 2
11/LJ/11		NIST hearings	obsolete
11/LJ/12	Rypinski	WINLAB workshop record	obsolete
11/LJ/13	Rypinski	Winlab, Development in wireless communications - navigating the regulatory morass	obsolete
11/LJ/14		Measurement-based calculations of bit-error-rate distributions in urban Los microcells at 900 MHz	reference
11/LJ/15		Design considerations for a future portable multimedia terminal	obsolete
11/LJ/16	Neeley	Attendance list	Appendix 1 to minutes
11/LJ/17		Message re CCIR frequency selection	obsolete
11/LJ/18		Draft Reply comment from IEEE	obsolete, see 11/90-21

Appendix 3
List of annexes

(For members only)

1 Doc 11/90-17 page 4 with line numbers
2 Call for papers International symposium on personal, indoor and mobile radio communications
3 Wireless Information Network Group at the Worcester Polytechnic Institute
4 CCIR 8/1014 - Study report on Future Land Mobile Telecommunication systems (FPLMTS)
5 Doc 11/90-17r Intermediate version of draft PAR
6 Doc 11/90-17Rr Intermediate version of draft PAR

6. Scope of proposed standard

To develop a Medium Access Control (MAC) and Physical Layer (PHY) specification for wireless connectivity for fixed, portable and moving stations within a local area.

Type of medium

The goal is that the MAC shall support PHYs using electromagnetic waves through the air (i.e. radio waves as well as infra-red or visible light)

PHY layer suitable for use with unlicensed RF equipment will be defined with this standard. If evidence of need and sufficient interest exists other PHY layers will be considered at a later time.

Radio spectrum

Currently the only available spectrum is in the ISM bands in the USA provisionally 915 MHz band in Canada and Australia. Test programs are underway in the UK and elsewhere, evaluating license free operation.

T fore the initial work of this committee will be for the ISM bands.

However, these bands are already heavily used, and it is felt that service degradation from other users will happen, increasing with time. Therefore, in order to further development of the standard, the 802.11 committee should participate in the development of changed or new regulations for short distance radio services in which all authorized users of any new frequency allocation shall be permitted to radiate only a defined maximum power density.

To further enhance the standard the 802.11 committee will undertake to document the benefits of, and make recommendations for international standardization where possible.

Supported Stations

The standard shall support stationary stations, movable stations, and mobile stations moving at pedestrian and vehicular speeds. This is to be implemented with one PHY if feasible.

Environment

Because the range of wireless transmission / reception may be smaller than the physical coverage area desired, a distribution system designed to provide range extensibility will be addressed as part of this standard.

Supported environments include:

- in buildings such as offices, financial institutions, shops, malls, small and large industry, hospitals,
- outdoor areas such as parking lots, campuses, building complexes and outdoor plants and storages.

Note: The definition of performance classes within a PHY may be necessary to support environments with benign or hostile characteristics.

The standard will include support of the following:

- Basic Service Area (BSA) in which each station can communicate with any other station in the BSA.
- Extended Service Area (ESA) in which each station can communicate with any other station via the defined and managed Distribution System.
- Stations which interoperate in both BSA and ESA shall be defined if feasible.

The Institute of Electrical and Electronics Engineers
Incorporated

United Kingdom and
Republic of Ireland Section

CALL FOR PAPERS

International Symposium on Personal, Indoor and Mobile Radio Communications

King's College - University of London
23rd-24th September 1991

The Symposium is being organized by the COM/SP Chapter of the UK & RI section of IEEE. Papers describing research, development and new concepts are invited for technical sessions. The following topics are suggested but not limited to:

- *state-of-the-art future technology*
- *experiments, trials and services*
- *performance studies*
- *user considerations*
- *coding and modulation techniques*
- *spread spectrum techniques*
- *signal processing applications*
- *antennas and RF subsystems*
- *equalization and diversity techniques*
- *multiple access techniques*
- *propagation study results*
- *novel network architectures*
- *land-mobile satellite communications*

Those wishing to offer a contribution should submit three copies of the full typescripts of not more than 5 A4 papers before 1st April 1991 to:

<u>Europe & Middle East Submissions</u>
Dr A H Aghvami
Dept of Electronic & Electrical Eng,
King's College London,
Strand,
London, WC2R 2LS
UK
Tel: +44-71-873-2898
Fax: +44-71-836-4781

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Dr K Pahlavan,
Electrical Eng. Dept.,
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<u>Far East Submissions</u>
Dr S Kato
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1-2356
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Fax: +81-468-59-3351

Requests for further information should be sent to Dr Aghvami.

