

**Before the  
FEDERAL COMMUNICATIONS COMMISSION  
Washington, D. C. 20554**

In the Matter of	)	
	)	
Amendment of the Commission's	)	GEN Docket No. 90-314
Rules to Establish New Personal	)	ET Docket No. 92-100
Communications Services	)	
	)	
To: The Commission		

**COMMENTS OF IEEE PROJECT 802  
LOCAL AND METROPOLITAN AREA NETWORK STANDARDS  
COMMITTEE  
on the  
NOTICE OF PROPOSED RULEMAKING AND TENTATIVE DECISION**

**Filed November 13, 1992**

The IEEE Project 802 Local and Metropolitan Area Network Standards Committee ("Committee" or "IEEE Committee") has a vital interest in the Commission's proposal to establish emerging technologies bands in the 2 GHz region of the radio spectrum. The IEEE Committee includes individuals from companies that now are delivering wireless Local Area Network (LAN) equipment that operates in infrared, ISM, DTS and other parts of the spectrum. These companies and others have been engaged, since September, 1990, in the Committee's effort to develop standards and protocols for wireless LANs.

The Committee applies a unique focus to local networks for data communications. Unlike some of the other services referred to in the above-referenced Notice of Proposed Rulemaking and Tentative Decision ("NPRM"), wireless networking is a natural extension of already-mature computer networking technology that has a proven utility, already agreed-upon standards for interoperability, and an enormous installed base. There is no uncertainty about the values to be gained by providing spectrum for wireless LANs; there remains only the urgent imperative for doing so.

**SUMMARY**

The Committee applauds the expeditious actions that the Commission is taking to implement unlicensed PCS, including the wireless Local Area Networks (LANs) that are the purview of the Committee.

The Committee, however, finds that the Commission's proposed allocation for unlicensed PCS does not fulfill the many compelling needs for such services. The initial designation of only 20 MHz — 1910 to 1930 MHz — for both voice and data unlicensed PCS services is substantially less than is required for wireless LANs alone, let alone for the expected mixture of services described in the NPRM. Indeed, there is a risk that such a paucity of frequencies could delay the development and market success of wireless LANs, as well as the ability to develop effective technical standards to permit wireless LANs and the other services to share the unlicensed PCS spectrum.

Accordingly, the Committee urges the Commission to allocate additional spectrum, including 70 to 140 MHz for wireless LANs as previously called for by the Committee<sup>1</sup>, in the 2 GHz "emerging technologies bands." If the Commission cannot make available this amount of spectrum in the initial allocation for unlicensed services, the Commission should, as part of the current proceeding, create a substantial spectrum reserve allocated for the exclusive use of wireless LANs, which could be used to supplement this initial allocation in the near future.

Given the natural dichotomy between the issues affecting licensed PCS and those affecting unlicensed PCS, the Committee takes no position on most of the licensed PCS questions raised in the NPRM. In fact, the Committee urges the Commission to move first to resolve the unlicensed PCS issues in this proceeding and implement unlicensed services immediately, while the more complex licensed PCS issues are being resolved.

In the discussion below, the Committee also addresses certain of the Commission's proposed technical standards for unlicensed services. These suggestions involve proposed limits on radiated power, power spectral

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<sup>1</sup> See Comments and Reply Comments submitted by IEEE 802 LOCAL AREA NETWORK STANDARDS COMMITTEE in GEN Docket 90-314, the "PCS NOI."

density, frequency accuracy, out of band emissions, and normative spectrum efficiency.

## INTRODUCTION

The Institute of Electrical and Electronic Engineers (IEEE) is a U.S.-based, international professional organization with more than 320,000 members, recognized throughout the world for its standards-making activities. The Committee is a group within the IEEE chartered to develop standards for local and metropolitan area networks that provide information transfer among computers at data rates of 1 megabit per second or more, on wire, optical and radio media. The IEEE Committee previously has promulgated standards, such as CSMA/CD or "Ethernet" by the 802.3 working group, the "Token Bus" by the 802.4 working group and the "Token Ring," by the 802.5 working group, which have been adopted worldwide in the International Organization for Standardization (ISO).

The IEEE 802.11 Working Group concentrates on wireless LANs. The group was formed in September, 1990, and has since met every two months. Ninety-three individuals, employed by more than 60 companies, have qualified for voting membership. More than 300 documents have been discussed in the course of these meetings; many of these have been or will be published in domestic and international professional journals including those of the IEEE.

