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Before the
Federal Communications Commission
Washington, D.C. 20554

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In the Matter of	)	
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Allocations and Service Rules for the 71-76 GHz, 81-86 GHz and 92-95 GHz Bands	)	WT Docket No. 02-146
	)	
Loea Communications Corporation Petition for Rulemaking	)	RM-10288

NOTICE OF PROPOSED RULE MAKING

Adopted: June 13, 2002 **Released: June 28, 2002**

Comment Date: 90 days after publication in the Federal Register
Reply Comment Date: 135 days after publication in the Federal Register

By the Commission: Commissioners Abernathy, Copps and Martin issuing separate statements.

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I. INTRODUCTION AND EXECUTIVE SUMMARY

1. With this *Notice of Proposed Rulemaking* (*Notice*), we examine methods to promote the commercial development and growth of the "millimeter wave" spectrum in the 71-76 GHz, 81-86 GHz and 92-95 GHz bands under Parts 15 and 101 of our Rules.[1] This action follows an initiative by our Office of Engineering and Technology concerning possible development of these bands. We also take this action pursuant to our mandate under Sections 7(a) and 303(g) of the Communications Act of 1934, as amended, "to encourage the provision of new technologies and services to the public" and "encourage the larger and more effective use of radio in the public interest."[2] We also seek comment on a proposal by Loea Communications Corporation (Loea) to establish service rules for the licensed use of the 71-76 GHz and 81-86 GHz bands. We seek to develop a flexible and streamlined regulatory framework that will encourage innovative uses of the spectrum; accommodate future developments in technology and

[1] The term "millimeter wave" derives from the wavelength of radio signals on frequencies between 30 GHz and 300 GHz, which ranges between 1 and 10 millimeters.

[2] 47 U.S.C. §§ 7(a), 303(g).

equipment; promote competition in the communications services, equipment and related markets; and advance the potential sharing between non-Federal Government and Federal Government[3] systems.[4] Additionally, we anticipate that our proposals will encourage the use of technologies developed in military and scientific applications in a broad range of new products and services, such as high-speed wireless local area networks and broadband access systems for the Internet.

2. In July 2000, the Commission held a public forum on possible new uses of the 92-95 GHz band.[5] Several speakers at the forum indicated that due to recent technological developments, new uses of this band are approaching practicality. In addition, in July 2001, Loea experimented with technology it developed for use of the 71-76 GHz and 81-86 GHz bands.[6] As a result, Loea filed a petition requesting the establishment of service rules for the licensed use of the 71-76 GHz and 81-86 GHz bands on September 10, 2001.[7] Accordingly, we seek comment on our proposed rules to allow use of the 71-76 GHz, 81-86 GHz, 92-94 GHz and 94.1-95 GHz bands for a broad range of new fixed and mobile services. These proposals include allocation changes to the bands as well as provisions to ensure that new non-Federal Government operations can share the available frequencies with Federal Government operations in the same bands and protect operations in adjacent bands. Specifically, we seek comment on the following issues regarding use of the 71-76 GHz, 81-86 GHz and 92-95 GHz bands:

- Reallocating the 71-76 GHz, 81-86 GHz and 92-95 GHz bands to update the current allocations, which were established at the World Administration Radio Conference (Geneva, 1979) (WARC-79);
- Developing an appropriate band plan for the 71-76 GHz, 81-86 GHz and 92-95 GHz bands;
- Providing for unlicensed use of the 92-95 GHz band;
- Authorizing the new licensed services under Part 101 of our Rules and the new unlicensed devices under Part 15 of our Rules;
- The appropriate means of licensing spectrum for these bands (*e.g.*, geographic service areas or site-based licenses);
- Whether to permit licensees to select licensing as a band manager or as a regular non-band manager licensee; and

[3] In the context of spectrum management, "Federal Government" refers to use by the Federal Government and "non-Federal Government" refers to use by private entities and state and local governments. In the past, the Commission has sometimes used the terms "Government" and "non-Government" for this same dichotomy, but we feel these longer terms are more descriptive and thus, are phasing in the more descriptive terms.

[4] 47 U.S.C. §§ 7(a), 303(g).

[5] *See* Office of Engineering and Technology to Host Forum on 90 GHz Technologies, *FCC Public Notice*, DA 00-1191 (May 31, 2000).

[6] *See* Loea Communications Corporation, Petition for Rulemaking at 4 (filed Sept. 10, 2001) (Loea Petition).

[7] *See* Loea Petition.

- Developing an appropriate eligibility standard for potential licensees.

II. BACKGROUND

3. The use of wireless frequencies by entities regulated by the Commission is subject to two primary types of regulatory oversight: an allocation of spectrum and rules to govern the operations in the band.[8] Spectrum allocations are set forth in the United States Table of Allocations (U.S. Table) in Section 2.106 of our Rules.[9] The U.S. Table now extends up to 300 GHz and specifies the types of services for which each band may be used. Service rules describe the specific technical standards and licensing criteria to be used for licensed services or the technical standards that apply to unlicensed devices.[10] At present, the highest frequencies for which we authorize licensed services are in the 48.2-50.2 GHz band and the highest frequencies in which unlicensed devices may operate is the 76-77 GHz band.[11] Thus, currently, radio technology that operates above 50.2 GHz may not be licensed except on an experimental basis under Part 5 of our rules,[12] and devices for operation above 77 GHz on either a licensed or unlicensed basis may not be marketed.[13]

4. On September 10, 2001, Loea requested that the Commission commence a rulemaking proceeding to adopt service rules governing the licensing and point-to-point use of the 71-76 GHz and 81-86 GHz bands. Nine parties filed comments in response to Loea's Petition.[14]

5. The Commission is aware of the advances in microchip development, and of the special propagation characteristics of the 71-76, 81-86, and 92-95 GHz frequency bands that provide a new environment for the development and marketing of new applications in these bands. Current uses of the millimeter wave bands include radio astronomy, spaceborne cloud radars, and military applications. There also is the potential to use the spectrum for other applications such as passive imaging of airport runways (when obscured by fog or smoke), imaging to display hidden contraband, weapons and nonmetal objects, point-to-point communications, and point-to-multipoint communications. These special uses are possible because of the shorter wavelengths, which are about three to five millimeters, and because of

[8] For licensed services, these rules are called "service rules."

[9] 47 C.F.R. § 2.106.

[10] Unlicensed devices that intentionally emit radio frequency energy are regulated under Part 15 of our Rules. The Part 15 rules specify limits on the power and operating characteristics of these devices that are designed to avoid the potential for such devices to cause interference. These rules also provide that unlicensed devices may not cause interference and must accept interference from other radio transmitters. *See generally*, 47 C.F.R. Part 15.

[11] 47 C.F.R. §§ 15.253, 25.202(a)(1). Consistent with their class of licenses, Amateur licensees are permitted to use various bands allocated to the Amateur Service without authorization for specific frequencies. Therefore, it is unclear as to whether the 75.5-76 GHz Amateur Radio band is currently being used.

[12] 47 C.F.R. § 5.01 *et seq.* These rules permit simplified licensing of spectrum for experiments that would not otherwise be permitted under our Rules. In general, equipment may not be marketed in connection with such experiments and service may not be provided for commercial use. However, there are provisions for "limited marketed studies" that permit marketing on a small scale. *See* 47 C.F.R. § 5.93.

[13] No licensed service rules address frequency use above 50.2 GHz. The highest frequency specifically authorized for unlicensed use is 77 GHz, which is used for vehicular radar systems, 47 C.F.R. § 15.253.

[14] *See* Appendix C.

other technical characteristics that differentiate the 71-76, 81-86, and 92-95 GHz bands from other frequency bands.[15] Loea, for example, reports successful experiments in transmitting video and teleconferencing information in Maui, Hawaii over separate channels at 71.0-72.75 GHz and 73.0-74.75 GHz.[16] Loea points out the possibility of creating and offering terrestrial broadband services and applications in these bands, which would lead to rapid and wider deployment of broadband capacity.[17]

6. Because of shorter wavelengths, the 71-76, 81-86, and 92-95 GHz bands permit the use of smaller antennas than would be required for similar circumstances in the lower bands, to achieve the same high directivity and high gain.[18] The immediate consequence of this high directivity, coupled with the high free space loss at these frequencies, is the possibility of a more efficient use of the spectrum for point-to-multipoint applications. Since a greater number of high directive antennas can be placed than less directive antennas in a given area, the net result is higher reuse of the spectrum, and higher density of users, as compared to lower frequencies. Furthermore, due to the fact that one can place more voice channels or broadband information using a higher frequency to transmit the information, this spectrum could potentially be used as a replacement for or supplement to fiber optics.

