Wireless LANs

Excerpts from Notice of Inquiry on "Current and Future Requirements for use of Radio Frequencies in the USA"

National Telecommunications and Information Administration

Prepared by Vic Hayes, NCR

The NTIA has published a Notice of Inquiry on subject matter with filing dates of the comments on October 1, 1992 and reply comments on December 1, 1992.

I have copied those sections I thought would be relevant to IEEE P802.11 work.

National Telecommunications and Information Administration

[Docket No. 920532-2132]

Current and Future Requirements for the Use of Radio Frequencies in the United States

AGENCY: National Telecommunications and Information Administration (NTIA), Commerce.

ACTION: Notice of inquiry; Request for comments.

SUMMARY: NTIA is conducting a broadly-based investigation of future requirements for the use of the radio frequency spectrum in the United States, and technology trends that would impact use of the radio spectrum. Public comment is requested on issues relevant to such an investigation. Additionally, comments are requested on issues concerning International Telecommunication Union radio conferences, such as the 1992 World Administrative Radio Conference. After analyzing the comments, NTIA intends to issue a report on national spectrum requirements and technologies and use the information and analysis as the basis for more effective long-range planning for national spectrum management.

DATES: Comments should be filed on or before October 1, 1992, and Reply

Comments should be filed on or before December 1, 1992, to receive full consideration.

ADDRESSES: Comments and Reply Comments (6 copies) should be sent to: Office of Spectrum Management, NTIA, U.S. Department of Commerce, 14th Street and Constitution Avenue NW., room 4099, Washington, DC 20230, attention W. Russell Slye.Q02

FOR FURTHER INFORMATION CONTACT: W. Russel Slye, 202-377-1850, or Rob Haines, 301-261-8002, Office of Spectrum Management.

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I. Introduction

1. In this Notice of Inquiry (Notice), the National Telecommunications and Information Administration (NTIA) requests broadly-based technical and marketplace information on spectrum requirements [1] for different radio services and classes of users over the next ten years. We are requesting this information from users, manufacturers and service providers in the private sector, as well as users, system developers, and system managers in federal, state, and local governments. No person is required to supply specific information pertaining to the commenter, other than that necessary for self-identification, as a condition to NTIA's full consideration of the comment. NTIA intends to use the information we obtain in response to this *Notice* to develop more effective planning for U.S. spectrum management and to issue a report on national spectrum requirements.

2. Responses should include information on: New, currently unsatisfied spectrum requirements; current uses that will diminish with time; current uses of continuing or increasing dimensions; and future spectrum uses now in the early stages of formulation. Further, responses should include information on the amount of bandwidth and spectrum location required to satisfy various telecommunications needs. In most cases, this could be best stated in terms of the size of the user base by radio service, the estimated volume of information flow, the estimated amount of spectrum required, and the technical methods or procedures used to equate the telecommunications needs with the stated spectrum requirement.

3. Responses should include information, if available, on how new, currently unsatisfied spectrum requirements are being met in other countries (if they are being met) as well as any other current or anticipated spectrum allocation decisions abroad which will impact upon U.S. decisions.

4. Until recently, advancing technology has kept ahead of the demand for spectrum. As demand has increased, developing technology has resulted in radios that can perform the functions of earlier systems at higher, less used frequencies, or with decreased bandwidth at the same frequency. Moreover, advanced coding and spread spectrum techniques can permit multiple, concurrent uses of a single frequency band. Now, demand for spectrum is growing rapidly, from both expanded use of current services like digital cellular radio-telephone, and the development of new uses, such as personal communication systems (PCS), digital audio broadcasting (DAB), and advanced television (ATV). However, the technical advances in spectrum conserving techniques needed to meet that demand may be pushing the limits of practicality, at least in the short term.

5. This Notice will week to identify major technical and marketplace trends affecting spectrum usage, including the increased demand anticipated for various services (such as mobile radio), and any associated increased requirement for spectrum; how the use of new spectrum-based systems will be implemented; and the extent to which certain current spectrum requirements can be satisfied using other transmission media. As discussed in detail below, we seek specific comments on these technical and marketplace issues.