<u>Programme Comittee Members:</u>

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Dr H W Arnold
Bell Comm Research - USA

Dr K Feher
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Rutgers The State University - USA

Dr S Kato
NTT Radio Comm Syst Labs - Japan

Dr A D Kucar
Bell-Northern Research - Canada

Dr T Mathiopoulos
University of Br Columbia - Canada

Dr P J McLane
Queen's University - Canada

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Worcester Polytechnic Inst - USA

Dr R Prasad
Delft University of Technology - The Netherlands

Dr R S Swain
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distribute to .11

Wirelss Information Network Group

at the

Worcester Polytechnic Institute

Activity Report

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PREFACE

The Electrical Engineering Department at the Worcester Polytech has a long tradition in radio communications. Perhaps our most prominent alumni in the radio communication industry is Atwater Kent, one of the pioneers in the radio communication industry. The Electrical Engineering Department building is named after him: the Atwater Kent Laboratory. This building, originally build in 1906, is the first building in the U.S. which was used to host an Electrical Engineering Department.

Currently, a group of our faculty and graduate students have shown considerable interest in various aspects of Wireless Information Networks. The uniqueness of our group lies in the ability to investigate all issues related to wireless indoor communications. Unmatched by any other research group, in the past few years we have contributed in basic research in channel modeling and simulation, spread spectrum communications, adaptive equalization, multiple access methods, network architectures and wireless optical communications. Our group has performed numerous measurements at the Worcester Polytech campus and in particular the Atwater Kent Laboratories. As a result, it is an ideal place for performance evaluation of the new systems. Currently, we intend to expand our group to study multi-media wireless networks. The research work of our group was initially supported by GTE Laboratories and, recently, the main part was supported by the National Science Foundation with some contributions from the Raytheon Company, HP and TI. We are intending to increase our industry sponsored research activities.

PROJECTS

- Frequency domain meaurement and modeling indoor radio propagations
- Time domain measurement and modeling of the indoor radio propagations
- Simulation of the indoor radio propagations
- Spread spectrum for wireless offices
- Adaptive equalization of the indoor radio channel
- Multiple access techniques for local wireless networks
- Performance evaluation of wireless office information networks
- Speech and image coding for wireless local communciations
- Optical wireless indoor networks

FACILITIES

The lab. is equipped with time and frequency domain measurement systems. The main component of the frequency domain measurement system is a network analyzer (HP 8753B) which outputs a swept frequency signal and analyzes the received signal. The network analyzer is capable to measure upto 3GHz and it can be updated to perform measurements upto 6GHz. The signal generated by the network analyzer is used as the input to a 45 dB transmitter RF amplifier. The output of the RF power amplifier is propagated by a dipole antenna. The signal from the receiver dipole antenna is passed through an attenuator and a series of amplifiers with a gain of 60 dB. The output of the amplifiers is returned to the network analyzer to determine the frequency response of the channel. The measured data is then read and stored by the PC controller for further analysis. The network analyzer is equipped with the Fourier transform board which provides the time domain response of the channel.

The time domain measurements are based on a fast digital scope (Tektronix 11402) with 600 MHz bandwidth. A carrier frequency of around 1 GHz is modulated by a train of narrow pulses providing 5nsec resolution for the received signal (the HP8082A pulse generator can generate pulses upto 2nsec width). The pulses are repeated every 500 ns. The modulated carrier is input to the 45 dB amplifier and the output is transmitted with a quarter-wave dipole antenna. The stationary receiver also uses a similar antenna to capture the radio signal. This is followed by a step attenuator and a low-noise high gain ($\approx 60dB$) amplifier chain. The signal is then demodulated using an envelope detector whose output is displayed on a digital storage oscilloscope coupled to a AT&T 6300 PC with a GPIB instrument bus.

In addition, analog and digital spectrum analyzers covering the frequency range of 0-110MHz are available, as well as function generators, frequency synthesizers, analog and digital scopes, as well as standard laboratory instruments. A high quality shielded room for low-level, noise free measurements is also available. Recently, Texas Instruments has donated about 100,000 dollars equipment for DSP design which are used by the members of the group for speech and image coding projects.

RECENT PUBLICATIONS

General Tutorials:

K. Pahlavan," Wireless Intra-Office Networks", Invited paper, ACM Trans. on Office Inf. Sys., July 1988.

K. Pahlavan,"Wireless Communication for Office Information Networks", IEEE Comm. Mag., June 1985.

K. Pahlavan,"Wireless Data Communication Techniques for Indoor Applications", Proceedings of IEEE Int. Conf. of Comm.,Chicago, June 1985 .

K. Pahlavan, "Modeling and Computer Simulation of the Indoor Radio Channel", International Conference on Control and Modeling, University of Teheran, Iran, July 1990.

K. Pahlavan, ".Wireless Indoor Communication Networks", A tutorial course, IEEE Workshop on Mobile and Cordless Telephone Communications", Kings College, University of London, England, Sep. 1989.

K. Pahlavan, "Wireless LANs for Offices and Manufacturing Environments", Simon Fraser University and University of Victoria, British Columbia, Canada, July 1989.