7. Another important propagation characteristic of the millimeter wave bands is its particular behavior under certain atmospheric conditions.[19] While free space loss is proportional to the distance between the two points in a link, and the frequency used in the link, losses due to atmospheric absorption are dependent on the frequency, distance and weather conditions. Most notable is how the loss due to the presence of oxygen or water vapor in the path varies greatly with frequency and increases exponentially with distance. Under certain circumstances, it can be much greater than the free space loss that is the main factor at lower frequencies. For example, attenuation below 30 GHz due to the atmosphere absorption is about 0.4 dB/km for the worse case of atmospheric conditions graphed. With the same conditions, a 40 GHz signal was shown to be attenuated at about 0.7 dB/km, and signals between 92-95 GHz were shown to be attenuated at the rate of about 2-3 dB/km.[20] Near 60 GHz, the signal loss due to absorption by oxygen molecules shows a dramatic jump in signal loss to a peak of about 15 dB/km.[21]

8. One can take advantage of the peculiar behavior of different frequencies within the Extremely High Frequency (EHF) band[22] in the presence of oxygen or water vapor. Around 60 GHz the oxygen

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[15] By contrast, the wavelengths in the UHF-TV band are about half a meter and wavelengths in the AM broadcast band are hundreds of meters. The wavelength (expressed in meters) for a given frequency can be found by dividing 300 by the frequency (expressed in MHz).

[16] *See* Loea Petition at 4.

[17] *Id.*

[18] For a given beamwidth (directivity), the required antenna size scales inversely with frequency. Thus a 45 GHz antenna would be twice as large as a 90 GHz antenna with the same beamwidth and a 22.5 GHz antenna would be four times as large as a 90 GHz antenna with the same diameter.

[19] *See* Millimeter Wave Propagation: Spectrum Management Implications, OET Bulletin No. 70 (July 1997).

[20] *See* Loea Petition, Attachment A, Loveberg Paper at 3.

[21] *See* Millimeter Wave Propagation: Spectrum Management Implications, OET Bulletin No. 70 (July 1997) at 6.

[22] The EHF frequencies are between 30 GHz and 300 GHz.

absorption produces so much loss, compared to other parts of the EHF band, that it makes this part of the spectrum less suitable for fixed point-to-point or point-to-multipoint links, but more suitable for applications requiring the re-use of the spectrum. However, above 60 GHz, oxygen absorption decreases. In the 92-95 GHz frequencies, oxygen absorption in dry air is comparable to the oxygen absorption at 40 GHz, thus making these frequencies more desirable for fixed applications. We also note that while absorption by oxygen of radio energy at 92-95 GHz is relatively low, absorption of such energy by water molecules is much higher at these frequencies. As a result, in non-desert conditions the limiting factor in achievable range is usually governed by humidity and precipitation conditions. High humidity and rain increase path absorption by increasing the number of water molecules in the air.[23] This increased absorption, in turn, affects the range/channel reliability tradeoff.[24] An engineer designing a telecommunications system for this band can choose to achieve increased communication range at the expense of reliability due to weather-related absorption or can seek shorter ranges with higher reliability. We also note that the propagation characteristics of the 71-95 GHz band suggest applications in conjunction with other types of communications systems that can increase reliability of the overall communications system. For example, fog has less impact on millimeter wave propagation than it does on optical propagation[25] because the wavelength of millimeter wave signals in the 71-95 GHz spectrum is much larger than the size of the fog particles. Therefore, the radio signal only has minimal interaction with fog particles, thus making EHF spectrum potentially a good choice as a wireless back-up for an optical laser communications link.

9. Although the generation and experimental use of millimeter wave frequencies goes as far back as the work of Dr. J. C. Bose about 100 years ago in India, practical and affordable technology for the use of such frequencies has been generally lacking.[26] However, a variety of development efforts in the 1990s in millimeter wave device technology, such as the Defense Advanced Research Project Agency's Monolithic Microwave Integrated Circuit (MIMIC) program and Microwave and Analog Front End Technology (MAFET) program, have led to the development of practical designs of components in the millimeter wave area, such as in the 92-95 GHz band.[27] Currently, such devices are produced only in small quantities for experimental use in the 70-90 GHz bands and limited Federal Government applications and are, therefore, very costly. The creation of markets for 70, 80 and 90 GHz technology, which could result from the adoption of rules by this agency, could reduce the costs of such equipment by increasing production quantities and "learning curve" efficiencies. Such increased production may also benefit Federal Government users of this band because most millimeter wave component production facilities would serve both military and private sector markets.

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[23] Fog absorption can be about 1 dB/km. Heavy rain, approximately 10 mm/hr, can increase fog absorption to 5 dB/km.

[24] That is, the longer the telecommunications path, the higher the possibility of weather related outages, and the lower the reliability of the microwave path.

[25] Optical propagation refers to the propagation of visible electromagnetic waves carrying intelligence such as voice, data, or video.

[26] John F. Ramsay, "Microwave Antenna and Waveguide Techniques Before 1900", *Proc. IRE*, February 1958, p. 405-415.

[27] These two programs spent about $700,000,000 on developing component technology for millimeter wave frequencies. *See* Chapter 7.4 Monolithic Microwave Integrated Circuit Technology in *The RF and Microwave Handbook*, Mike Golio, Ed., CRC Press, 2001 for a discussion of the component technologies involved.

III. DISCUSSION

10. As noted previously, this region of the spectrum is essentially undeveloped and available for new uses. It has been our experience that opening new regions of the spectrum to new applications and technologies fosters the development of new communications products and services for the public and the concomitant economic growth and jobs.[28] For example, opening certain bands to spread spectrum technology on an unlicensed basis in 1985 stimulated rapid private sector development of that technology. Today, numerous businesses and other entities use millions of spread spectrum devices for such diverse applications as remote meter reading, utility load management, voice-secure cordless telephones, and radio local area networks.[29] Similarly, we believe that opening portions of the millimeter wave spectrum could stimulate new applications of radio technology, facilitate technology transfer from the military sector, and create opportunities for economic growth and jobs. This action will also promote United States competitiveness internationally by enabling the development of technology for potential international use.

A. Allocation Proposals

1. Overview

11. All of the current domestic allocations for the 71-76 GHz, 81-86 GHz, and 92-95 GHz bands were established at WARC-79 and were codified in the Commission's Rules in January 1984.[30] All 13 gigahertz of this spectrum is allocated to satellite services (specifically, the broadcasting-satellite (BSS), fixed-satellite (FSS), mobile-satellite (MSS), and amateur-satellite (AMSAT) services) and nearly all of this spectrum (12.5 GHz) is allocated to the fixed and mobile services. Satellite services in the 71-75.5 GHz and 92-95 GHz bands are to transmit in the Earth-to-space direction (uplinks) and satellite services in the 81-86 GHz band are to transmit in space-to-Earth direction (downlinks). Portions of this spectrum are also allocated to the broadcasting, radiolocation, and amateur services. All of these allocations are on a primary basis. In addition, small portions of this spectrum are available to the radio astronomy service

[28] *See* Redevelopment of Spectrum to Encourage Innovation in the Use of New Telecommunications Technologies, *First Report and Order and Third notice of Proposed Rule Making*, 7 FCC Rcd 6886 (1992) (reallocating portions of the 2 GHz from fixed microwave services to emerging technology systems, including personal communications services (PCS)); *See* Authorization of Spread Spectrum and Other Wideband Emissions not Presently Provided for in the FCC Rules and Regulations, *First Report and Order*, GEN Docket No. 81-413, 101 FCC 2d 419 (1985) (*Spread Spectrum First R&O*) (adopting rules in Part 15 for low power spread spectrum devices).

[29] *Spread Spectrum First R&O*, 101 FCC 2d 419 (1985). In 1989, the Commission recodified and clarified the Part 15 spread spectrum rules. Revision of Part 15 of the Rules Regarding the Operation of Radio Frequency Devices without an Individual License, *First Report and Order*, GEN Docket No. 87-389, 4 FCC Rcd 3493 (1989). *See also* Amendment of Parts 2 and 15 of the Rules with Regard to the Operation of Spread Spectrum Systems, *Report and Order*, GEN Docket No. 89-354, 5 FCC Rcd 4123 (1990) (amending Parts 2 and 15 of the Rules with regard to operation of spread spectrum systems). *See* 47 C.F.R. § 15.247.

[30] *See Amendment of Part 2 of the Commission's Rules Regarding Implementation of the Final Acts of the World Administrative Radio Conference, Geneva, 1979*, General Docket No. 80-739, *Second Report and Order*, 49 FR 2357 (January 19, 1984).

(RAS).[31] Table 1 provides an overview of the WARC-79 and current United States allocations for the 71-76 GHz, 81-86 GHz, and 92-95 GHz bands.

Table 1: Overview of WARC-79 and Current United States Allocations

FSS uplinks			Amateur & AMSAT	Changes not considered	FSS downlinks	BSS	No changes to consider	FSS uplinks		
MSS uplinks					MSS downlinks	Broadcasting		Radiolocation		
	RAS								RAS	
Fixed & mobile					Fixed & mobile			Fixed & mobile		
71 GHz	72.91 72.77	74 GHz	75.5	76 GHz	81 GHz	84 GHz	86 GHz	92 GHz	93.27 93.07	95 GHz

12. The World Administrative Radio Conference for Dealing with Frequency Allocations in Certain Parts of the Spectrum (Malaga-Torremolinos, 1992) (WARC-92) allocated the 74-84 GHz band to the space research service (space-to-Earth) (SRS downlinks) on a secondary basis throughout the world in order to provide 10 gigahertz of contiguous spectrum for space Very Long Baseline Interferometry (VLBI) purposes.[32] The World Radiocommunication Conference (Geneva, 1997) (WRC-97) allocated the 94-94.1 GHz band to the Earth exploration-satellite service (EESS) and SRS for active sensor operations (EESS (active) and SRS (active)) and limited the use of these allocations to spaceborne cloud radars.[33] In order to provide spectrum for the spaceborne cloud radars, WRC-97 deleted the fixed, mobile, and FSS uplink allocations from the 94-94.1 GHz band.[34]

13. Many technological and scientific advances and discoveries pertaining to radio waves of natural (including cosmic) origin have occurred since the passive allocations (RAS, EESS (passive), and SRS (passive)) were made at WARC-79.[35] At the World Radiocommunication Conference (Istanbul, 2000) (WRC-2000), the frequency bands above 71 GHz were realigned to reflect present and foreseeable future requirements for the passive services.[36] This realignment essentially reshuffled the allocations in

[31] Radio astronomy is astronomy based on the reception of radio waves of cosmic origin. *See* 47 C.F.R. § 2.1. The status of these RAS allocations are discussed in detail in paragraphs 15, 16, and 35.