6. In examining both private sector and government needs in this *Notice*, spectrum requirements for systems supporting national security operations will continue to have a high priority. NTIA will work closely with the U.S. military services and other federal government agencies involved in national security regarding spectrum requirements that are of a classified nature. Classified spectrum requirements will not be included in the report resulting from this Notice, but we anticipate that they will be available to NTIA for analysis and evaluation in cases where potential spectrum allocation or frequency sharing options may impact these requirements.

7. Although we are seeking technical information on spectrum requirements, we are not soliciting requests for specific frequencies to support a commenter's individual radio systems or networks. We also do not seek to reexamine the fundamental policy issues considered in the NTIA Spectrum Notice [2] and addressed in the NTIA Spectrum Study.[3] Responses to the questions in this Notice should, as much as possible, also take into account the decisions made at the February 1992 World Administrative Radio Conference

[1] The term "spectrum requirement" as used herein means generally spectrum required or needed, under stated conditions, to support the accomplishment of a goal, mission, or business function consistent with efficient and effective use of the spectrum.

[2] Comprehensive Policy Review of Use and Management of the Radio Frequency Spectrum, Notice of Inquiry, 54 FR 50,694 (1989) [hereinafter *NTIA Spectrum Notice*].

[3] National Telecommunications and Information Administration, U.S. Dep't of Commerce, Special Pub. No. 91-23, U.S. Spectrum Management Policy: Agenda for the Future (Feb. 1991) [hereinafter NTIA Spectrum Study].

(WARC–92),[4] and current proceedings [5] of the Federal Communications Commission (FCC) that may lead to domestic spectrum reallocation.

II. Background

A. NTIA's Telecommunications Role

8. The Communications Act of 1934 (the Act) [6] established the FCC and gave it the authority to assign frequencies to all radio stations in the United States, except for those belonging to the federal government. Under section 305 of the Act, the President is authorized to assign the frequencies to federal government stations. The President has delegated this authority to the Secretary of Commerce, who has in turn delegated it to the Administrator of NTIA.[7] Section 2–401 of Executive Order 12,046 provides that "[t]he Secretary of Commerce shall serve as the President's principal adviser on telecommunications policies pertaining to the Nation's economic and technological advancement and to the regulation of the telecommunications industry." [8] Thus, NTIA, on behalf of the Secretary of Commerce, develops telecommunications policies in the overall national interest, rather than limiting its scope to the interests of federal government agencies. In coordination with the Department of State and the FCC, NTIA develops plans, policies and programs which relate to international telecommunications issues. NTIA conducts studies and evaluations concerning telecommunications research and development, and ensures that Executive Branch views on telecommunications matters are effectively presented to the Congress, the FCC, and the public.

B. Recent NTIA Spectrum Planning Efforts

9. NTIA recently completed a comprehensive study recommending fundamental changes to the existing spectrum management system in the United States. The NTIA Spectrum Study contains a number of proposals regarding planning for innovative uses of the spectrum and emphasized "the importance of long-range planning by the FCC and NTIA * * * to anticipate user needs and to avoid unnecessary conflicts among proposed uses." [9] The report also states that:

> NTIA will move to open its process of managing federal government spectrum use to permit a greater degree of public participation * * *.[10]
>
> When practical, NTIA will publicize, and seek public comment on, major new policy proposals that could significantly affect the private sector * * *.[11]
>
> To aid in long-range planning through forecasting, NTIA and the FCC should draw expert input from their constituent users to attempt to predict spectrum requirements for five years, ten years, and beyond. Users should identify specific trends and new technologies * * *.[12]
>
> NTIA and the FCC should seek to institute a coordinated, strategic, long-range planning process. A two- to five-year planning cycle should be established * * *.[13]
>
> NTIA and the FCC should seek to modify [the block allocation system] in the next decade to increase flexibility.[14]

10. NTIA, on behalf of the Department of Commerce, is also required to "[d]evelop, in cooperation with the Federal Communications Commission, a comprehensive long-range plan for improved management of all electromagnetic spectrum resources."[15] NTIA has published editions of the Long-Range Plan for Management and Use of the Spectrum (LRP) in 1986, 1988, and 1989.[16] The later editions increasingly have emphasized goal, policies, and plans primarily for federal spectrum management processes because of a lack of detailed private sector information on spectrum requirements.

