IEEE 802,11
802 LAN Acess Method for Wireless Physical Medium

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TITLE: **MOTION:**
INITIATION OF EFFORT ON 1.9 AND 5.2/5.8 GHZ PHY'S

SUMMARY

This paper offers for approval a motion recommending the development of new PHYs defined as:

1. Best use of 10 MHz of spectrum (scalable from 5 to 20 MHz) in the 1.85-2.20 GHz band as allocated by the FCC in the Second Report and Order on Docket 90-314 released October 22, 1993; and more particularly the spectrum from 1900-1920 MHz for asynchronous devices including specified etiquette.
2. Best use of 40-70 MHz of spectrum offering a transfer rate of 10 Mbps or higher:
   a) in the USA Part 15 ISM band at 5.7250-5.8375 GHz, or
   b) in the ETSI RES 10 HIPERLAN proposed band near 5.2 GHz.

The motivations for initiating the new PHYs also include the following:

A) These bands are capable of offering speed, capacity, accuracy and the integrated services that are required for a large scale business and all smaller businesses as a subset.

B) The design of a MAC for mediums of adequate bandwidth may be common for all rates and mediums supported increasing the benefit from the necessary effort.

C) The MAC and necessary adaptation layers for the present FH PHY will be specialized to that medium, and not elsewhere usable.

D) *The FH (frequency hopping) PHY now proposed may be incapable of providing the minimum usable accuracy, speed and capacity of service as defined by IEEE 802 and the 802.11 Functional Requirements.* The direct sequence proposal could result in a workable system but of only minimal capability.

MOTION: INITIATION OF EFFORT ON 1.9 AND 5.2/5.8 GHZ PHY'S

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UNLICENSED PERSONAL COMMUNICATIONS SERVICES
Summary of Decisions in
Second Report & Order in GEN Docket No. 90-314
Transcription of Slides presented by Mr. Julian Knapp, FCC
October 26, 1993
FCC Laboratories -- Columbia, MD

MOTION: INITIATION OF EFFORT ON 1.9 AND 5.2/5.8 GHZ PHY'S

GENERAL DISCUSSION

Initiation of work on new PHYs is advocated based on evidence of feasibility and functional need. The need is accelerated as a result of the recent FCC Second Report and Order on Docket 90-314 released October 22.[1] The conclusion is a motion for decision by this Committee.

A previous contribution has made most of the technical points,[2] from a detail point of view. Feasibility was argued in terms of fairly specific proposals. The motion does not contain or assume this specific material. Passage of the motion accepts the goals but is silent on the means.

The feasibility arguments below are brief and generic. The *Author's Opinions* are marked by italic font. The technical argument is only relevant until it is accepted that an answer exists. There is no intent to define that answer.

The feasibility arguments include an attempt to distinguish against the starting premises that led to the adoption of the present direction..

> *Use of these frequencies and bandwidths will enable a data transfer rate and accuracy comparable with that of present generation wired LANs and sufficient to provide more than the lowest level of "multi-media" video and fax service.*

FEASIBILITY IN THE 1.90-1.92 GHZ BAND

This band must be considered as two 10 MHz bands because only half of it has a low density of incumbents which can be cleared at an earlier date. Use of this band requires the incorporation of an LBT etiquette based on the WINForum proposal.

The 10 MHz bandwidth is too narrow to consider frequency hopping requiring 75 MHz for a 1 Mbps transfer rate. Resolution of overlapping coverage with frequency division channelization is likely to compare unfavorably with time division methods.

The allocation is also too narrow for 11-chip direct sequence spreading to be used at data rates above 1 Mbps. Even at the maximum chipping rate, the chips will be too long to resolve separate propagation paths. It follows that there will be fading, and measures are required to mitigate the resulting accuracy degradation.

> *It will be possible to obtain a sufficiently high data rate and transfer accuracy, but not without using techniques associated with access-points using priviledged antennas with more than minimal diversity functions. Direct peer-to-peer capabilities may remain available, but the system performance cannot be maximized if this were the primary mode. It is*

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1 See Attachment A which is a transcription of slides summarizing the aspects of the Report and Order related to unlicensed PCS

2 "Necessary PHY Layer Alternatives for ET Band and for 'HIPERLAN,' " C. Rypinski, 802.11-93/152

assumed that there are compromise methods that will enable a yield of 4 Mbps transfer rate from 10 Mbps of spectrum.

The defintion of anticipated interferers will be quite different in this band falling into two categories: 1) incumbent microwave systems during the introductory years, and 2) other low-powered systems using mostly like bandwidth and etiquette. *This is a further conclusive criteria for the inapplicability of current FH PHY to this band.*

FEASIBILITY IN THE 5.8 GHZ ISM BAND

The primary advantages of using this band are: 1) increased spectrum space for operation at higher transfer rates, and 2) reduced probability of interference from foreign transmitters. It is the only immediately available band where transfer rates in the 16-24 Mbps range can be accomplished, albeit with a short radio range.

Inhibiting Considerations

The main reasons for NOT using this band are: 1) reduced capture area (aperture) of non-directional receiving antennas, and 2) anticipated additional cost for microwave radio components. *Neither of these reasons are sufficient in magnitude to foreclose use of this band.*

Station antennas on portable computers are unlikely to be horizontally omni-directional and certainly will and must be vertically directional. If the antenna is not at or above the top of the display it will surely be shielded in some directions. For these and other reasons, it is inevitable that stations will use two or more moderately directive antennas in diversity on any microwave radio band.