[32] *See Final Acts of the World Administrative Radio Conference for Dealing with Frequency Allocations in Certain Parts of the Spectrum (WARC-92)* at p. 92.

[33] An active sensor is an EESS or SRS measuring instrument by means of which information is obtained by transmission and reception of radio waves. *See* 47 C.F.R. § 2.1.

[34] *See Final Acts of the World Radiocommunication Conference (WRC-97)* at p. 71.

[35] A passive sensor is an EESS or SRS measuring instrument by means of which information is obtained by reception of radio waves of natural origin. *See* 47 C.F.R. § 2.1.

[36] *See Final Acts of the World Radiocommunication Conference (WRC-2000)* at pp. 43-46. *See also* United States Proposals for the Work of the Conference, Document 12-E, dated January 12, 2000. at pp. 31-67.

the 71-275 GHz frequency range to account for a better understanding of how spectrum in this range might be used. While numerous allocations were moved to different frequency bands, generally the amount of spectrum available for specific services did not change. The most significant WRC-2000 change to the frequency bands at issue in this proceeding was that the 81-86 GHz, 92-94 GHz, and 94.1-95 GHz bands were allocated to the radio astronomy service (RAS) on a primary basis. The RAS can not share the same spectrum with satellite downlinks. Thus, it was necessary to change the 81-86 GHz band from a downlink band to an uplink band. This was achieved by interchanging the directional indicators of the FSS and MSS allocations in the 71-74 GHz and 81-84 GHz bands.[37] Likewise, the BSS allocation was moved from the 84-86 GHz band to the 74-76 GHz band in order to protect the new RAS allocation. In particular, we observe that these and other WRC-2000 actions together have provided the FSS with 5 gigahertz of downlink spectrum (71-76 GHz) that can be paired with 5 gigahertz of uplink spectrum (81-86 GHz). However, WRC-2000 also provided that this very same spectrum can be used for fixed applications, which is the focus of this proceeding. In contrast, there are no co-frequency satellite sharing issues in the 92-94 GHz and 94.1-95 GHz bands because WRC-2000 deleted the FSS uplink allocations from these bands.

14. In this proceeding, we will consider only those allocation changes that concern the 71-76 GHz, 81-86 GHz, and 92-95 GHz bands because we have requests before us to use that spectrum. Domestically, the 71-75.5 GHz, 81-86 GHz, and 92-95 GHz bands are shared between Federal and non-Federal Government users on an equal basis.[38] The 75.5-76 GHz band is currently non-Federal Government exclusive spectrum. We will consider the remaining WRC-2000 realignments in the 76-81 GHz band and in the 95-400 GHz frequency range and the WARC-92 SRS downlink allocation in the 76-81 GHz band in a separate proceeding.

2. 71-76 GHz

15. Prior to WRC-2000, the 71-75.5 GHz band was allocated to the fixed, mobile, and FSS uplink services on a primary basis throughout the world. The 71-74 GHz band was also allocated for MSS uplinks on a primary basis throughout the world. Footnote 5.556 stated that radio astronomy observations could be carried out under national arrangements in the 72.77-72.91 GHz band and, in making assignments to stations of other services, footnote 5.149 urged administrations to take all practical steps to protect the RAS in this band from harmful interference.[39] The 74-76 GHz band was allocated for SRS downlinks on a secondary basis throughout the world. The 75.5-76 GHz band was allocated to the amateur and AMSAT services on a primary basis throughout the world.

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[37] Directional indicators specify the direction in which satellites or earth stations would be authorized to transmit. For example, FSS uplinks mean that fixed earth stations would be authorized to transmit to satellites. Another frequency band would be used for FSS downlinks, wherein satellites would be authorized to transmit to fixed earth stations.

[38] Frequency assignments in bands shared by Federal and non-Federal Government services are subject to coordination between NTIA and the FCC. No priority is recognized unless the terms of such priority are specifically defined in the U.S. Table or unless they are subject to mutually agreed arrangements in specific cases.

[39] *See* 47 C.F.R. § 2.106, footnotes 5.149, 5.556. In the 2001 Edition of the ITU Radio Regulations, the "S" has been dropped from the footnote numbering. We will employ the new convention throughout this Notice in order to minimize confusion. *See* International Telecommunication Union Radio Regulations, Edition of 2001.

16. In the United States, these pre-WRC-2000 allocations have been implemented, except that the secondary allocation for SRS downlinks made at WARC-92 has not yet been considered.[40] Additionally, the Commission adopted footnote US270, which states that the 72.77-72.91 GHz band is also allocated to the RAS, in lieu of international footnotes 5.149 and 5.556.[41] The Commission also adopted footnote US297, which states that a portion of the FSS uplink allocation (74-75.5 GHz) is available to be used as BSS feeder links. The 75.5-76 GHz band has been allocated to the Amateur Radio Service under Part 97 of our Rules.[42]

17. At WRC-2000, the 81-86 GHz band was allocated to the RAS on a primary basis. In order to avoid having satellite downlinks in the 81-84 GHz band, which would cause harmful interference to the new primary RAS allocation, the MSS and FSS uplink allocations in the 71-74 GHz band were interchanged with the MSS and FSS downlink allocations in the 81-84 GHz band. WRC-2000 also deleted the 72.77-72.91 GHz band from footnotes 5.149 and 5.556 and added RAS allocations above 76 GHz.

18. WRC-2000 shifted the primary amateur and AMSAT allocations from 75.5-76 GHz to 77.5-78 GHz.[43] However, footnote 5.559A states that stations in the amateur and AMSAT services in the 75.5-76 GHz band may operate on a primary basis until 2006. In its comments on the Loea petition, ARRL, the National Association for Amateur Radio (ARRL), states that it has only a limited interest in this proceeding, due to a "legacy" allocation in the 75.5-76 GHz band for the amateur and AMSAT services.[44] ARRL requests that we, in any rules adopted in this proceeding, note that the amateur service is, until 2006, entitled to operate on a primary basis in the 75.5-76 band.[45]

19. WRC-2000 relocated the BSS allocation, which was at 84-86 GHz, to the 74-76 GHz band in order to protect RAS observations above 76 GHz. The FSS uplink allocation at 74-75.5 GHz was moved to 84-86 GHz, and the 74-76 GHz band was allocated for FSS downlinks. Footnote 5.561 was modified to recognize the change in the BSS allocation and now reads as follows:

> 5.561 In the band 74-76 GHz, stations in the fixed, mobile and broadcasting services shall not cause harmful interference to stations of the fixed-satellite service or stations of the broadcasting-satellite service operating in accordance with the decisions of the appropriate frequency assignment planning conference for the broadcasting-satellite service.

20. Proposal. We propose to implement the *WARC-92 Final Acts* and most of the *WRC-2000 Final Acts* with respect to the 71-76 GHz band. Specifically, we propose to change the FSS directional

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[40] The amateur and AMSAT services are regulated solely by the Commission and thus, these allocations were added only to the non-Federal Government Table.

[41] *See* 47 C.F.R. § 2.106, footnote US270.

[42] *See* 47 C.F.R. § 97.301(a).

[43] The Commission has already raised the allocation status of the amateur and AMSAT services to primary in the 77.5-78 GHz band.

[44] *See* ARRL Comments at 1.

[45] *Id.* at 3.

indicator in the 71-75.5 GHz band and the MSS directional indicator in the 71-74 GHz band from uplinks to downlinks. As a consequence of the proposal to change the FSS directional indicator in the 74-75.5 GHz band, we propose to revise footnote US297 in order to state that 81-82.5 GHz (instead of 74-75.5 GHz) is available for BSS feeder links. We propose to delete the RAS allocation from the 72.77-72.91 GHz band by removing footnote US270 from the Table. We also propose to allocate the 74-76 GHz band to the BSS and broadcasting service on a primary basis and for SRS downlinks on a secondary basis.[46] Further, we propose to allocate the 75.5-76 GHz band to the fixed, mobile, and FSS downlink services on a primary basis and to delete the amateur and AMSAT allocations from the 75.5-76 GHz band.

21. In order to protect future Federal Government use, NTIA requests that footnote 5.561 be adopted domestically, which would require that the fixed, mobile, and broadcasting services not cause harmful interference to FSS or BSS reception in the 74-76 GHz band.[47] NTIA alternatively requests that the requirements contained in this international footnote be placed in the Federal Government Table of Frequency Allocations.[48] Given NTIA's stated need for future Federal FSS operations, we propose to adopt the following United States footnote:

> USwww In the band 74-76 GHz, stations in the fixed, mobile and broadcasting services shall not cause harmful interference to stations of the Federal Government fixed-satellite service.