11. Several bills currently under consideration in Congress also address planning for the accommodation of emerging telecommunications technologies.[17] These bills require that the Secretary of Commerce (or the Assistant Secretary of Commerce for Communications and Information) meet twice a year with the Chairman of the FCC to conduct joint spectrum planning.[18] The FCC and the Department of Commerce would also be required to submit a joint annual report to Congress on their joint spectrum planning activities, including recommendations for action developed pursuant to such activities.[19]

C. Strategic Long-Range National Planning and Spectrum Reform

12. NTIA has consistently advocated reform of the spectrum management process through greater use of flexible, market-based mechanisms and better long-range planning for spectrum management. These policy goals are closely related. Greater reliance on market incentives, through such reforms as competitive bidding for spectrum licenses [20] and more flexibility for licensees to use and transfer spectrum,[21] can help to ensure that spectrum, a renewable but limited resource, is used most efficiently to serve user needs.

13. At the same time, improve planning by NTIA and the FCC can ease the transition from the current highly centralized U.S. management system to one that relies more on market principles, by permitting modification of existing spectrum allocations in an organized, non-disruptive way. In particular, such planning helps ensure that adequate spectrum will continue to be available for public safety needs, other non-commercial uses such as amateur radio and scientific research, and local, state, and federal government uses. Moreover, improved planning is essential for the U.S. government to represent effectively the interests of all U.S. spectrum users in international spectrum negotiations. Such planning is especially important to permit the presentation of consistent policies in

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[4] Decisions of WARC–92, as detailed in the Final Acts of the conference, will change portions of the International Telecommunication Union (ITU) Table of Frequency Allocations. The U.S. National Table of Frequency Allocations will also reflect appropriate revisions from WARC–92. International Telecommunication Union, Final Acts of the World Administrative Radio Conference (WARC–92) (1992) [hereinafter WARC–92 Final Acts].

[5] See, e.g., Redevelopment of Spectrum to Encourage Innovation in the Use of New Telecommunications Technologies, ET Docket No. 92–9, 7 FCC Rcd 1542 (released Feb. 7, 1991) [hereinafter Emerging Technology Rulemaking]; Amendment of the Commission's Rules to Establish New Personal Communications Services, Gen. Docket No. 90–314, 5 FCC Rcd 3995 (released June 28, 1990) [hereinafter PCS Docket]; Spectrum Efficiency in the Private Land Mobile Radio Bands in Use Prior to 1968, PR Docket No. 91–170, 6 FCC Rcd 4126 (released July 2, 1991).

[6] 47 U.S.C. 151 *et seq.*

[7] See Exec. Order No. 12046, as amended, *reprinted in* 47 U.S.C. § 305 n. (1989); U.S. Dep't of Commerce, Department Organization Orders 10–10 and 25–7.

[8] Exec. Order No. 12046, *supra* note 7, § 2–401.

[9] NTIA Spectrum Study, *supra* note 3, at 2.

[10] *Id.* at 1.

[11] *Id.* at 3.

[12] *Id.* at 11.

[13] *Id.*.

[14] *Id.* at 5

[15] Exec. Order No. 12046, *supra* note 7, §2–409.

[16] National Telecommunications and Information Administration, U.S. Dep't of Commerce, Special Pub. No. 89–22, Long Range Plan for Management and Use of the Radio Spectrum by Agencies and Establishments of the Federal Government (June 1989).

[17] H.R. 1407, Emerging Telecommunications Technologies Act of 1991, 102d Cong., 1st Sess. (1991); S. 218, Emerging Telecommunications Technologies Act of 1991, 102d Cong., 1st Sess. (1991); and H.R. 531, Emerging Telecommunications Technologies Act of 1991, 102d Cong., 1st Sess. (1991).

[18] *Id.*, §3(a) of each Bill.

[19] *Id.*, §3(b) of each Bill.

[20] See, HR 1407, *supra* note 17; NTIA Spectrum Study, *supra* note 3, at 115–118.