At present, the Committee is concentrating its attention on high speed, on-premises wireless LANs for transmission of digital information among computing devices, because wireless LANs are a natural extension of wired computer networks. Wireless LANs bring the benefits of network communications to the growing number of users of mobile and portable computers, as well as enabling immediate, flexible, interconnection of desktop devices. LANs are used to convey a variety of information including numbers, text, sounds and images.

Unlike many other PCS concepts, wireless LANs may not require any critical backbone or infrastructure to be constructed before they can be used. For example, many wireless LANs applications involve direct communications among laptop and notebook computers or between such

devices and other computer resources. Unlike a number of other PCS applications, which require significant development and demonstration of consumer acceptance, Wireless LANs can be placed into operation as quickly as regulations are implemented and equipment complying with those regulations is manufactured.

The Committee has participated in previous Commission proceedings involving PCS, and has consistently, as herein, urged the Commission to allocate a substantial amount of radio spectrum — 70 to 140 MHz — for user-provided wireless local area digital networks.<sup>2</sup>

## DISCUSSION

### I. 70 To 140 MHz Of Radio Spectrum Will Be Required To Satisfy The Foreseeable Demand For Wireless LANs.

The Commission has proposed that only 20 MHz be allocated in the 1850-1990 MHz Emerging Technologies Bands for all unlicensed PCS applications including cordless telephones, wireless PBXs and wireless LANs, which may carry voice, data, or even video. Yet the Commission has proposed to allocate 90 MHz for licensed PCS to provide only traditional telephone voice services and low-speed data services to a comparable number of users of the unlicensed PCS applications.

The unlicensed user-PCS applications identified by the Commission as meriting only 20 MHz include a wide variety of voice and data services. While wireless PBXs are not the area of primary competence or emphasis of the Committee, businesses and institutions need both wireless PBXs and wireless LANs, and some do not even make sharp distinctions between these applications. Both PBXs and LANs may serve many individuals within a small physical area — often the same individuals in precisely the same area. Both can be placed in operation for the user's own benefit, rather than that of a carrier or other third party service provider, and both can be accessed without airtime charges or tariffs.

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<sup>2</sup> See Id.; Comments and Reply Comments submitted by IEEE 802 LOCAL AREA NETWORK STANDARDS COMMITTEE to RM No. 7618, the "Apple Petition, Data-PCS; and to the Commission's *en banc* hearing on PCS (December 5, 1991).

High densities of users in a small area must have assurance of an adequate quality of service, including being able to obtain a communications channel when needed without encountering excessive busy conditions. These high user densities, and the composite bandwidth requirements of these users, translate directly to a need for substantial spectrum, as well as a need for prudent microcellular frequency reuse.

It is therefore appropriate that the Commission consider both wireless LANs and cordless PBXs in the same proceeding, but the Committee emphasizes that the bandwidth requirements for high-data-rate wireless LANs need special attention to assure that at least the critical minimum of spectrum for this application is made available on a timely basis. Compared with either licensed PCS or wireless PBXs, the high rates of data transfer that are characteristic of computer-to-computer communications require substantially more bandwidth than the combined potential traffic of a similar population of voice users. Wireless LANs, which will become even more vital as great numbers of people use portable computers, will carry by far the largest information load.

Wired Ethernet and Token Ring are two of the most popular computer networking standards, used to interconnect millions of computers. These networks transfer data at rates of ten and sixteen megabits per second respectively. In many businesses, educational institutions and industrial concerns, a single network of such capacity is inadequate today and multiple cables and much higher speed networks are being deployed.

For the wireless LAN industry to provide the wireless equivalent of the data-handling capacity of such cable networks, upward of 100 megahertz of RF bandwidth in any given local area could be required. Additional spectrum must be used to facilitate microcellular frequency reuse. Constraining wireless networking to data transfer rates of only a fraction of their wired counterparts would be unresponsive to the demonstrated need for wireless connectivity among people using computers. The Committee has, from the inception of its activities, concluded that there is an immediate need for at least 70 MHz of spectrum for wireless LANs, with a future total requirement of up to 140 MHz.