22. We request comment on this proposal and on whether similar protection should be provided to non-Federal FSS and BSS operations. If both satellite and terrestrial allocations are implemented in the 71-76 GHz band, technical and regulatory guidelines will be necessary to allow spectrum sharing. We seek comment on what requirements would be necessary to facilitate sharing between the various services, such as coordination requirements and power flux-density (PFD) limits for satellite operations in the 71-76 GHz band. We also request comment on whether any coordination requirements adopted to facilitate sharing would eliminate the need for the footnote to protect future FSS use, thus placing all allocations on equal footing. PFD limits are the normal means by which FSS downlinks and fixed point-to-point operations share the same spectrum. We also request comment on the appropriate PFD limit for the 71-76 GHz band.

23. We propose to permit the amateur and AMSAT services in the 75.5-76 GHz band to continue on a secondary basis until January 1, 2006, rather than to adopt footnote 5.559A, which would allow these services to operate on a primary basis until 2006. We believe that this proposal provides the best transition mechanism from amateur use to new licensed fixed and mobile services. It is unclear to us how extensively the amateur community is using the 75.5-76 GHz band, but we tentatively find that the impact would be minor, especially since the nearby primary amateur and AMSAT allocation at 77.5-78 GHz has been available for nearly four years.[49] Moreover, since it is unlikely that there will be any fixed

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[46] The BSS and broadcasting service are regulated solely by the Commission and thus, these allocations will be added only to the non-Federal Government Table.

[47] *See* Letter from Associate Administrator, Office of Spectrum Management, NTIA, U.S. Department of Commerce, to Acting Chief, Office of Engineering and Technology, FCC, dated July 18, 2001.

[48] *See* Letter from Associate Administrator, Office of Spectrum Management, NTIA, U.S. Department of Commerce, to Chief, Office of Engineering and Technology, FCC, dated May 28, 2002.

[49] *See Amendment of Parts 2, 15, and 97 of the Commission's Rules to Permit Use of Radio Frequencies Above 40 GHz for New Radio Applications*, ET Docket No. 94-124, *Third Report and Order*, 13 FCC Rcd 15074 (1998). (continued....)

or mobile users for several years, amateur users will continue to have the band to themselves until fixed licensed systems begin their service rollout. Accordingly, we propose to adopt a United States footnote that would read as follows:

> USyyy The band 75.5-76 GHz is also allocated to the amateur and amateur-satellite services on a secondary basis until January 1, 2006.

24. In order to implement this proposal in the Commission's Rules for the Amateur Radio Service, we propose to add a new frequency sharing requirement to Section 97.303, which would read as follows:

> No amateur or amateur-satellite station transmitting in the 75.5-76 GHz segment shall cause interference to, nor is protected from interference due to the operation of, stations in the fixed service. After January 1, 2006, the 75.5-76 GHz segment is no longer allocated to the amateur service or to the amateur-satellite service.

25. We request comment on all of the above proposals for the 71-76 GHz band. Table 2 summarizes our proposals for the 71-76 GHz band.

Table 2: 71-76 GHz (All allocations are on a primary basis unless otherwise stated)

Existing U.S. Allocations	Proposed U.S. Allocations	Summary of Major Changes
71-74 GHz Fixed Mobile FSS uplinks MSS uplinks US270 (RAS)	71-74 GHz Fixed Mobile FSS downlinks MSS downlinks	In 3 gigahertz of MSS & FSS spectrum, change transmission direction from uplink to downlink. Delete RAS from 140 megahertz.
74-75.5 GHz Fixed Mobile FSS uplinks US297 (74-75.5 GHz available for BSS feeder links)	74-76 GHz Fixed Mobile FSS downlinks Broadcasting BSS Secondary SRS downlinks USwww (In the band 74-76 GHz, stations in the fixed, mobile and broadcasting services will not cause harmful interference to stations of the Federal FSS.) USyyy (secondary amateur & AMSAT allocations in the 75.5-76 GHz band until 2006)	In 1.5 gigahertz of FSS spectrum, change transmission direction from uplink to downlink. Delete 500 megahertz from amateur & AMSAT services, but permit these services to be used on a secondary basis until 2006. Allocate 500 megahertz for fixed, FSS downlink & mobile services. Allocate 2 gigahertz for BSS & broadcasting service on primary basis & for SRS downlinks on secondary basis.
75.5-76 GHz Amateur AMSAT		

3. 81-86 GHz

26. Prior to WRC-2000, the 81-86 GHz band was allocated to the fixed and mobile services on a primary basis throughout the world. The 81-84 GHz band was also allocated throughout the world for FSS downlinks and MSS downlinks on a primary basis and for SRS downlinks on a secondary basis. The

(Continued from previous page)

The amateur and AMSAT services are regulated solely by the Commission and thus, these allocation changes were made only to the non-Federal Government Table.

84-86 GHz band was also allocated to the BSS and the broadcasting service on a primary basis throughout the world. Footnote 5.561 stated that, in the 84-86 GHz band, stations of the fixed, mobile, and broadcasting services may not cause harmful interference to the BSS stations operating in accordance with the decisions of the appropriate BSS frequency assignment planning conference.

27. In the United States, these pre-WRC-2000 allocations have been implemented, except that the SRS downlink allocation, which was established at WARC-92, has not yet been considered.[50] Additionally, the Commission adopted footnote US211, which urges applicants for airborne or space station assignments in the 84-86 GHz band to take all practicable steps to protect RAS observations in adjacent bands from harmful interference.

28. At WRC-2000, the 81-86 GHz band was allocated to the RAS on a primary basis. The addition of this RAS allocation satisfies the requirements for radio astronomy spectral line and wideband continuum observations from remote locations worldwide. WRC-2000 also revised footnote 5.149 to add the 81-86 GHz band to the list of frequency bands wherein administrations are urged to take all practicable steps to protect the RAS from harmful interference when making assignments to stations of other services.

29. As previously stated, the MSS and FSS downlink allocations in the 81-84 GHz band were interchanged with the MSS and FSS uplink allocations in the 71-74 GHz band. WRC-2000 relocated the BSS, which is currently allocated to the 84-86 GHz band, to the 74-76 GHz band. WRC-2000 took these actions because co-frequency satellite downlinks would cause interference to the new primary RAS allocation. Footnote 5.560A, which allocates the 81-81.5 GHz band to the amateur and AMSAT services on a secondary basis, was added to maintain the current amount of secondary amateur and AMSAT spectrum. Footnote 5.561 is no longer relevant to the 84-86 GHz band; it was appropriately modified to apply to the 74-76 GHz band.

30. Proposal. We propose to implement the *WARC-92 Final Acts* and most of the *WRC-2000 Final Acts* with respect to the 81-86 GHz band. Specifically, we propose to allocate the 81-86 GHz band to the RAS on a primary basis, to change the directional indicators on the FSS and MSS allocations in the 81-84 GHz band from downlinks to uplinks, to allocate the 84-86 GHz band for FSS uplinks, and to delete the BSS and broadcasting allocations from the 84-86 GHz band. We propose to revise footnote US297 in order to state that 81-82.5 GHz (instead of 74-75.5 GHz) is available for BSS feeder links. We also propose to revise footnote US211 by deleting the 84-86 GHz band from those bands in which applicants for airborne or space station assignments are urged to take all practicable steps to protect RAS observations in adjacent bands from harmful interference because the 81-86 GHz band has been proposed to be allocated to the RAS on a primary basis.

31. Consistent with international footnote 5.149, we propose to revise footnote US342 in order to add the 81-86 GHz band to the list of frequency bands wherein all practicable steps are to be taken to protect the RAS from harmful interference when assignments to stations of other services are made.

32. We request comment on whether footnote 5.560A, which would allocate the 81-81.5 GHz band to the amateur and AMSAT services on a secondary basis, should be adopted domestically. The Commission has previously allocated the 77.5-78 GHz band to the amateur and AMSAT services on a primary basis. We therefore seek comment on whether these secondary allocations are needed. Further,

[50] The BSS and broadcasting service are regulated solely by the Commission and thus, these allocations were only added to the non-Federal Government Table.

we request comment on whether amateur and AMSAT services in the 81-81.5 GHz band would be compatible with primary commercial operations.

33. If both satellite and terrestrial allocations are implemented in the 81-86 GHz band, technical and regulatory guidelines will be necessary to allow spectrum sharing. We seek comment on what requirements would be necessary to facilitate sharing between the various services, such as coordination and terrestrial station antenna pointing requirements in the 81-86 GHz band.

34. We request comment on all of the above proposals for the 81-86 GHz band. Table 3 summarizes our proposals for the 81-86 GHz band.