[21] See NTIA Spectrum Study, *supra* note 3, at 79–84; Emerging Technologies Inquiry, *supra* note 5.

such forums as the new series of biennial World Administrative Radio Conferences recommended by the High Level Committee of the International Telecommunication Union (ITU). Thus, the long-range planning effort that this Notice supports can aid spectrum reform in the United States generally.

14. This Notice is thus a natural outgrowth of the recommendations of the NTIA Spectrum Study regarding planning, market-based spectrum management, and open interchange of information with the public, the ITU regulatory development processes (*e.g.*, WARC–92), our earlier long-range planning efforts, and the interest in planning displayed by Congress. The information received in response to this *Notice* will be used to identify national spectrum requirements, identify technology trends that impact the use of the spectrum, and plan for the accommodation of new radio systems.[22] The spectrum planning we contemplate will consider both the implementation of market-based and other innovative spectrum management techniques, and the changes to the traditional regulatory processes necessary to implement such techniques while maintaining effective regulatory oversight.

15. Based on the responses to this Notice and our own analysis, NTIA intends to prepare a "requirements study" to help identify national spectrum requirements and technology trends.[23] The study will be prepared in consultation with the FCC,[24] the Interdepartment Radio Advisory Committee (IRAC),[25] and the Spectrum Planning Advisory Committee (SPAC).[26] The "requirements" study will specify: (a) Anticipated national spectrum requirements, (b) a forecast of radiocommunication technology and trends, and (c) the future spectrum requirements that should be addressed by the FCC and NTIA.[27] Depending on the record that we obtain in this proceeding, we may undertake additional detailed investigations of the technical, policy, and economic factors affecting the potential of accommodating specific new radio services in the currently allocated frequency bands.

III. Areas of Inquiry

A. National Spectrum Requirements

16. Within this are of inquiry, NTIA solicits broadly-based technical and marketplace information concerning the future requirements for the use of the radio frequency spectrum in the United States, including requirements for systems that have international operations and implications. The specific information we seek for each group of radio services includes: How much spectrum does each require, and what are the technical methods or procedures used to calculate this requirement? When will any additional spectrum be required or excess be available for other uses? Are there any requirements limited to specific geographic areas? Can these requirements be satisfied in bands shared with other services and classes of users? For a given service, with which services or types of services can frequency resources not be shared? If no sharing is possible, why? Are there physical limitations that preclude the use of particular portions of the radio spectrum? What alternatives to spectrum use are available to meet a requirement? Responses should include information on new, currently unsatisfied spectrum requirements, current uses that will diminish with time, current uses of continuing or increasing importance, and future spectrum uses now in the early stages of formulation. The following paragraphs indicate specific additional information of interest to NTIA for each group of services.

1. Mobile and Mobile-Satellite Services

17. The mobile service is a "radiocommunication service between mobile and land stations, or between mobile stations." [28] This includes the conventional dispatch-oriented land-, maritime-, and aeronautical-mobile services and the newer public-switched operations like cellular radio and PCS. Mobile service is used by the federal, state, and local government sector for may purposes, including such critical areas as national defense, law enforcement, public safety, and air traffic control. The private sector uses the mobile service to satisfy a myriad of communications requirements, including specialized needs such as electronic news gathering, aeronautical passenger communications, and biomedical telemetry.

18. Although mobile radiocommunication applications have been in use for most of this century, only in recent years have we seen their tremendous growth. This expansion has been stimulated both by technological advances and by increased demand for mobile services. In comments on the NTIA Spectrum Notice, several organizations predicted serious spectrum shortfalls for mobile services in the near future.[29] However, one organization commented that this shortage was more a perception than a reality, and that the lack resulted from resistance to the use of more efficient digital technologies.[30] Some have also postulated that a part of any spectrum shortage can be attributed to undue regulatory constraints on how the spectrum can be used.[31] The FCC itself has expressed concerns about the effects of its regulations on efficient spectrum use for mobile services and is presently investigating the elimination of certain regulatory constraints now imposed on the frequency bands below 470 MHz that are used by Private Land Mobile Radio Service (PLMRS) licensees.[32]

19. In the 1980s, mobile-satellite service technology advanced from initial concepts to practical system designs and service demonstrations. Now, in the early 1990s, successful implementation of the mobile-satellite service, in many different forms, is expected at the national and international levels. The

[22] NTIA expects that this series of studies will be among the inputs to the preparatory process for the new series of biennial World Administrative Radio Conferences mentioned *supra* para. 13.