The IEEE Committee recognizes that the total of the new unlicensed PCS spectrum needs expressed by industry and users exceeds the amount under examination in the NPRM.<sup>3</sup> If the Commission cannot allocate at least 70 MHz for unlicensed services at the outset, the Committee urges the Commission to allocate a substantial portion of that bandwidth immediately, and reserve additional frequencies for unlicensed services from the spectrum now proposed for licensed PCS. The frequencies set aside in such a reserve would be made available to accommodate the expansion of wireless LANs, pursuant to terms and conditions established now in this proceeding.

## II. Other Regulatory Requirements Of Wireless LANs Have Generally Been Reflected In The Commission's Actions

To a large degree, the Commission has been responsive to the regulatory requirements and operating characteristics of wireless LANs.

- 1. The Commission has recognized that wireless LANs can be deployed advantageously on an unlicensed basis. Schools, businesses, individuals and institutions, who provide their own computer network services, will be the most immediate beneficiaries of this unlicensed band.

An unlicensed regime with minimal regulation is highly likely to encourage technological innovation, an objective especially valued by the IEEE. By addressing a fertile regulatory environment and contemplating defined interference limits, the Committee can proceed confidently to develop proper and effective protocols and standards.

While other organizations may effectively establish overall guidelines for frequency usage which could facilitate coexistence of many diverse uses of the unlicensed spectrum, or suggest minimal technical rules to the Commission, the IEEE Committee has the charter and the expertise to develop technical standards that in addition will

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<sup>3</sup> The subject NPRM refers to unfulfilled requests for spectrum for new services and technologies which total 376 MHz. See Docket ET 92-9 at ¶4.

provide for true interoperability among unlicensed devices produced by a variety of manufacturers for local area networks.

- 2. The FCC has shown that it is well aware of the needs of manufacturers to implement new wireless LAN technologies on a worldwide basis to facilitate their widespread use and to enhance U.S. competitiveness. The Commission also understands that users of wireless technologies need to have those technologies as mobile as possible, which often may entail crossing borders and transiting hemispheres. In this regard, the Commission has chosen optimum frequencies (albeit not yet in adequate measure) in the midst of the 1850-1990 MHz band for wireless LAN technologies. As a result of the Commission's decision, some high-capacity LANs will be able to interact with unlicensed wireless PBXs in the same frequency band, and potentially can bridge to voice PCS networks in the U.S. and abroad.

The Committee respectfully suggests that, by establishing a substantial industrial base of wireless products to serve the U.S. market, U.S. manufacturers will be able to compete effectively in world markets. The Commission can further this effort by initially allocating the same amount of, and perhaps even the same, frequencies that have been allocated in Europe in the 1850-1990 MHz band.<sup>4</sup>

- 3. The Committee previously expressed concern that the Commission was not moving quickly enough to clear existing microwave users from the emerging technologies bands. The equitable transition and conflict-resolution process set out in the NPRM for identifying and clearing spectrum for unlicensed operation holds great promise for meeting current needs for wireless LANs. The Committee strongly endorses the concept under consideration in the Third Further Notice of Proposed Rulemaking in Docket No. 92-9 of beginning the process for clearing spectrum for unlicensed operation on a "zero transition" timetable, permitting unlicensed services to be deployed immediately, as

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<sup>4</sup> CEPT, the pan-European telecommunications entity, has allocated 20 MHz at 1880-1900 MHz for Digital European Cordless Telecommunications (DECT), which provides in-building digital voice connectivity along with a limited data networking capacity. An additional contiguous 30 MHz may be allocated for expansion of the DECT frequencies as the demand develops.

soon as the necessary conditions have been met and without waiting for resolution of the many complex issues surrounding the implementation and regulation of licensed PCS.

### **III. Coexistence And Interoperability Among Disparate Applications Can Be Achieved Through The Committee's Professional Activities.**

The Committee has stated that:

Unless the Commission provides spectrum for wireless LANs on a primary and exclusive basis, advantageous, spectrum-efficient protocols optimized for effective computer communications cannot be developed and applied. . . . (A) separate and exclusive spectrum allocation for wireless LANs is a *sine qua non* for successful widespread deployment of wireless LAN technologies.<sup>5</sup>

The Commission has indicated in its NPRM that, instead of segmenting an unlicensed band by applications, it prefers to allocate a frequency range for a mix of services, including wireless LANs and cordless PBXs, and has referred to the possibility that an industry group could help resolve interference issues within that unlicensed band. The Committee endorses the idea of a "spectrum etiquette" for users of the overall frequency band. Such an etiquette could help assure that wireless LANs will have reliable access to an adequate portion of the spectrum, most likely on an exclusive basis, in a manner that best serves the technological requirements of LANs.