K. Pahlavan," Wireless Local Area Networks", Illinois Institute of Technology, Chicago, March. 1989.

K. Pahlavan, " Wireless Distribution Technology: Transmission Techniques", National Communication Forum, Chicago, Sept. 1988.

K. Pahlavan, " Wireless LANs for Offices and Manufacturing Floors", Eastern Telecommunication Forum, Apr. 1988.

K. Pahlavan," Intera-Office Wireless Data Networks", IEEE Communication Theory Workshop, Florida, Apr. 1987.

M. Marcus, P. Ferert, and K. Pahlavan, The Wireless Office, MIT Communication Forum, Sep. 1985.

Channel Characterization

Frequency Domain Channel Modeling and Simulation

S. J. Howard and K. Pahlavan, "Autoregressive Modeling of Wideband Indoor Radio Propagation", submitted to the IEEE Trans. on Comm. (also presented in the IEEE GLOBECOM'90).

K. Pahlavan and S. J. Howard, "Statistical AR Models for the Frequency Selective Indoor Radio Channels", IEE Elect. Let. July 19, 1990.

S. J. Howard and K. Pahlavan, "Autoregressive Modeling of the Indoor Radio Channel", IEE Elect. Let., June 7, 1990.

S. J. Howard and K. Pahlavan,"Measurement and Analysis of the Indoor Radio Channel in the Frequency Domain", IEEE Trans. on Instrumentation and Measurements, Oct. 1990.

S. Howard and K. Pahlavan,"Doppler Spread Measurements of the Indoor Radio Channel", IEE Elec. let, Jan. 19, 1990.

K. Pahlavan and S. J. Howard, "Frequency Domain Measurements of the Indoor Radio Channel", IEE Electronics Letters, Nov. 23, 1989.

S.J. Howard and K. Pahlavan,"Autoregressive Modeling of Wideband Indoor Radio Propagation", Proceedings of the IEEE Globecom, San

Diego, Dec. 1990.

Time Domain Modeling and Simulations

R. Ganesh and K. Pahlavan, "Modeling of the Indoor Radio Channel", submitted for publication in IEE Proceedings (also presented in GLOBECOM'89).

R. Ganesh and K. Pahlavan,"Effects of Local Traffic and Local Movements on the Multipath Characteristics of the Indoor Radio Channel", IEE Electronics Let., June 7, 1990.

R. Ganesh and K. Pahlavan, "On the Arrival of the Paths in Multipath Fading Indoor Radio Channels", IEE, Electronic Letters, June 1989, pp763-765.

K. Pahlavan, R. Ganesh, and T. Hotaling, "Multipath Propagation Measurements on Manufacturing Floors at 910MHz", IEE Electronics Letters, Feb. 1989.

R. Ganesh and K. Pahlavan, "On the Modeling of the Fading Multipath Indoor Radio Channels", IEEE Globecom, Dallas, Texas, Dec. 1989.

R. Ganesh and K. Pahlavan, "A Report on Fading Multipath Indoor Radio Channels" IEEE Workshop on Mobile and Cordless Telephone Communications", Kings College, University of London, England, Sep. 1989.

T. Sexton and K. Pahlavan," Effects of Multi-Cluster Delay Spectrum on Wireless Indoor Communications" Proceedings of 1987 Conference on Information Science and Systems, John Hopkins University, Baltimore, MD., March 1987.

Spread Spectrum

K. Pahlavan and J. W. Matthews," Channel Measurement Noise and the Performance of Adaptive Matched Filter Receivers over Fading Multipath Channels", IEEE Trans. on Comm., Nov. 1990.

K. Pahlavan and M. Chase, " Spread Spectrum Multiple Access Performance of Orthogonal Codes for Indoor Radio Communications", IEEE Trans. on Comm., June 1990.

K. Pahlavan, "Spread Spectrum for Wireless Offices" tutorial paper, IEEE Symposium on Spread Spectrum Techniques and Applications, King's College, London, England, Sep. 1990.

M. Chase and K. Pahlavan, "Spread Spectrum Multiple Access Performance of Orthogonal Codes Over Measured Indoor Channels", IEEE Symposium on Spread Spectrum Techniques and Applications, King's College, London, England, Sep. 1990.

M. Chase and K. Pahlavan,"Spread Spectrum Multiple Access Performance of Orthogonal Codes in Fading Multipath Channels", IEEE MILCOM, Oct. 1988.

K. Pahlavan," Spread Spectrum for Wireless Local Networks", Proceedings of IEEE PCCC, Feb. 1987.

K. Pahlavan, RF Spread Spectrum for Wireless Local Networks, GTE Laboratories, Tech. Report No. TN-86-507.1, Feb. 1986.

Adaptive Equalization

K. Pahlavan, S. Howard, and T. Sexton,"Adaptive Equalization of Indoor Radio Channel", accepted for publication in the IEEE Trans. on Comm.