[23] All data collected as a result of this Notice will be made available to the FCC for their use in spectrum planning.

[24] The FCC consultation will involve the Administrator of NTIA, the Chairman of the FCC, and appropriate staff. See NTIA Spectrum Study, *supra* note 3, at 5, where this group is called the Joint Strategic Planning Council.

[25] The IRAC is an advisory committee consisting of representatives from 20 federal government agencies and a liaison member from the FCC. The IRAC advises NTIA on spectrum-related matters and assists in the development of federal spectrum policies and the assignment of frequencies to federal government entities.

[26] The SPAC is an advisory committee under the Federal Advisory Committee Act (FACA), 5 U.S.C.A. app. 2 §9 (Supp. 1992). SPAC consists of 15 members from the private sector and 4 members from the federal government.

[27] This report will provide a basis on which the FCC can initiate its own inquiries as recommended by the NTIA Spectrum Study, *supra* note 3, at 169, 176.

[28] National Telecommunications and Information Administration, U.S. Dep't of Commerce, Manual of Regulations & Procedures for Federal Radio Frequency Management, § 6.1.1 at 6–8 (May 1989 ed., rev. through Sept. 1991) [hereinafter *NTIA Manual*]. The NTIA Manual an all changes to it are incorporated by reference in 47 CFR 300.1 (1990). The NTIA Manual defines a land station as: "A station in the mobile service not intended to be used while in motion" [e.g., a base station or a repeater]. NTIA Manual, supra § 6.1.1 at 6–7.

[29] *See, e.g.*, Comments of Advanced MobileComm, Inc. at 27, Comments of Land Mobile Communications Council at iii, and Comments of Motorola Inc. at 22–24 NTIA Spectrum Notice, supra note 2.

[30] Comments of Personal Radio Steering Group at 2, NTIA Spectrum Notice, supra note 2.

[31] Gilder, What Spectrum Shortage?, Forbes Magazine, May 27, 1991, at 324, 324.

[32] Spectrum Efficiency in the Private Land Mobile Radio Bands In Use Prior to 1968, 6 FCC Rcd 4126 (1991) [hereinafter Refarming Inquiry].

mobile-satellite service can support land, maritime and aeronautical operations (including personal communications). Systems using geostationary or low-Earth orbit (LEO) satellites are in place or being proposed to provide users with mobile service over most of the Earth's surface. The number of mobile-satellite service systems that are being proposed and developed indicates that this is a significant growth area with increased spectrum requirements. For example, the International Civil Aviation Organization (ICAO) assembly recently endorsed the move away from a purely terrestrial system for air traffic control to the satellite-based Future Air Navigation Systems (FANS).[33]

20. We seek comments on the future spectrum requirements for the mobile services. We are not requesting duplication of any spectrum requirements information associated with PCS that may have been recently supplied in the FCC's PCS Docket, supra note 5, as this information is available to NTIA. What categories (*e.g.*, land, maritime, or satellite) require spectrum and how much do they require? When will any additional spectrum be required or excess be available? Do these requirements pertain to specific geographic areas? Are there physical limitations that preclude the use of particular portions of the radio spectrum? What alternate means to radio are available to meet this telecommunication requirement? Do these requirements include any additional features (*e.g.*, need for priority and preemptive capabilities)? Would it be practical to reallocate spectrum to the general mobile service, thereby permitting accommodation of all categories of mobile user in the same bands? Would the general mobile service lead to greater and more uniform usage of mobile service spectrum and provide a stimulant for the development of new and innovative services? What are the requirements for support for mobile services involved in the national security mission, including weapons system requirements?