Table 3: 81-86 GHz (All allocations are on a primary basis unless otherwise stated)		
Existing U.S. Allocations	Proposed U.S. Allocations	Summary of Major Changes
81-84 GHz Fixed Mobile FSS downlinks MSS downlinks	81-84 GHz Fixed Mobile FSS uplinks US297 (81-82.5 GHz available for BSS feeder links) MSS uplinks Radio astronomy Secondary SRS downlinks US342 (take all practicable steps to protect RAS in the 81-84 GHz band from harmful interference)	In 3 gigahertz of MSS & FSS spectrum, change transmission direction from downlink to uplink. Specify that 1.5 gigahertz of FSS uplink spectrum is available for BSS feeder links. Allocate 3 gigahertz for RAS on a primary basis. Allocate 3 gigahertz for SRS downlinks on a secondary basis.
84-86 GHz Fixed Mobile Broadcasting BSS 5.561 (fixed, mobile & broadcasting must not cause harmful interference to BSS) US211 (protect RAS in the adjacent 86-92 GHz band)	84-86 GHz Fixed Mobile FSS uplinks Radio astronomy US342 (take all practicable steps to protect RAS in the 84-86 GHz band from harmful interference)	Allocate 2 gigahertz to RAS & FSS uplinks. Delete 2 gigahertz from broadcasting & broadcasting-satellite services. Remove requirement in 2 gigahertz that fixed, mobile & broadcasting can not cause harmful interference to BSS.

4. 92-95 GHz

35. Prior to WRC-97, the 92-95 GHz band was allocated to the fixed, mobile, FSS uplink, and radiolocation services on a primary basis throughout the world. Footnote 5.556 stated that radio astronomy observations could be carried out under national arrangements in the 93.07-93.27 GHz band and, in making assignments to stations other services, footnote 5.149 urged administrations to take all practical steps to protect the RAS in this band from harmful interference.[51] In the United States, these pre-WRC-97 allocations have been implemented.[52]

[51] *See* 47 C.F.R. § 2.106, footnotes 5.149, 5.556.

[52] We observe that footnote 5.556 has been inadvertently deleted from the U.S. Table.

36. In the United States' proposals for WRC-97, the 94-94.1 GHz band was proposed for use by spaceborne cloud radars to determine the vertical profile of clouds and their global distribution.[53] The allocation would be limited to 100 megahertz because it could be coupled with the primary spaceborne active sensor allocations in the 78-79 GHz band, which are provided for in footnote 5.560. The EESS and SRS allocations in 94-94.1 GHz band would be limited to use by spaceborne cloud radars because the 78-79 GHz band is suitable for use by active spaceborne sensors other than cloud radars. The 94-94.1 GHz band was proposed because it is of less interest to the RAS (it has relatively few spectral lines) and because it has adequate frequency separation from the 86-92 GHz band, which is allocated for passive use. At the 1997 Conference Preparatory Meeting (CPM-97), it was determined that cloud radars and the radiolocation service are compatible in the 92-95 GHz band. However, because studies indicated compatibility problems between cloud radars and both the fixed and FSS uplink services in the 92-95 GHz band, these allocations were proposed to be deleted.

37. At WRC-97, the 94-94.1 GHz band was allocated to the EESS (active) and the SRS (active) on a primary basis; the radiolocation allocation in the 94-94.1 GHz band was maintained; and the fixed, mobile, and FSS uplink allocations were deleted from the 94-94.1 GHz band. WRC-97 added footnote 5.562, which states that the use of the 94-94.1 GHz band by the EESS (active) and SRS (active) is limited to spaceborne cloud radars. Recently, we agreed that the Air Force could operate its "Cloudsat" system at 94.045 GHz on a non-interference basis, pending the outcome of this allocation proceeding. Cloudsat is a spaceborne radar that will collect high resolution vertical profile data in thick clouds.

38. At WRC-2000, the 92-94 GHz and 94.1-95 GHz bands were allocated to the RAS on a primary basis and the 94-94.1 GHz band was allocated to the RAS on a secondary basis. The addition of these RAS allocations satisfies the requirements for radio astronomy spectral line and wideband continuum observations from remote locations worldwide. Consequently, the RAS band at 93.07-93.27 GHz was deleted from footnote 5.556. The FSS uplink allocations in the 92-94 GHz and 94.1-95 GHz band, which were no longer needed to balance the FSS allocation at 102-105 GHz, were deleted.

39. WRC-2000 added footnote 5.562A, which states that EESS transmissions that are directed into the main beam of a RAS antenna have the potential to damage some RAS receivers and that space agencies operating these transmitters and the RAS observatories should mutually plan their operations so as to avoid such occurrences to the maximum extent possible. WRC-2000 revised footnote 5.149 to replace the 93.07-93.27 GHz band with the 92-94 GHz and 94.1-95 GHz bands in the list of frequency bands wherein administrations are urged to take all practicable steps to protect the RAS from harmful interference when making assignments to stations of other services.

40. Proposal. We propose to implement the *WRC-97 Final Acts* and *WRC-2000 Final Acts* with respect to the 92-95 GHz band. Specifically, we propose to allocate the 92-94 GHz and 94.1-95 GHz bands to the RAS on a primary basis; to allocate the 94-94.1 GHz band to the EESS (active) and SRS (active) on a primary basis for Federal Government use, limited to cloud radars; to allocate the 94-94.1 GHz band to the RAS on a secondary basis; to delete the FSS uplink allocation from the 92-95 GHz band; and to delete the fixed and mobile allocations from the 94-94.1 GHz band.

41. Consistent with international footnote 5.149, we propose to revise footnote US342 in order to add the 92-94 GHz and 94.1-95 GHz bands to the list of frequency bands wherein all practicable steps are

[53] *See* Unites States Proposals for the Work of the Conference, Document 30-E, dated September 4, 1997, Proposals for Agenda Item 1.9.2, at p.120.

to be taken to protect the RAS from harmful interference when assignments to stations of other services are made.

42. We request comment on all of the above proposals for the 92-95 GHz band. Table 4 summarizes our proposals for the 92-95 GHz band.

Table 4: 92-95 GHz (All allocations are on a primary basis unless otherwise stated)		
Existing U.S. Allocations	Proposed U.S. Allocations	Summary of Major Changes
92-95 GHz Fixed Mobile FSS uplinks Radiolocation 5.149 (in making assignments to stations of other services to which the 93.07-93.27 GHz band is allocated, administrations are urged to take all practicable steps to protect RAS from harmful interference)	92-94 GHz Fixed Mobile Radiolocation Radio astronomy US342 (take all practicable steps to protect RAS in the 92-94 GHz band from harmful interference)	Allocate 2 gigahertz to the RAS on a primary basis. Delete FSS uplinks from 2 gigahertz.
	94-94.1 GHz Radiolocation Federal Government EESS (active) Federal Government SRS (active) Secondary radio astronomy 5.562 (EESS & SRS limited to cloud radars) 5.562A (EESS & RAS should mutually plan their operations)	Allocate 100 megahertz to the EESS (active) and SRS (active) on a primary basis for Federal Government use, limited to cloud radars. Allocate 100 megahertz to the RAS on a secondary basis. Delete fixed, mobile & FSS uplinks from 100 megahertz.
	94.1-95 GHz Fixed Mobile Radiolocation Radio astronomy US342 (take all practicable steps to protect RAS in the 94.1-95 GHz band from harmful interference)	Allocate 900 megahertz to the RAS on a primary basis. Delete FSS uplinks from 900 megahertz.

5. RAS Protection in the 81-86 GHz, 92-94 GHz, and 94.1-95 GHz Bands

43. In order to avoid interference to 18 RAS observatories that currently receive in the 81-86 GHz, 92-94 GHz, and 94.1-95 GHz bands, National Science Foundation (NSF) requests that we require licensees of all other allocated services in these bands to coordinate with these RAS sites.[54] NSF states that coordination radii on the order of 150 kilometers (93 miles) around the 8 single dish observatories and 25 kilometers (15.5 miles) around the 10 Very Long Baseline Array (VLBA) stations appear to be sufficient to ensure protection of these RAS facilities.

44. In paragraphs 30 and 40, above, we propose to allocate the 81-86 GHz, 92-94 GHz, and 94.1-95 GHz bands to the RAS on a primary basis. These RAS allocations were made at WRC-2000 as result

[54] *See* NSF letter to Convener, Ad Hoc 212, dated March 1, 2002.

of U.S. proposals and NTIA has requested their implementation.[55] We recognize that radio astronomers must observe radio waves of cosmic origin at frequencies over which they have no control.[56] We note, however, that the 86-92 GHz band is already allocated to the RAS on a primary basis. In light of this adjacent 6 gigahertz primary allocation, we request comment on whether the 81-86 GHz, 92-94 GHz, and 94.1-95 GHz bands should also be allocated to the RAS on a primary basis. Is this quantity of spectrum necessary for RAS purposes and would such a large allocation hinder effective use of spectrum needed for other applications? If not all of this spectrum is needed by the RAS, which portions are most essential or, alternatively, should certain portions be on a secondary or unprotected basis?