S. Howard and K. Pahlavan "Performance of Adaptive Equalization over Measured Indoor Radio Channels", IEE Electronics letters, Sep. 1989.

T. A. Sexton and K. Pahlavan, "Channel Modeling and Adaptive Equalization of Indoor Radio Channels", IEEE Jour. of Sel. Areas in Comm. (JSAC), Jan. 1989.

S. Howard and K. Pahlavan, " Performance of a DFE Modem Evaluated from Measured Indoor Radio Multipath Profiles", Proceedings of the IEEE ICC, Atlanta, GA, June 1990.

P. A. Bello and K. Pahlavan," Adaptive Equalization for Staggered QPSK and QPR Over Frequency Selective Microwave LOS Channels", IEEE Trans. on Communications, May 1984.

S. J. Howard and K. Pahlavan, "Adaptive Equalization of Indoor Radio channels for High Speed Wireless LANs", Proceedings of the twenty third Annual Conference on Information Science and System, John Hopkins University, Maryland, March 1989.

T. A. Sexton and K. Pahlavan, "Delay Densities and Adaptive Equalization of Indoor Radio Channels", IEEE MILCOM, Oct. 1988.

T. A. Sexton, "Channel Modeling and Adaptive Equalization of Indoor Radio Channels", Ph.D. Thesis, Due to Aug. 1989. Journaled Articles

Network Architectures and Multiple Access

K. Zhang and K. Pahlavan, " Relation Between Transmission and Throughput of the Slotted ALOHA Local Packet Radio Networks" accepted for publication in the IEEE Trans. on Comm.

K. Zhang and K. Pahlavan, "CSMA Local Radio Networks with BPSK Modulation in Rayleigh fading Channels", IEE Elect. Let., Sep. 27th, 1990.

K. Zhang and K. Pahlavan,"An Integrated Voice-Data System for Wireless Local Area Networks", IEEE Trans. on V.T., April 1990.

K. Zhang, K. Pahlavan, and R. Ganesh, "Slotted AHOLA Networks with PSK Modulation in Rayleigh-Fading Channels", IEE Electronics Letters, March 1989.

K. Zhang and K. Pahlavan,"A New Approach for the Analysis of the Slotted ALOHA Packet Radio Networks", Proceedings of the IEEE ICC, Atanta, GA, June 1990.

K. Zhang and K. Pahlavn, "An Integrated Voice/Data System for Mobile Indoor Radio Networks Using Multiple Transmission Rate", IEEE Globecom, Dallas, Texas, Dec. 1989.

K. Zhang and K. Pahlavan, "A Radio System for Integrated Voice/Data Local Networks" IEEE Workshop on Mobile and Cordless Telephone Communications", Kings College, University of London, England, Sep. 1989.

K. Zhang and K. Pahlavan, "An Integrated Voive/Data System for Wireless Local Area Networks" Proceedings of the Twenty-Second Annual Conference on Information Sciences and Systems, Princeton University, Princeton, NJ, March 1988.

K. Zhang, Wireless Local Networks for Integrated Voice/Data Services, Ph.D. Dissertation, EE Dept., WPI, June 1990.

R. Ganesh, "Multiple Accessing in Local Area ALOHA Networks in Presence of Capture", M.S. thesis, WPI, June 1987.

R. Ganesh and K. Pahlavan," Effects of Retransmission and Capture for Local Area ALOHA Systems", Proceedings of 1987 Conference on Information Science and Systems, John Hopkins University, Baltimore, MD., March 1987.

Other Related Publications

K. Pahlavan " Nonlinear Quantization and Multi-Level/Phase Modulation and Coding", IEEE Trans. on Comm., Jan. 1991.

K. Pahlavan and J. L. Holsinger,"Voice-Band Data Communication, A Historical Review: 1919-1988", invited paper, IEEE Comm. Soc. Mag., Jan. 1988.

K. Pahlavan, " Comparison Between the Performance of QPSK, SQPSK, QPR, and SQPR Systems Over Microwave LOS Channels" IEEE Trans. on Communications, March 1985.

K. Pahlavan and J.L. Holsinger, QAM Trellis-Coded Signal Structure, U.S. Patent, Apr. 21, 1987.

J. L. Holsinger and K. Pahlavan," A Historical Overview of Voice-Band Data Communications", Proceedings of IEEE Int. Conf. in Comm., Seattle, WA, June 1987.

K. Pahlavan and J. L. Holsinger," Expanded Trellis Code Modulation for Voice-Band Data Communications", Proceedings of IEEE Int. Conf. Of Comm., June 1987.

K. Pahlavan and J. L. Holsinger, "A Method to Counteract the Effects of PCM Systems on the Performance of Ultra High Speed Voice-band Modems", Proceedings of IEEE ICC, Ontario, Canada, June 1986.