21. What effect will advances in services like cellular radio or personal communications services have on traditional dispatch land-mobile services? [34] What are the implications of WARC-92 decisions on the development of mobile services and future requirements? When will worldwide personal, mobile voice and data communications services become technically and economically feasible and widely available to the public? Information concerning the expected users of the service and the number of projected users is also requested.

22. To what extent can mobile service requirements be satisfied in bands shared by several classes of users and by different services? With which services or types of services can frequency resources not be shared? If no sharing is possible, why? Are there any reasons for or benefits to restricting certain frequency bands to terrestrial mobile services, rather than sharing the band with the mobile-satellite service? If so, what frequency bands should be used in this manner?

23. To what extent can satellites designed for the mobile services be used to meet requirements for remote telephone service? Can some of the current mobile service requirements for use of the High Frequency (HF) band for longer distance communications be satisfied by the mobile-satellite service? How much HF spectrum could be made available for other applications? How should INMARSAT spectrum requirements for the mobile-satellite service be factored into U.S. spectrum plans? To what extent can LEO satellite services share the same spectrum with geostationary satellite services? To what extent have WARC-92 decisions satisfied future needs for the mobile-satellite services? What is the impact of present allocation regulations upon efficient use of the mobile service frequency bands?

2. Fixed and Fixed-Satellite Services

24. The fixed service is "radiocommunication * * * between specified fixed points." [35] Major users of the fixed service in the United States include common carrier, private operational, auxiliary broadcast, and cable TV relay service users, and the federal government. The federal government uses a number of fixed service systems in its internal cross-country voice and data communications systems; the military uses them for both tactical and strategic communications. In addition to operations in the microwave and higher bands, there are a number of continuing applications in the HF channels for single channel emergency and message communications. Alternatives to fixed point-to-point radiocommunications include land lines and satellite communications. In many telecommunications networks, fiber optic cables are replacing fixed point-to-point microwave systems, especially in and between city centers and other communications hubs and in areas where rights-of-way for cable laying can be inexpensively obtained.[36]

25. To what extent will alternative transmission media replace fixed microwave service? If such replacement occurs, what should be done with any unused frequencies? [37] Could unused microwave bands allocated to the fixed service be geographically shared with other services in a practical manner? [38] What factors tend to discourage the use of fiber optic cables as an alternative to microwave systems? What other trends are there that would affect the future use of the fixed service?

26. NTIA is seeking information on how much spectrum will be required for future fixed service operations. Can fixed service requirements migrate to higher frequency bands in the future? What types of applications are most likely at the higher frequencies and which cannot be moved to higher frequencies? What new modulation techniques are being developed for fixed service applications and what effect do these techniques have on bandwidth, channel capacity, and spectrum requirements?

27. NTIA is also seeking similar information on the future use of the fixed-satellite service. What effect does increased fixed-satellite service use have on fixed service use? What trends are there that affect the future use of the fixed-satellite service (*e.g.*, voice, data, and video trends)? What are the trends concerning separate fixed-satellite service systems (*e.g.*, PANAMSAT, Columbia) performing the same functions as INTELSAT's international communications satellites? What are future plans concerning very small

[33] International Civil Aviation Organization, Council Action on Recommendation 9/1 of the 1991 Air Navigation Conference (Dec. 11, 1991).

[34] These newer technologies are discussed in greater detail *infra* paras. 57–62.

[35] NTIA Manual, *supra* note 28, § 6.1.1 at 6–5.

[36] National Telecommunications and Information Administration, U.S. Dep't of Commerce, Special Pub. No. 91–26, The NTIA Infrastructure Report: Telecommunications in the Age of Information 94–97 (Oct. 1991).

[37] Note that under current FCC rules, unused licenses must be returned to the FCC. See 47 CFR 21.303(b), 22.303, 23.40 (1991) for common carriers, which require FCC approval to discontinue service. See also 47 CFR 73.1750, 80.31, 87.35, 90.157, 94.53 (1991), respectively, for the broadcast radio services, the safety and special radio services, the aviation services, the private land mobile radio services, and the private operational-fixed microwave service.

[38] That is, could the replacement by fiber optic cable in hubs allow sharing with other services that could not be permitted in areas where microwave systems are still required?