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Background on Development
of 60GHz for Commercial Use

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Introduction

In October of 1994, the United States Federal Communications Commission (FCC) issued a Notice of Proposed Rulemaking (NPRM) in which it proposed “to open for commercial development and use a portion of the ‘millimeter wave’ frequency bands above 40 GHz.”¹ Prior to that time, millimeter wave technology in this portion of the spectrum had been limited in the U.S. to military and scientific applications. The purpose of the FCC’s proposal was to encourage the use of existing, and in particular, *new* technology in commercial products and services operating above 40 GHz. Beginning with the issuance of that first NPRM, a series of comment filings and hearings ensued, all of which resulted in the issuance of a first Report and Order in December of 1995 and a final Report and Order in June of 1998 that governs the use of this spectrum.

The present report is a brief summary of a few of the key documents that trace the development of the technical regulations, commercial interests, safety requirements, and use etiquette for a portion of the spectrum above 40 GHz: the unlicensed spectrum that extends from 57 to 64 GHz.

1. FCC NPRM for Spectrum Above 40 GHz

In this broad-reaching announcement,² the FCC noted that the extremely limited propagation range of the 59-64 GHz band,³ as well as higher millimeter wave frequency bands, suggests that major portions of those bands be designated for general use by unlicensed devices. By this dramatic opening of 5 GHz (later expanded⁴ to 7 GHz, from 57 – 64 GHz) of unlicensed spectrum, the FCC designated more available bandwidth for commercial (including wireless LAN) use than had previously existed, by a wide margin.

The NPRM generally outlined several areas where further comment and discussion should take place within the community of potential users: maximum radiation power levels, safe exposure limits and methods of their measurement, limits on interference (unintentional out-of-band emissions), and so forth. A set of deadlines was established to permit industry and government agencies a period of time in which to comment and propose specific technical parameters that would subsequently be adopted as regulations. A period of almost three years followed during which intense scrutiny, discussion, and rulemaking took place, resulting in the adoption of a final Report and Order in June of 1998.

¹ Notice of Proposed Rulemaking, ET Docket No. 94-124, RM 8308, October 20, 1994

² NPRM, ET Docket No. 94-124, RM 8308, October 20, 1994, *ibid.*

³ Making it ideally suited for short-range, indoor use

⁴ See complete reference at *FCC 47 CFR Part 15*, September 19, 2005

2. Comments by Industry and Governmental Agencies: 1994 – 1995

Following the first NPRM, the FCC received numerous comments from industry and governmental agencies, both domestic and foreign, in which petitions for favorable rulemaking were expressed. For example, several Japanese automobile manufacturers and their suppliers wished to set aside 1 GHz of bandwidth in the 59 – 64 GHz range for vehicular radar applications.^{5,6,7,8,9} Manufacturers of computer equipment^{10,11} expressed support for the use of this band for computer and personal communications devices. Terrestrial and satellite communications companies and their suppliers,¹² as well as conventional industrial equipment manufacturers¹³ requested a variety of special exemptions and considerations for established or planned use of this spectrum. Government agencies^{14,15} also expressed support and concern for the protection of this spectrum for special use by sensors and other detection devices.

In all, this healthy exchange of ideas and proposals served the community well. What emerged were two important developments: the First Report and Order from the FCC for use of the spectrum above 40 GHz, and the formation of an industry group dedicated to the task of establishment of an etiquette for sharing the spectrum in the License-exempt 59 – 64 GHz band.

3. FCC First Report and Order for Spectrum Use Above 40 GHz

In December of 1995 the FCC issued its first Report and Order¹⁶ (R & O) in which it opened for commercial development and use a portion of the spectrum above 40 GHz. Notable in this R & O were the 5 GHz between 59 and 64 GHz made available for general use by unlicensed device under Part 15 of the FCC's Rules. This document noted and responded to most of the comments that had been received from industry and

⁵ *Comments on the Notice of Proposed Rulemaking*, Ikuya Kobatashmi, Fujitsu Ten, Ltd., February 7, 1995

⁶ *Comment for Reconsideration of Vehicular Radar Bands*, Hiroshi Kojima, Japan Association to Promote Millimeter Wave Wireless, January 27, 1995

⁷ *Comment for Reconsideration of Vehicular Radar Bands*, Hiroshi Furukawa, Japan R&D Center for Radio Systems, January 27, 1995

⁸ *Comment for Reconsideration of Vehicular Radar Bands*, Eiji Amoto, American Honda Motor Co., January 30, 1995

⁹ *Comment for Reconsideration of Vehicular Radar Bands*, Hiroshi Aoki, Mitsubishi Electric Corporation, January 30, 1995

¹⁰ *Comments of Apple Computer, Inc.*, James F. Lovette, Apple Computer, Inc., January 31, 1995

¹¹ *In Support of Proposed Rulemaking for Frequencies Above 40 GHz*, Rory Van Tuyl, Hewlett-Packard Co., January 30, 1995

¹² *FCC Report No. SPB-29*, in which the interests of Motorola, Hughes, and Lockheed-Martin are expressed, November 1, 1995.