K. Pahlavan, " Nonlinear Quantization and Data Communication", Proceedings of IEEE ICASSP, Tokyo, Japan, April 1986.

K. Pahlavan and J. L. Holsinger,"Signal Constellation for Voice-band Data Communication Over Channels with Non-uniform Quantization", Proceedings of IEEE Phoenix Conf. on Computers and Communications, March 1986.

K. Pahlavan,"A Review of Wireless In-House Data Communication Systems", Proceedings of IEEE Computer Communication Symposium, Washington D.C., Dec. 1984.

K. Pahlavan and J. L. Holsinger," A Model for the Effects of PCM Compandors on the Performance of High Speed Modems", IEEE Globecom, New Orleans, Dec 1985.

K. Pahlavan, Signal Processing in Telecommunications, (chapter 22 of handbook of signal processing, edited by Chen), Marcel Dekker Inc., 1988.

J.L. Holsinger, C. Jotikasthira and K. Pahlavan, Signal Structure for Data Communication, U.S. Patent, No. 4,660,213, Apr. 21, 1987.

K. Pahlavan and J. L. Holsinger, QAM Trellis Coded Signal Structures , U.S. Patent, No. 4,660,214, Apr. 21, 1987.

K. Pahlavan,Optimum Signal Space Design in the Presence of Compandors ,Tech. Memo, INFINET Inc., Feb. 1984.

K. Pahlavan, Viterbi Algorithm and High Speed Modems, Tech. Memo., June 1984.

K. Pahlavan and J.L. Holsinger , Comparative Evaluation of Very High Speed Modems, Tech. Memo, Oct. 1984.

Grad. students and their projects

1. M. Chase, Spread Spectrum Multiple Access for Indoor Radio Channels. He is currently working in Kodak Inc., Waltham, MA (he is expected to complete his Ph.D. requirements by June 1991).
2. T. A. Sexton, Adaptive Equalization of Indoor Radio Channels. He is currently working at Motorola Inc, Schaumberg, IL (completed his Ph.D. requirements on Aug. 1989).
3. R. Ganesh, Multipath Channel Characterization for Indoor Radio Channels. R. Ganesh was a Research Assistant supported by NSF (he will complete his Ph.D. requirements by June 1991). He is currently an instructor at WPI.
4. K. Zhang, Integrated Voice Data for Wireless Indoor Radio Networks. He was a Research Assistant supported by NSF (completes his Ph.D. requirements in June 1990). He is currently with Motorola Inc.- Cellular Division, Arlington Heights, IL.
5. S. J. Howard, Characterization of the Indoor Radio Propagations in Frequency Domain. He was a Raytheon fellow (completes his Ph.D. requirements by the June 1991). He is currently with Raytheon Equipment Division, Marlboro, MA.
6. A. Falsafi, Spread Spectrum for Indoor Applications. He is currently with the Digital Equipment Corporation, MA (he has started his Ph.D. program).
7. Paul Fay, Channel Simulation for Indoor Radio Channel, M.S. candidate started recently.
8. Y. Q. Wang, Wireless Netwroks, Ph.D. candidate started recently.
9. S. Wang, Implementation and Analysis of Wireless Optical Indoor Networks. He was originally supported by the Government of China and this year he is full-time M.S. student.

Samples of undergrad. projects

1. S. Smith, T. Hotaling, and G. Jouret, RF Spread Spectrum Implementation of Wireless Terminals, June 1987 (initiated by GTE Laboratories).
2. J. Clark, B. McCullen, and P. Paglia, and A. Rosantone, Infrared Wireless Terminals, June 1987 (initiated by BTE laboratories).
3. D. Brissette, E. Pauer, and D. Willard, Implementation of Wireless Modem Using TMS-320, June 1988 (initiated by Tech-Man Int.).
4. W. Noel, W. Iannacci, and J. Peidavosy, Local Area Network (LAN) Using Wireless Infrared Transmission, June 1988.
5. B. Silvester and B. Hare, Simulation of the Indoor Radio Channel, expected to complete by June 1991 (supported by NSF).

11/LS6

CCIR
XVIIth Plenary Assembly
Düsseldorf, 1990

Document 8/1014-E
15 December 1989

Ref.: Document 8/433(Rev.1)

REPORT M/8 (MOD F)

FUTURE PUBLIC LAND MOBILE TELECOMMUNICATION SYSTEMS

(Question 39-1/8)

1. Introduction and summary

Interim Working Party 8/13 was set up by Decision 69 in 1985 with the task of investigating the form of Future Public Land Mobile Telecommunication Systems (FPLMTS) with particular regard to the overall objectives, suitable frequency bands and the degrees of compatibility or commonality. A proposed new draft Recommendation on FPLMTS has been generated and is given in Draft New Recommendation AH/8.

This Report summarizes the result of the study.