45. The customary means of protecting RAS reception is through coordination around RAS observatories. We tentatively propose to adopt a new United States footnote (footnote USzzz) that would specify the maximum coordination distances requested by NSF at the 18 indicated observatories with regard to RAS reception in the 81-86 GHz, 92-94 GHz, and 94.1-95 GHz bands.[57] However, we request comment on means to minimize any coordination burden on relevant parties. For example, are the coordination distances proposed by NSF appropriate? Further, we believe that terrain shielding, pointing directions when narrow beam antennas are used, and other factors could be taken into account in order to reduce unnecessary coordination requirements. We note that the radio telescope in Owens Valley, California is shielded from radio frequency interference (RFI) by high mountains in the direction of Fresno, California, which is an urban area within the 150 kilometer maximum coordination radius. We also note that the Haystack Observatory in Westford, Massachusetts is within 150 kilometers of most of the western suburbs of Boston and that NSF's request would require coordination of pencil beam antennas within this distance even if they were pointed away from radio telescope. Therefore, in order to minimize unnecessary coordination, while fully protecting the new RAS allocations, we request comment on whether RAS observatories should be required to operate a web site where fixed point-to-point licensees can input end points of links, power, and antenna characteristics and receive back promptly whether coordination is required. This process would take into account the observatory sensitivity, terrain shielding, and the azimuth of the path relative to the observatory. This approach is similar to the coordination method that was developed for the 1670-1675 MHz Government transfer band, where the National Oceanic and Atmospheric Administration (NOAA) agreed to maintain a web site to assist in

[55] *See* United States of America Proposals for the Work of the Conference, Document 12-E, dated January 12, 2000, Proposals for agenda item 1.16, entitled "A proposal to modify the allocations above 71 GHz," at pp. 31-67. *See also* Letter from Associate Administrator, Office of Spectrum Management, NTIA, U.S. Department of Commerce, to Acting Chief, Office of Engineering and Technology, FCC, dated July 18, 2001.

[56] The radio frequencies of interest for the RAS depend on the characteristics of the object studied. Celestial radio sources radiate radio waves varying with time and frequency, with intensity and with the polarization determined by their physical conditions. Each part of the radio spectrum gives specific information about a source. Radio astronomers have to follow the constraints on frequency selection imposed by nature. A similar situation holds for atmospheric studies based on observations of atmospheric gases. These gases generate radio emissions at one or more discrete frequencies—such a discrete frequency is called a spectral line. These spectral lines are often of interest for Radio astronomers. In addition, various RAS projects depend on measurements of broadband or continuum emission. *See* CRAF [Committee on Radio Astronomy Frequencies] handbook for frequency management, dated February 2002, at p. 6.

[57] *See* Appendix A for the text of proposed footnote USzzz, which contains the list of RAS telescopes that would be protected under this proposal.

coordination near two of its receive earth stations.[58]

46. We also seek comment on whether we should geographically limit the scope of these RAS allocations in a similar fashion to the RAS allocation in the 10.6-10.68 GHz band, which provides that the RAS will not receive protection from stations in other allocated services that are licensed to operate in the one hundred most populous urbanized areas as defined by the U.S. Census Bureau.[59] This would facilitate commercial deployment in areas where spectrum demands are most intense.

B. Band Plan

47. As we examine methods to promote development and growth of the 71-76 GHz, 81-86 GHz and 92-95 GHz bands, we must consider the current and projected uses of these bands, and the current use of adjacent bands, such as the 86-92 GHz band. We are aware of a variety of military research and development projects that are in progress in the 71-76 GHz, 81-86 GHz and 92-95 GHz band. As all of these bands (except for the amateur band at 75.5-76 GHz) are shared on a co-primary basis between Federal and non-Federal Government services, our rules must provide for equitable sharing with Federal Government users, especially those with national security implications.

48. We recognize that there may be Federal installations where existing and planned uses in the 71-76 GHz, 81-86 GHz and 92-95 GHz bands require high confidence protection from FCC licensees for national security reasons. We propose to include in the final rules specific areas proposed by NTIA during this proceeding which will require coordination with the Frequency Assignment Subcommittee (FAS) of the Interdepartment Radio Advisory Committee (IRAC) for frequency assignments and licensing. We seek comment on this proposal. We also ask commenters how we can limit the administrative burdens for the Commission, NTIA and potential licensees while still requiring IRAC coordination. For example, rather than specifying a simple geographic area, we might require all licensees within a certain distance of these sites to verify that the predicted power flux density at a reference point is less than a specified value. Any potential assignment exceeding the specified value would require coordination.

1. 92-95 GHz Band

49. Given that we are aware of where the Federal Government is operating in the 92-95 GHz band, we are able to propose specific band plans for the 92-95 GHz band. However, as we noted earlier, the 92-95 GHz band is shared between Federal and non-Federal Government services.[60] We also believe the adjacent passive allocation in the 86-92 GHz band will have an impact on the use of the 92-95 GHz

[58] *See Reallocation of the 216-220 MHz, 1390-1395 MHz, 1427-1429 MHz, 1429-1432 MHz, 1432-1435 MHz, 1670-1675 MHz, and 2385-2390 MHz Government Transfer Bands*, ET Docket No. 00-221, *Report and Order and Memorandum Opinion and Order*, 17 FCC Rcd 368 (2002) at Appendix C, Section 1.924(f)(1) of the Commission's Rules.

[59] This approach would parallel footnote US277 where the 10.6-10.68 GHz band is allocated to the RAS on a primary basis. However, the RAS does not receive protection from fixed stations that are licensed to operate in the one hundred most populous urbanized areas as defined by the U.S. Census Bureau. *See* 47 C.F.R. § 2.106, footnote US277.

[60] *Id.*

band because the 86-92 GHz band is shared among several passive services.[61] Specifically, the aeronautical community has been considering use of the passive band for aircraft-based 86-92 GHz imaging systems that would allow aircraft to view runways during landings in inclement weather.[62] Thus, there may be future safety-related passive aeronautical systems in the 86-92 GHz band. Consequently, we must consider adequate protection of such systems as we examine commercial development and growth in the 92-95 GHz band. We seek comment on this tentative conclusion. We also seek comment on whether we must consider adequate protection in adjacent 95-100 GHz band, which is currently licensed to the mobile, MSS, radionavigation and radionavigation-satellite services on a primary basis and to the radiolocation service on a secondary basis. We observe that WRC-2000 added primary fixed and RAS allocations to the 95-100 GHz band, raised the secondary radiolocation allocation to primary status, and deleted the MSS allocation from the 95-100 GHz band.[63]

50. In light of the considerations mentioned above, we request comment on three band plans for the 92-95 GHz band. Band Plan I provides for three 900-megahertz segments and one 300-megahertz segment. Under this plan, we would license the 92.3-93.2 GHz and 94.1-95 GHz spectrum blocks for commercial use. That is, non-Federal licensees would have access to two 900-megahertz segments that are separated by 900 megahertz. Primary Federal assignments would be made in the 92.3-93.2 GHz and 93.2-94.1 GHz spectrum blocks throughout the nation. In the licensed non-Federal bands (92.3-93.2 GHz and 94.1-95 GHz), primary Federal assignments could be authorized at designated military installations. Thus, under this option, Federal users would have access to the entire 92-95 GHz band on a primary basis at designated military installations. Outside the designated military installations, we propose that Federal assignments would be authorized in the licensed non-Federal bands on a secondary basis. These secondary Federal allocations would permit Federal use in areas of low population density, as well as permitting other uses such as ground-based Federal radar in rural areas. Band Plan I would also make the 92-95 GHz band available for unlicensed Part 15 use.

51. Band Plan II would provide Federal and non-Federal users with the same amount of spectrum as in Band Plan I. However, the Federal bands would now be equal in size, that is, two 600-megahertz channel blocks. Another option, Band Plan III, would provide Federal and non-Federal licensees with access to 2,900 megahertz of spectrum on a shared basis. Additionally, we encourage commenters to propose alternative band plans that will stimulate growth in the 92-95 GHz band and to submit rationale supporting adoption of their proposed alternative band plans.

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[61] These passive services are earth exploration satellite (passive), radio astronomy, and space research (passive), which use highly sensitive receivers for signals from outer space. These devices are not used for transmitting.

[62] *See* M. Shoucri, G.S. Do, S. Fornaca, B. Hauss, L. Yujiri, J.Shannon and L. Summers, Passive Millimeter Wave Camera for Enhanced Vision Systems," Proceedings of the SPIE Conference on Enhanced and Synthetic Vision, 2736, pp. 2-8, 1996; S. Fornaca, M. Shoucri and L. Yujiri, "Passive Millimeter Wave Video for Aviation Applications," Proceedings of the SPIE Conference on Enhanced and Synthetic Vision 1998, 3364, pp. 20-25, 1998. This region of the spectrum has some of the characteristics of infrared radiation. Objects such as runways and vehicles spontaneously emit low levels of 90 GHz power based on their composition and temperature. A scanning receiver can use this emitted power to image an area. While fog, rain and clouds affect emissions in this band, the emissions are affected significantly less than visual light waves. Hence the possibility of imaging airports from an airplane in adverse weather is attractive to the aeronautical community if the technology can be commercialized.

[63] *See WRC-2000 Final Acts* at p. 45.

52. We tentatively conclude that Band Plan I will stimulate growth in the 92-95 GHz band without hindering growth in the adjacent 86-92 GHz band. Additionally, we believe these segments provide sufficient capacity for licensees to utilize and provide new innovative services to the public. Accordingly, we propose to adopt Band Plan I for use in the 92-95 GHz band.[64] We tentatively conclude that the mixture of licensed and unlicensed use in Band Plan I will satisfy the needs of most potential users of this band while facilitating sharing with Federal Government users. We seek to maximize the opportunities for new 90 GHz services and technologies, avoid interference to passive services operating in the lower adjacent band at 86-92 GHz, protect the 94.0-94.1 GHz cloud sensing radar allocation, and maximize sharing potential for Federal Government systems in the same band.