Taking its signal from the Commission, the Committee is prepared to further efforts, or work in liaison with other professional and industry groups, to work towards coexistence among unlicensed PCS spectrum users. Going beyond mere coexistence, however, the IEEE Committee has a twelve year history of successfully developing voluntary standards for interoperability among products designed and sold by numerous manufacturers. Although lacking the imprimatur of law, standards such as those developed by the Committee, implemented within a flexible regulatory structure, can offer

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<sup>5</sup> See Comments submitted by IEEE 802 LOCAL AREA NETWORK STANDARDS COMMITTEE on ET Docket 92-9 at p. 5.

unmatched benefits to developers, manufacturers and users of new technologies alike.

#### IV. Technical Issues

The Committee is continuing to develop positions on the several technical specifications or guidelines set out in the NPRM. In general, any technical requirements should optimize the use of the unlicensed band for the operations contemplated and avoid imposing unrealistic technical requirements on unlicensed PCS devices.

The Committee believes the Commission's proposal for the unlicensed PCS spectrum reflects undue regard for protecting the fixed point microwave stations now operating in the band. This is an unwarranted and limiting constraint which, if imposed, could prevent deployment of these unlicensed applications. In the general case, there is no realistic means of permitting co-primary sharing between mobile computing devices and fixed microwave stations on a basis that guarantees unconditionally that the operations of the latter will not be adversely affected.

Based, therefore, upon the assumption that use of the unlicensed PCS spectrum can be optimized for the services that will occupy it and it will not be regulated for the benefit of co-primary microwave users, the Committee offers the following responses to specific technical issues.

1. The Commission's proposal for a spectrum efficiency formula to be applied to band usage is, we believe, at least premature and possibly may be unwarranted. Spectrum efficiency can be evaluated on many different bases, some of which may not be quantifiable within the Commission's equipment authorization process. While the IEEE Committee favors the development of spectrum-efficient technologies, the Committee recommends that no measure of spectrum efficiency be included in the regulations.

2. The Committee agrees with the principle of adaptive (RF) power control.<sup>6</sup> However, we recommend that a threshold power level, *e.g.*, 10 dB below the maximum authorized power level, be selected, above which adaptive power control is required, and below which adaptive power control is not required. Low power devices, incapable of exceeding the specified power levels, should not be burdened with such a requirement.
3. The Committee addresses wireless LANs conveying data at rates from 1 to 20 megabits per second. Such data rates inherently require relatively wide RF bandwidths. As emphasized above, the proposed allocation for unlicensed operation is inadequate, and this limitation bears directly upon merits of channel partitioning schemes. In this context, the Committee has not yet reached conclusions regarding channelization, but it appears unlikely that either of the Commission's proposals will prove to be satisfactory.
4. The Committee believes that the 1 part/million frequency tolerance of the proposed §15.253 (c) is neither realistic nor necessary. Instead, we believe that the regulations on frequency tolerance in conjunction with other specifications should require only that the devices meet the final out-of-band emissions specifications.
5. We recommend that out of band emission levels must be referenced to the maximum authorized power, not the actual radiated power. This will assure that manufacturers are not penalized as to out of band emissions because they are efficient in limiting in-band emissions.
6. We agree with the specification on maximum power spectral density as appears to be the Commission's intention.<sup>7</sup> However, we recommend an explicit measurement means that numerically smoothes the inevitable measurement peaks (or correspondingly, that

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<sup>6</sup> NPRM at §15.253(d)(4)

<sup>7</sup> NPRM at §15.253(b)

allows a suitable peak-to-average ratio that accounts for natural peaks in the emission envelope).

7. The Committee agrees in principle that the absolute power levels expressed in the NPRM are in the ranges appropriate for wireless LAN applications. We recommend, however, that attention be paid to achieving a more uniform power spectral density among wireless LANs and applications employing a disparate range of bandwidths.

The Committee welcomes further dialogue with the Commission on the subjects addressed in these Comments, and stands ready to respond to questions.

Respectfully submitted,

**IEEE Project 802**  
**Local and Metropolitan Area Networks Standards Committee**

  
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