From the beginning of the study it was apparent that a light-weight personal pocket radio would be a dominant feature of FPLMTS. Most administrations advocated the desirability of such a personal station (PS) being usable anywhere world-wide, with the inherent implication of a requirement for a single radio interface standard. However, considerations of the varieties of radio coverage scenarios for personal communications (from very short range ones for use within buildings or urban areas through medium range suburban and longer range rural coverage, together with the desire for links to aircraft or satellites) indicated that a number of RF transmission requirements and frequency bands are likely to be required. Moreover, a tandem link could well be involved from the PS via another mobile connection. There is a possibility that the final link to the PS could be the same. However, the situation of the vehicle mounted mobile accessing terrestrial links is different, and some administrations emphasized the much reduced requirements for inter-regional roaming (although international roaming within a region will be a requirement). Hence, it was agreed that greater flexibility for regional standards for roaming is needed. Nevertheless, it was also recognized that a common world-wide radio interface and frequency band may increase the possibility of reduced costs of network and terminals and availability of equipment.

The frequency allocations made by WARC-MOB-87 for the land mobile satellite service also influenced the study on FPLMTS, with the realization of the opportunities that satellite links could bring to such systems.

A number of objectives for FPLMTS has been agreed. It was found desirable to partition them into 19 primary ones and 10 secondary. The secondary status allows more freedom of choice for implementation.

The FPLMTS could be considered as either an adjunct to or an integral part of the fixed network (PSTN/ISDN). The particular characteristics of the radio channel will, however, impose some constraints on the services offered as well as providing opportunities for others such as dispatch, group call, etc. Service should be provided to a variety of mobile terminals ranging from the PS to vehicle mounted mobile stations (MS). Additionally FPLMTS should be usable as a temporary or permanent substitute for the fixed network. The standards of services provided should be comparable with those of the fixed network, and particular attention will have to be paid to the need for enhanced privacy/security on the radio channel (not only for speech, but also for billing, etc.).

Two complementary scenarios are postulated. The first is concerned with land-based systems. This involves the PS operating in five modes, i.e. accessing a private "domestic" base, accessing a private office base, accessing a public personal base, accessing a public mobile base directly or communicating via an MS. The MS is linked to a base station (BS) for its mobile service and operates either in its own right or as a relay for a PS. The second scenario involves satellite links to mobile earth stations (MES) either in their own right or for relay to a PS. Also envisaged are satellite and terrestrial paging systems.

An architecture is defined that shows interfaces within the FPLMTS and with the fixed network. The functionality of the mobile equipment is also indicated.

The factors which affect the choice of desired frequency bands of operation are discussed. Starting with services to be offered and traffic models, estimates are made of the requirements of such factors as modulation, coding, re-use, etc., in order to assess the bandwidth requirement. This Report also contains comments on the choice of frequency bands including any biological factors.

The desire for compatibility within and between FPLMTS is commented on in several sections of the present Report as are the benefits of commonality. Considerations of compatibility with the ISDN give rise to the concept of mapping its B (bearer) and D (signalling) channels onto I (information) and C (control) channels for FPLMTS.

2. Objectives for future public land mobile telecommunication systems

FPLMTS should aim to achieve the following objectives which are classed as primary and secondary. Secondary objectives are those which some administrations or regions may not wish to include. Within each class the numbers are for reference purposes only and do not convey an order of priority.

PRIMARY:

P1. To make available voice and non voice telecommunication services to users who are on the move or whose location may change (mobile users).

P2. To provide these services over a wide range of user densities and geographic coverage areas.

P3. To make efficient and economical use of the radio spectrum consistent with providing service at an acceptable cost.

P4. To provide, as far as practical, a service of high quality and integrity, comparable to the fixed network.

P5. To accommodate a variety of mobile terminals ranging from those which are small enough to be easily carried on the person (the personal pocket radio), to those which are mounted in a vehicle.

P6. To provide a framework for continuing extension of mobile network services, and access to services and facilities of the fixed network (PSTN/ISDN) subject to the constraints of radio transmission, spectrum matters and system economics.

P7. To admit the connection of mobile users to other mobile users or fixed users, using the fixed network (PSTN/ISDN) or other telecommunication networks as appropriate.

P8. To permit the use of the FPLMTS for the purpose of providing its services to fixed users, under conditions approved by the appropriate national or regional authority, either permanently or temporarily, either in rural or urban areas.

P9. To admit the provision of service by more than one network in any area of coverage.

P10. To allow mobile and fixed network users to use the services irrespective of location (i.e. national and international roaming).

P11. To provide for the required user authentication and billing functions.

P12. To provide for unique user identification and PSTN/ISDN numbers in accordance with appropriate CCITT Recommendations.

P13. To support integrated communication and signalling.

P14. To establish signalling interface standards in terms of the Open System Interconnection (OSI) model.

P15. To provide an open architecture which will permit the easy introduction of technology advancements, as well as different applications.

P16. To enable each mobile user to request particular services, and initiate and receive calls, as desired.