¹³ *Comments of Cutler-Hammer, Inc.*, Tim Christensen, Cutler-Hammer, Inc., May 28, 1996.

¹⁴ *Comments of the National Aeronautics and Space Administration*, Charles T. Force, January 30, 1995

¹⁵ *European Radiocommunications Committee Report No. 25*, filed on behalf of the ERC by Richard B. Engelmann, Chief, Technical Rules Branch, OET, July 14, 1995.

¹⁶ *First Report and Order and Second Notice of Proposed Rulemaking*, FCC 94-499, December 15, 1995.

government agencies as of the date of its publication. The document established, for the first time in this portion of the spectrum, the limits on radiated power in the band and the method by which radiation levels are to be measured (i.e., power density measured at a specified distance from the source of radiation). It also noted that more work needed to be performed to determine proper safety standards for radiation exposure.

4. **Report from the Millimeter Wave Working Group**

Both industry and the FCC recognized the need for the establishment of standards to regulate the sharing of such a large band of the spectrum allocated between 57 and 64 GHz. Such a group was established in early 1996 and was called the Millimeter Wave Working Group (MMWWG).¹⁷ This alliance of companies (Apple, Hewlett-Packard (lead company), Hughes, Metricom, Motorola, Rockwell, and Sun Microsystems) was broadly representative of those engaged in the research, development, sales, or marketing of information technology products. In the absence of an industry standard for this band, such as those developed by the IEEE in other regions of the spectrum, the MMWWG group of technical experts worked toward the development of “rules of the road” that would allow many users to share the spectrum.

The results of the MMWWG efforts were published in a report in December of 1996.¹⁸ That report addresses technical issues such as peak emissions limitations, power limits, transmitter identification requirements, the establishment of a “transmitter coordination channel,” and a general “listen before talk” approach to sharing the band.

5. **FCC Third Report and Order for Spectrum Use Above 40 GHz**¹⁹

In this 1998 document²⁰ the FCC adopted, among other things, rules to establish a spectrum etiquette for unlicensed operation in the band from 59 – 64 GHz. It was their belief that “this spectrum etiquette will promote the efficient use of the 59 – 64 GHz band without hampering the development of new products and service.”²¹ Essentially all of the recommendations of the Millimeter Wave Working Group were adopted.

6. **Radiation Exposure and Safety Limits**

Being mindful of the potential for harm that exists for any electromagnetic radiation, the FCC established an exposure limit based on its own technical expertise (Office of Engineering and Technology) and on medical studies that had been performed in non-governmental laboratories. With regard to the License-exempt 59 – 64 GHz, band the

¹⁷ *Comments of the Millimeter Wave Working Group*, May 28, 1996

¹⁸ *Report and Recommendations of the Millimeter Wave Working Group to the FCC*, December 13, 1996.

¹⁹ The Second R&O, omitted from this summary, says essentially nothing about the 59 – 64 GHz unlicensed band

²⁰ *Third Report and Order of the FCC*, July 15, 1998

²¹ *Ibid.*, paragraph 11.

FCC recognized the work of Dr. Henry Kues of Johns-Hopkins University. His studies established a bound below which no damage to living tissue could be observed.²² The FCC adopted an extremely conservative interpretation of those results by limiting radiation exposure to essentially an order of magnitude less than the lower bound studied by Kues.²³ For a more complete report, see the SiBEAM White Paper on 60GHz safety.

In conclusion, this summary of a selected body of documentation filed with the FCC traces a carefully-considered path of open dialogue among industry members, governmental agencies, and a U.S. Federal regulatory body showing the development of a set of rules that permits the fair use of a large portion of the radio spectrum. The results of these deliberations and comments, as captured in FCC Rules Part 15.255, represent an enormous amount of work on the part of all parties concerned and provide a level playing field for the development and use of the License-Exempt 57 – 64 GHz band for new products and services.

²² *Absence of Ocular Effects After Either Single or Repeated Exposure to 10 mW/cm² from a 60 GHz CW Source*, Henry A. Kues, et. al., *Bioelectromagnetics*, Vol. 20, 1999, pp. 463-473.

²³ *Federal Register*, Vol. 63, No. 152, August 7, 1998, p. 42280.