53. In order to codify the nature of the Federal/non-Federal Government sharing in the 92-95 GHz band, we propose to add a new United States footnote to the U.S. Table, which would read as follows:

> USxxx In the band 92-95 GHz, Federal and non-Federal users may operate low power, unlicensed devices. In the band 92-92.3 GHz and 93.2-94.1 GHz, Federal assignments shall operate on a primary basis. In the bands 92.3-93.2 GHz and 94.1-95 GHz, non-Federal licensed systems shall operate on a primary basis and Federal assignments may operate on a secondary basis, except that Federal assignments at the following military installations shall operate on a primary basis: . . .[65]

54. We believe that Band Plan I would simplify duplexer design for full duplex bidirectional systems. Non-Federal use of the 300-megahertz segment that is adjacent to the 86-92 GHz passive band would be limited to unlicensed Part 15 devices. This placement minimizes the likelihood that out-of-band emissions would cause harmful interference to passive band receivers. We also believe that it would be more economically feasible for manufacturers to build low power unlicensed devices to meet the necessarily restrictive out-of-band emission limits for protection of passive band receivers than it would be for them to meet those limits for higher power equipment for licensed use. The 93.2-94.1 GHz unlicensed band includes the cloud sensing radar allocation. We tentatively conclude that sharing between these two types of operations is possible without harmful interference to systems operating under the radar allocation. We seek comment on this tentative conclusion. The unlicensed segments also provide possible locations for Federal Government systems that may not be able to share with licensed systems. We request comment on whether to provide two licensed portions of 900-megahertz each or to further divide the licensed portions. We also seek comment whether unlicensed devices can share the 94-94.1 GHz band with cloud sensing radars without causing harmful interference to Cloudsat and other such systems. Finally, we seek comment on whether it would be appropriate for non-Federal licensees to operate on a secondary basis in the 92.0-92.3 GHz and 93.2-94.1 GHz bands. Table 5 summarizes our band plan proposal for the 92-95 GHz band.

[64] *See* Appendix B for proposed rules.

[65] NTIA will supply the list of large military installations prior to the adoption of the Report and Order.

Table 5: Commission Proposal for the 92-95 GHz Band (Band Plan I)			
Band	Bandwidth	Type of Use (Federal and non-Federal unlicensed use permitted throughout the 92-95 GHz band)	
		Federal Government	non-Federal Government
92.0-92.3 GHz	300 MHz	Primary assignments	No licensed use
92.3-93.2 GHz	900 MHz	Secondary assignments, except on specified military installations where assignments are on a primary basis	Licensed on a primary basis
93.2-94.0 GHz	800 MHz	Primary assignments	No licensed use
94.0-94.1 GHz	100 MHz	Cloudsat and primary radiolocation assignments	No licensed use
94.1-95.0 GHz	900 MHz	Secondary assignments, except on specified military installations where assignments are on a primary basis	Licensed on a primary basis

55. Band Plan II shares many of the favorable characteristics of Band Plan I as it also divides the licensed spectrum from the unlicensed spectrum. However, the segmentation of the band is different. Under Band Plan II, commercial users have full access to the 92-95 GHz band for unlicensed Part 15 use and two 900-megahertz licensed bands. This band plan also provides additional interference protection to the passive band receivers in the 86-92 GHz passive band. However, this band plan results in licensed non-Federal Government users having only a 600-megahertz wide separation rather than a 900-megahertz separation between paired bands.[66] Table 6 summarizes the Band Plan II option for the 92-95 GHz band.

Table 6: Band Plan II Option for the 92-95 GHz Band			
Band	Bandwidth	Type of Use (Federal and non-Federal unlicensed use permitted throughout the 92-95 GHz band)	
		Federal Government	non-Federal Government
92.0-92.6 GHz	600 MHz	Primary assignments	No licensed use
92.6-93.5 GHz	900 MHz	Secondary assignments, except on specified military installations where assignments are on a primary basis	Licensed on a primary basis
93.5-94.0 GHz	500 MHz	Primary assignments	No licensed use
94.0-94.1 GHz	100 MHz	Cloudsat and primary radiolocation assignments	No licensed use
94.1-95.0 GHz	900 MHz	Secondary assignments, except on specified military installations where assignments are on a primary basis	Licensed on a primary basis

56. Band Plan III, proposed by Boeing, provides licensees in the 92-95 GHz band with access to 2,900 megahertz of spectrum, which is all of the 92-95 GHz band that can be allocated to the fixed and

[66] This separation might complicate the isolation of transmit and receive antennas that are closely spaced and require duplexers.

mobile services.[67] It does not make any spectrum available for unlicensed use and thus, may not provide adequate protection for Federal operations in the 92-95 GHz band or for receivers in the adjacent 86-92 GHz passive band. However, Boeing argues that in order to provide very high, fiber-like data transmissions rates, the entire band must be made available.[68] Boeing claims that any segmentation of the band would deny potential licensees the ability to realize fiber-like data transmission rates that are possible in this band.[69] We seek comment on Boeing's proposed band plan for the 92-95 GHz band. Commenters supporting Boeing's proposal should address how its proposal could accommodate and address the concerns raised above with the Federal Government operations and operations in adjacent bands. Table 7 summarizes the Band Plan III option for the 92-95 GHz band

Table 7: Band Plan III Option for the 92-95 GHz Band

Band	Bandwidth	Type of Use	
		Federal Government	Non-Federal Government
92.0-94.0 GHz	2,000 MHz	Primary assignments	Licensed on a primary basis
94.0-94.1 GHz	100 MHz	Cloudsat and primary radiolocation assignments	None
94.1-95.0 GHz	900 MHz	Primary assignments	Licensed on a primary basis

2. 71-76 GHz and 81-86 GHz Bands

57. Similarly, in developing a band plan for the 71-76 GHz and 81-86 GHz bands, we must consider that the 71-76 GHz and 81-86 GHz bands are allocated on a co-primary basis for Federal Government services.[70] Although Loea claims that the Federal Government is not using these bands,[71] we believe that any band plan proposal must consider the possibility that the Federal Government is currently operating or in the future will be operating in those bands and thus will require protection. We also must consider the proposed satellite allocations for these bands. Loea correctly states that there are no satellite services currently operating in these bands.[72] Nonetheless, we believe that we must address the issue of protection for these co-primary services in the event Federal Government or satellite operators seek to use these bands in the future. Finally, we believe that the bands adjacent to the 71-76 GHz and 81-86 GHz bands, especially the 86-92 GHz passive band, may require protection.

58. In the 36-51 GHz proceeding, the Commission addressed similar issues when it proposed a band plan for non-Government operations in the 36.0-51.4 GHz band. Prior to the commencement of the 36-51 GHz proceeding, the band was allocated on a co-primary basis to the fixed, mobile, FSS and MSS

[67] *See* Comments of The Boeing Company to Petition for Rulemaking at 4 (filed Oct. 29, 2001) (Boeing Comments). We observe that Boeing requested the entire 3,000 megahertz between 92 GHz and 95 GHz, but that the fixed and mobile allocations in the 94-94.1 GHz band have been proposed for deletion. *See* para. 40, *supra.*

[68] *Id.*

[69] *Id.* at 5.

[70] 47 C.F.R. § 2.106.

[71] *See* Loea Petition at 9.

[72] *Id.*

services for Federal and non-Federal Government use.[73] Therefore, the Commission had to consider the feasibility of sharing between the satellite and wireless services while sharing with the Federal Government.[74] The Commission concluded that the public interest would be best served by providing separate primary designations for the satellite and wireless services, as well as the Federal Government services, because of the technical difficulties in sharing.[75] In 2001, the Commission proposed a new band plan to reflect the decisions reached at WRC-2000.[76] The Commission sought to provide satellite and terrestrial operators with greater certainty about the scope of operations in the band and also proposed specific PFD limits on satellite operations in specific portions of the band.[77] In certain portions of the band where both wireless and satellite services share a co-primary allocation, the Commission proposed some sharing criteria.[78] For example, in the 37.5-42.5 GHz band, the Commission proposed specific PFD limits for the satellite services in order to provide adequate protection for the wireless services in the band.[79] We seek comment on whether this type of sharing criteria is appropriate for the 71-76 GHz and 81-86 GHz bands[80] and whether it provides adequate protection for the co-primary services.

59. In its Petition, Loea asks the Commission to authorize licensees use of the entire bandwidth of the 71-76 GHz and 81-86 GHz bands.[81] Loea claims that a service provider will need all ten-gigahertz of available spectrum in these bands in order to provide point-to-point access with sufficient throughput to meet local backhaul requirements beyond a three-year time horizon.[82] Loea also claims that because the systems will use narrow "pencil-beams" transmission, it will be difficult to interfere with them.[83] Loea, therefore, argues that with the low likelihood of interference there is no impetus for the Commission to

[73] *See* Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands, *Report and Order*, 13 FCC Rcd 24649, 24650 ¶ 1(1998) (*36-51 GHz R&O*).

[74] *See id.* at 24656 ¶ 13.