P17. To allow the co-existence with, and interconnection with, mobile systems which use direct satellite links taking into consideration CCITT Recommendation E.171.

P18. To provide for a unique equipment identification scheme.

P19. To provide a modular structure which will allow the system to start from as small and simple configuration as possible and grow as needed, both in size and complexity within practical limits.

SECONDARY:

S1. To provide for additional levels of security (for voice and data services) compared to that contained in P4. In addition, to allow for the provision of end-to-end encryption for voice and data services.

S2. To provide service flexibility which permits the optional integration of services such as mobile telephone, dispatch, paging and data communication, or any combination thereof.

S3. To provide an indication to the paying party of added call charges, e.g. due to roaming.

S4. To support terminal interfaces which allow the alternative use of terminal equipment in the fixed ISDN network.

S5. To support equipment and component design that can withstand typical rural conditions (rough roads, dusty environment, extreme temperatures and humidity, etc.).

S6. To allow the system to be configured for special conditions where mobility between cells, or even within a cell, is not required, or where a high traffic per user is required.

S7. To take account of the communications requirements for road traffic management and control systems.

S8. To accommodate the use of repeaters for covering long distances between terminals and base stations, providing this does not constrain the specification of the radio interfaces.

S9. To allow the connection of PABX's, or small rural exchanges to mobile stations.

S10. To allow for an extension of the cell size in rural or remote areas, providing this does not constrain the specification of the radio interfaces.

IEEE P802.11

Wireless Access Method and Physical Layer Specifications

Proposal for improved PAR

Attached is a Project Authorization Request Form completed according to decisions made at the IEEE P802.11 meeting held at La Jolla, CA, up to 14 November 1990 and subsequent improvements made at the end of Wednesday. The Working Group will review the document as printed and give final approval before 15 November noon.

The plan is to submit the final draft PAR to the EC with the following motion:

To submit the PAR to the Computer Society for further approval and to request withdrawal of PAR IEEE P802.4c as soon as the 802.11 PAR has been approved.

IEEE Standards
PROJECT AUTHORIZATION REQUEST (PAR)

1. Date of Request: 1990-11-15 2. Assigned Project #:

3. Does this PAR revise a previously approved PAR? X_ YES __ NO

4. Description of Proposed Document: Standard X_ New X_ Trial Use __
Recommended Practice __ Revision __ of Std. _____ Full Use X_
Guide __

5. Project Title:

Wireless Access Method and Physical Layer Specifications

6. Scope of Proposed Standard: (Use attachment sheet if necessary)

To develop a Medium Access Control (MAC) and Physical Layer (PHY) specification for wireless connectivity for fixed, portable and moving stations within a local area.

Refer to the attachment for details

7. Purpose of Proposed Standard: (Use attachment sheet if necessary)

To provide wireless connectivity to automatic machinery, equipment or, stations that require rapid deployment, which may be portable, or hand-held or which may be mounted on moving vehicles within a local area.

To offer a standard for use by regulatory bodies to standardize access to one or more radio frequency bands for the purpose of local area communication.

Refer to the attachment for details

8. SPONSOR: Society: Computer Society

Committee: Technical Committee on Computer Communications (TCCC)

9. Name of Group that will write the standard: IEEE P802

10. Target Completion Date: 1992-12-31

11. Proposed Coordination: (See instructions.) Method of Coordination:
SCC10 (IEEE Dictionary)

Refer to the attachment for details

12. Are you aware of any patent, copyright, or trademark issues? X_ YES __ NO

Are you aware of any standards or projects with a similar scope? X_ YES __ NO

(If yes, attach a sheet with a complete description of the impact of the similarities.)

PROJECT AUTHORIZATION REQUEST (PAR)

(cont'd)

13. Copyright Agreements for IEEE Standards

I hereby acknowledge my appointment as Official Reporter to the _____IEEE P802_____Committee to write/~~revise~~ a Standards Publication (entitled or to be entitled)___Wireless Access Method and Physical Layer Specifications_____

____

In consideration of my appointment and the publication of the Standards Publication identifying me, at my option, as an Official Reporter, I agree to avoid knowingly incorporating in the Standards Publication any copyrighted or proprietary material of another without such other's consent and acknowledge that the Standards Publication shall constitute a "work made for hire" as defined by the Copyright Act, and, that as to any work not so defined, I agree to and do herby transfer any right or interest I may have in the copyright to

said Standards Publication to IEEE.

Name_____Vic Hayes_____

(chair of working group)

Title_____Chairman IEEE P802.11 Working Group_____

Date_____

14. Person delegated to receive communications and conduct liaison with interested bodies:

(This is normally the chair of the working group. If not please indicate IEEE position.)

Name_____Vic Hayes_____ Telephone____+31 3402 76528_____

Company_____NCR Systems Enginering b.v._____ Fax_____+31 3402 39125_____

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15. Submitted by:

(This is normally the sponsor's liaison to the Standards Board. If not please indicate IEEE position and relationship to the sponsor.)