The proportion of *microwave components* in a radio can be made very small--few enough to favor discrete components. While design of a 5.8 GHz receiver and transmitter requires the skill of experienced radio designers, it does not follow that a microwave radio front end is best executed on a single chip however convenient that might be for designers without radio skill. *With or without integration, this part of the radio will be a sufficiently small fraction of the total cost of the wireless implementation so that overall feasibiity will not turn on the cost question.*

A further mitigating factor is that the transmitter power and required receiver sensitivity are not required to be on the edge of the achievable. Excess sensitivity may be harmful in reducing the overload point where strong out-of-band signals become disabling.

Encouraging Considerations

When moderately directional antennas with controlled shapes are required, the shorter wavelength in this band enable such antennas to be much smaller in area and volume. Some types that probably will be used are optimal in this band; e.g., "patch" and shielded slot.

Coverage and excess coverage are more easily defined and controlled with physical barriers at the higher microwave frequencies. Propagation losses through barriers are generally higher, however coverage via apertures and from secondary reflection is increased--sometimes when not wanted. *With intent, systems in adjoing rooms might be cochannel without material interference.*

The value of having enough bandwidth to provide the necessary peak transfer rate cannot be over-estimated. *For those who believe that "multi-media" services are a requirement, there must be a menu of connection-type transfer rates for video.* 64 Kbps is useful but it is not video as most of the world thinks of it. With clever compression algorithms beyond MPEG, a medium providing a 384 Kbps connection could properly claim to be adequate for live video.[3] With the T-1 rates at 1.472 and 1.536 and CCITT 2.048 Mbps, there is no question. *The provision of such services with a delay restriction requires that the channel transfer rate be many times larger than any one service that it provides to a single user.* This is possible in the 5.2/5.8 GHz bands.

Enough bandwidth means that there is enough time for overhead functions that increase accuracy including error detection and correction, polling, diversity selection and others which might be found beneficial. Enough bandwidth means that delays will be significantly smaller and responses quicker.

The mitigation of multipath fading is greater the greater the bandwidth of the signal for several available modulation techniques. This is the largest inherent problem of narrower bandwidths. It is not always understood that **adequate signal level may be a necessary but not a sufficient condition for accurate data transfer** with narrow band modulations.

> *The cost benefits of omitting some of the functions necessary to reduce the negative consequences of lower bandwidths must be considered as part of the evaluation of the 5.8 GHz alternative.*

FEASIBILTY IN THE 5.2 GHZ "HIPERLAN" [4] BAND

*The same technology coould be used in this band as may be defined by 802.11 for the 5.8 GHz band. This parallel could be a key factor in bringing about **parallel action on this spectrum in both Europe and the US.** There must be a demonstration of technical feasibility and the usefulness of the service function for bandwidths above 20 MHz to be made available to the data communication community at some future date.*

The service goals selected by ETSI RES 10 are quite transferrable to the 802.11 work. If modification seems necessary, the inducements should be brought out to be resolved on a wider scale. *A goal of 1000 Mbps/hectare with a minimum transfer rate of 10-20 Mbps seems excessive by a factor of 4, but not wholly out of reach.* A 1 Mbps LAN with 100 meters range, might have 1/1000th of the RES 10 capacity.

Technical feasibility exists for the same reasons as given for 5.8 GHz.

> *The political feasibility of acquiring the right to use this frequency space in North America is greatly dependent on showing the value of the service at 5.8 GHz.*

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3 "Variable Rate Video Compression," A. Zakhor, D. Taubman, et al; The Infopad Project Review, University of California at Berkeley, 14-15 Oct 93

4 "ETSI, Radio Equipment and Systems (RES 10), HIPERLAN, Services and Facilities," 802.11-93/43, mailing of 23 October. See "5.9 Summary of HIPERLAN parameters" and "7. Services."

CONCLUSION

These new PHYs should be undertaken so that 802.11 may respond with a Standard that provides the speed, capacity, accuracy and integration of services necessary in large scale businesses. The bandwidth needed for this range of capabilities exists in the bands cited.

The present 802 PHY proposals do not meet this need. The developing FH proposal is marginal in meeting the 802.11 functional requirements. Continued activity on the FH PHY will project upon the MAC group a very difficult (possibly insoluble) problem at least requiring more effort than can be timely expected. This effort would solve problems that are peculiar to frequency hopping, and it could not be applied to either of the PHYs above proposed.

It is now recommended for these and other good reasons that the Committee vote in favor of the following motion when made:

MOTION

The 802.11 Committee asks its Physical Medium Subcommittee to initiate development of new physical mediums of the following description:

1. Best use of 10 MHz of spectrum (scalable from 5 to 20 MHz) offering a transfer rate of 4 Mbps or higher (scalable from 2-8 Mbps) in the 1.85-2.20 GHz band as allocated by the FCC in the Second Report and Order on Docket 90-314 released October 22, 1993; and more particularly the spectrum from 1900 -1920 MHz for asynchronous devices including the specified etiquette; and

2. Best use of 40-70 MHz of spectrum offering a transfer rate of 16 Mbps or higher:

   a) in the USA Part 15 ISM band at 5.7250-5.8375 GHz, or

   b) in the ETSI RES 10 HIPERLAN proposed band near 5.2 GHz; and

further, that the effort on these PHYs be equal in priority to the existing 2.4 GHz PHYs with the possibility of completion at nearly the same time contingent upon adequate support from the membership; and

further, that the PHY selected be suitable for both connectionless and connection-type services either of which may be optionally deleted, and

further that the closed issues which are affected by this motion be revised by the editor's to reflect this decision and then resubmitted to the Committee for approval.

802.11 ISSUES AFFECTED

To be added in a later revision