[75] *Id.* The Commission had considered to allow "underlay" licenses, *i.e.*, the licensing of a second service in the bands designated for satellite services, but it concluded that underlay licenses could make it more difficult to administer the various services and could increase the potential for interference between satellite and wireless services. *See id.* at 24651 ¶ 3.

[76] *See* Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands, *Further Notice of Proposed Rulemaking*, 16 FCC Rcd 12244 (2001) (*36-51 GHz FNPRM*).

[77] *Id.* at 12245 ¶ 1.

[78] *Id.* at 12258 ¶ 39.

[79] *Id.* at 12258-60 ¶¶ 39-50.

[80] We note that PFD limits were utilized in downlink (space-to-Earth) bands. The current US Table shows this band to be 81-86 GHz. WRC-2000 reallocated the satellite allocation at 81-86 GHz into an uplink (Earth-to-space) band, while also changing the satellite band at 71-75.5 GHz band from an uplink into a downlink allocation.

[81] *See* Loea Petition at 10.

[82] *Id.* at 11.

[83] *Id.* at 12.

subdivide the bands into channels.[84] In further support of its request for the entire ten gigahertz of spectrum, Loea contends that leaving the bands undivided provides equipment developers with the greatest amount of flexibility to design systems.[85] Loea also contends that there would be little to no advantage to a "spectrum grab" here because new competitors could enter a geographical location at any time and connect new points without causing, or being affected by, harmful interference from existing service providers in the same location.[86] Boeing, Endwave and the Fixed Wireless Communications Coalition (FWCC) all filed comments supporting Loea's proposal to allow licensees in the band access to the entire ten gigahertz of available spectrum in these bands.[87] Boeing notes, however, that interservice compatibility should be required, and it expresses its belief that sharing criteria should be easier to develop in these bands because of the nature of propagation in these bands.[88]

60. We seek comment on Loea's proposal to authorize the entire 71-76 GHz and 81-86 GHz bands for fixed use.[89] We specifically seek comment on whether Loea's band plan proposal for the 71-76 GHz and 81-86 GHz bands provides adequate protection for the Federal Government and non-Federal Government services that share the bands on a co-primary basis.[90] We also seek comment on the extent to which we can implement sharing criteria between fixed services and other services authorized for the bands. We also seek comment on whether Loea's proposed band plan for the 71-76 GHz and 81-86 GHz bands provides adequate protection for the adjacent bands, especially the passive 86-92 GHz band.

61. We also invite commenters to propose alternative band plans for this spectrum. We seek band plan proposals that will provide flexibility and efficient spectrum usage while providing adequate protection for the co-primary users described above. We also ask commenters to consider the bands adjacent to the 71-76 GHz and 81-86 GHz bands. Such a proposal may resemble our 92-95 GHz band plan proposal, in which adequate protection to the co-primary services described above and the adjacent bands is provided by dividing the spectrum into licensed and unlicensed use bands. Another possibility is a band plan resembling the 36-51 GHz proposal, in which the Commission provided PFD limits to protect co-primary users in certain portions of the band. Commenters may also consider proposing strict emission limitations to provide the necessary protection. Commenters are requested to provide detailed support for any band plan proposal.

C. Proposed Service Rules for Unlicensed Bands

62. As stated above, we have proposed to make the 92-95 GHz band available for unlicensed use. We are proposing rules for unlicensed operation in the 92-95 GHz band in Appendix B that are based on

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[84] *Id.*

[85] *Id.* at 13.

[86] *Id.*

[87] *See* Boeing Comments at 4-6, Comments of Endwave Corporation at 3 (filed Oct. 29, 2001) (Endwave Comments), Comments of the Fixed Wireless Communications Coalition at 2 (filed Oct. 29, 2001) (FWCC Comments).

[88] Boeing Comments at 3.

[89] *See* para. 94 for discussion of a channelization plan in the 71-76 and 81-86 GHz bands.

[90] *Id.*

our existing regulations for the 57-64 GHz band.[91] We believe that power levels for 57-64 GHz unlicensed operation are also appropriate for 92-95 GHz since they were based primarily on safety issues with respect to power densities.[92] The proposed rules are structured to be as flexible as possible with no restrictions on the types of modulation or applications, except that these devices may not be used in aircraft or satellites.[93] The prohibition on airborne and spaceborne use is necessary to protect in-band RAS observations.

63. We also seek comment on providing for operation of unlicensed devices in the 71-76 GHz and 81-86 GHz bands. We believe that unlicensed use of this spectrum could provide additional bandwidth for high capacity, short-range communications and other new and unique communications applications. One approach would be to permit unlicensed operation in these bands under the same rules (including technical parameters) that we are proposing for unlicensed operation in the 92-95 GHz. We request comment on this option and ask that commenting parties specifically address the operating parameters that should be specified for unlicensed devices in the 71-76 GHz and 81-86 GHz bands.

D. Proposed Rules for Licensed Bands

1. Introduction

64. With the increasing demand for radio spectrum, our spectrum management activities must focus on promoting more efficient use of the spectrum and increasing the amount of spectrum available for new services while continuing to ensure access to adequate spectrum for essential incumbent services. With these goals in mind, we hereby propose new service rules that we believe provide a flexible and efficient approach to spectrum management. We believe a flexible approach will allow licensees freedom to determine the services to offer and the technologies to use in providing these services. We also believe that any approach we take must be consistent with our responsibility to promote provision of communications services to all Americans in all parts of the United States and to promote diverse ownership of communications service providers via a variety of platforms. We seek an approach that will allow licensees to make the most efficient use of their assigned spectrum in response to market forces and that will advance the public interest.

2. Operational Rules

a) Geographic Area Licensing

65. Loea and the other commenters favor a site-by-site-only licensing scheme in these bands.[94] Loea contends that geographic area licensing would only succeed in keeping competing providers out of

[91] 47 C.F.R. § 15.255.

[92] As shown in Appendix B, the proposed power levels are 9 $\mu W/cm^2$ average power and 18 $\mu W/cm^2$ peak power, both measured 3 meters from the radiating structure.

[93] This flexibility follows the precedent set in 47 C.F.R. § 15.407(e) for the Unlicensed National Information Infrastructure band.

[94] *See* Loea Petition at 19; *see also* Boeing Comments at 6-8; Endwave Comments at 3; FWCC Comments at 2; PCIA Comments at 2; Reply Comments of the Wireless Communications Association International at 3 (filed Nov. 13, 2001) (WCIA Comments).

an area.[95] Under Loea's proposal, potential applicants would send applications to coordinators prior to filing an application.[96] If interference were predicted, the application would be amended at the coordination stage.[97] Loea believes that there is little likelihood of interference because the point-to-point systems operating in these bands would use very narrow "pencil-beams" to transmit data.[98] These pencil-sized beams will allow licensees to be located closely together.[99] Therefore, Loea argues that a site-by-site-only licensing scheme would enable an infinite number of providers to be authorized in the spectrum.[100] We seek comment on this proposal.

66. Alternatively, we seek comment on whether to define licenses in the licensed portions of the 71-76 GHz, 81-86 GHz, 92-94 GHz and 94.1-95 GHz bands on the basis of geographic areas. Our experience has been that geographic area licensing affords licensees substantial flexibility to respond to market demand and may result in significant improvements in spectrum utilization.[101] We believe that geographic area licensing allows licensees to coordinate usage of the spectrum across an entire geographic area to maximize the use of spectrum in areas of highest demand. Geographic area licenses also provide the flexibility to dynamically adjust spectrum usage depending upon market demands. Such adjustments may be significantly more difficult under a site-by-site licensing regime, where prior Commission approval is needed before a licensee can address growth or changes in demand.

67. We note that the 71-76 GHz, 81-86 GHz and 92-95 GHz bands are allocated to Federal Government services on a co-primary basis. However, we believe that any government use in these bands would be limited in both area and frequency. Therefore, we ask whether it would be appropriate to use a geographic area licensing scheme in the 71-76 GHz, 81-86 GHz, 92-94 GHz and 94.1-95 GHz bands, except in a limited number of defined frequencies or areas where, upon successful coordination with the Federal Government, licensees would use a site-by-site licensing scheme. We seek comment on whether this hybrid approach would provide the flexibility of geographic licensing while ensuring protection for the Federal Government services where necessary. We also ask commenters for alternative licensing schemes. For example, licensing by geographic area except in frequencies where the Federal Government is operating. In the limited spectrum where the Federal Government is operating, we then would require a geographic area licensee to apply for an individual station license.[102]

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[95] *Id.*

[96] *Id.* at 16.

[97] *Id.*

[98] *Id.* at 19.

[99] *See* Boeing Comments at 7.

[100] *See* Loea Petition at 19.

[101] *See, e.g.* Amendment of Part 90 of the Commission's Rules to Facilitate Future Development of SMR Systems in the 800 MHz Frequency Band, PR Docket No. 93-144, *First Report and Order, Eighth Report and Order, and Second Further Notice of Proposed Rule Making*, 11 FCC Rcd 1463 (1995) (restructuring licensing framework of 800 MHz Specialized Mobile Radio Service and adopting wide-area licensing); *See also* Gregory L. Rosston & Jeffery S. Steinberg, *Using Market-Based Spectrum Policy to Promote the Public Interest*, 50 Fed. Comm. L.J. 87, 94 (1997).

[102] There is a discussion of individual station licenses in para. 58.