Name_____Donald C. Loughry_____ Telephone_____408 447 2454_____

Company_____Hewlett-Packard Company_____ Fax_____408 447 3660_____

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_____

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6. Scope of proposed standard

To develop a Medium Access Control (MAC) and Physical Layer (PHY) specification for wireless connectivity for fixed, portable and moving stations within a local area.

Type of medium

The goal is that the MAC shall support PHYs using electromagnetic waves through the air (i.e. radio waves as well as infra-red or visible light).

PHY layer suitable for use with the electromagnetic frequency spectrum as described in the following paragraph will be defined with this standard. If evidence of need and sufficient interest exists other PHY layers will be considered at a later time.

Radio spectrum

Currently the only available unlicensed spectrum is in the ISM bands in the USA provisionally 915 MHz band in Canada and Australia. Test programs are underway in the UK and elsewhere, evaluating license free operation.

The initial effort will be for the ISM bands and to consider the use of additional bands beyond ISM.

However, these ISM bands are already heavily used, and it is felt that service degradation from other users will happen, increasing with time. Therefore, in order to further development of the standard, the 802.11 committee should participate in the development of changed or new regulations for short distance radio services in which all authorized users of any new frequency allocation shall be permitted to radiate only a defined maximum power density. The goal is to provide regulations which allow for an easy approval process for the end-user.

To further enhance the standard the 802.11 committee will undertake to document the benefits of, and make recommendations for international spectrum allocation and use, where possible.

Supported Stations

The standard shall support stationary stations, movable stations, and mobile stations moving at pedestrian and vehicular speeds. This is to be implemented with one PHY if feasible.

Environment

Because the range of wireless transmission / reception may be smaller than the physical coverage area desired, a distribution system designed to provide range extensibility will be addressed as part of this standard.

The standard will include support of the following:

- Basic Service Area (BSA) in which each station can communicate with any other station in the BSA.
- Extended Service Area (ESA) in which each station can communicate with any other station via the defined and managed Distribution System.
- Stations which interoperate in both BSA and ESA shall be defined if feasible.

Possible target environments include:

* in buildings and other premises such as offices, financial institutions, shops, malls, small and large industry, hospitals and residences,
* outdoor areas such as parking lots, campuses, building complexes and outdoor plants and storages.

Note: The definition of performance classes within a PHY may be necessary to support environments with benign or hostile characteristics.

Supported service

The Wireless MAC shall support both connectionless service as defined in the MAC Service definition at rates between 1 and 20 Mbit/s as well as a service supporting packetized voice.

Compatibility requirements

The specification shall meet the following standards and documents:

- the IEEE P802 Functional Requirements including section 5.6.1 (in version 6.5):

  "The MAC Service Data Unit (MSDU) loss rate shall be less than 4*10E-5 for an MSDU length of 512 octets.".

  A minimally conformant IEEE P802.11 network will meet all of the P802 requirements except that 5.6.1 will be met at least 99.9 % of the time on a daily basis, in 99.9 % of the total geography of the service area.

  IEEE P802.11 will define approaches to allow a minimally conformant network to achieve full conformance over the total geography of the service area.

  ~~* transmissions of one node do not necessarily have to be received by all other nodes simultaneously.~~

- IEEE 802.2 MAC service Definition
- ISO 10039 MAC Service Definition
- IEEE 802.1 A Overview and Architecture,
- IEEE 802.1 B for LAN/MAN Management,
- IEEE 802.1 D for T and SRT bridges,
- IEEE 802.1 F for Guidelines for the Development of Layer Management Standards,
- IEEE 802.10 Secure Data Exchange.

- The standard shall anticipate restrictions on Electromagnetic fields and pulsing of Electromagnetic fields due to potential biological hazards.

First draft conf standard ready for ballot in 802.11	March 1992
TCCC ballot of MAC & PHY standard	July 1992
TCCC ballot for conf standard	Nov 1992
Submission to ISO of MAC & PHY standard	Dec 31, 1992

11 Proposed Coordination

CCIR Task Group 8/1 (formerly IWP 8/13)	draft circulation
CEPT/RFC/FM	draft circulation
ETSI RES	corresp/common membership
ECMA TC32/TG10	corresp/participation
ISA SP-50	Common membership
SCC10 (IEEE dictionary)	Liaison
ANSI X3S3	Liaison
ISO/IEC JTC1/SC6/WG1 and WG3	Through ANSI X3S3
ANSI ASC T1P1	correspondence

12. Patent, Related Project

Patents potentially relevant to the work of IEEE P802.11 are known to exist.

CCIR Study Group 9 owns a project designated "Question AM/8 or Z/9" titled "Radio Local Area Networks". To date there is no understanding of the level of interest of the project.

To prevent duplication of effort, IEEE P802.11 has requested the mandate to liaise to CCIR.