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

In the matter of	)	
	)	
Revision of Part 15 of the Commission's Rules	)	
Regarding Ultra-Wideband Transmission	)	ET Docket No. 98-153
Systems	)	

SECOND REPORT AND ORDER AND SECOND MEMORANDUM OPINION AND ORDER

Adopted: December 15, 2004 **Released: December 16, 2004**

By the Commission: Chairman Powell issuing a statement.

TABLE OF CONTENTS

I. INTRODUCTION

1. By this action, we are amending Part 15 of our rules to provide greater flexibility for the introduction of new wide-bandwidth devices and systems. These amendments respond to comments received in response to the *Memorandum Opinion and Order and Further Notice of Proposed Rule Making* in this proceeding.[1] In the *FNPRM* portion we invited comment as to whether we should provide this flexibility by amending our rules for ultra-wideband (UWB) devices, or alternatively, by making changes to the general provisions for unlicensed devices. We have chosen the latter course. As stated previously, we are reluctant to change the existing UWB rules until we have more experience with UWB devices.[2] We continue to believe that any major changes to the rules for existing UWB product categories at this early stage would be disruptive to current industry product development efforts. However, we are amending the Part 15 non-UWB regulations to better accommodate devices and systems that use wide bandwidths. Specifically, we are permitting the use of peak emission levels, similar to the levels applied to UWB devices, for wideband emissions in the 5925-7250 MHz, 16.2-17.7 GHz and 23.12-29.0 GHz bands. This action will facilitate the introduction of some of the operating systems sought by the commenting parties, including radar systems that would be used to improve automotive safety and tracking systems that could be employed for personnel location, such as hospital patients and emergency rescue crew, as well as for such functions as inventory control. Limiting these devices to certain frequency bands will minimize the interference potential to critical authorized radio systems. We also are taking the opportunity provided by this order to address the petitions for reconsideration of the *First Report and Order* (*1st R&O*) in this proceeding filed by Cingular, Inc. and by the Satellite Industry Association.[3]

II. BACKGROUND

2. On February 14, 2002, the Commission adopted the *1st R&*O in this proceeding, amending Part 15 of its rules to permit the marketing and the unlicensed operation of products incorporating UWB technology.[4] UWB radio systems generally employ pulse modulation where extremely narrow (short) bursts of RF energy are modulated and emitted to convey information.[5] The

---

[1] *See Memorandum Opinion and Order and Further Notice of Proposed Rule Making* ("*MO&O*" and "*FNPRM*") in ET Docket No. 98-153, 18 FCC Rcd 3857 (2003).

[2] *Id*. at para. 1, 29, 33, 54, and 169. We are, however, instituting a minor change to the rules applicable to UWB vehicular radar systems. This change will conform the measurement procedures used for both UWB radars to the provisions for non-UWB radars being adopted in this order.

[3] *See First Report and Order* in ET Docket No. 98-153, 17 FCC Rcd 7435 (2002). An *Erratum* to the *First Report and Order* was adopted on May 30, 2002. *See Erratum* in ET Docket No. 98-153, 17 FCC Rcd 10505 (2002). *See*, also, *Order* in ET Docket No. 98-153, 17 FCC Rcd 13522 (2002), adopted July 12, 2002, regarding who may operate a ground penetrating radar ("GPR") and for what purpose. A petition for reconsideration filed by Multispectral Solutions, Inc. ("MSSI") was dismissed under delegated authority of the Chief, Office of Engineering and Technology, by letter dated August 4, 2003. The MSSI petition was found to be repetitious, addressing issues that had already been considered by the Commission and containing no new information or arguments. Further, the changes sought by MSSI were proposed in the *FNPRM* and, consequently, are being addressed in this instant proceeding without the need for reconsideration of the *MO&O*.

[4] In order to be classified as UWB, the emission, at any point in time, must have a fractional bandwidth of at least 0.20 or a -10 dB bandwidth of at least 500 MHz. *See* 47 C.F.R. §15.501(d).

[5] The rules adopted in the *1st R&O* also permit UWB devices to comply with the minimum bandwidth requirement by use of a high speed data rate or other modulation techniques instead of the width of the pulse or impulse signal.

emission bandwidths from these systems are large and may often exceed one gigahertz.[6] The frequency response characteristics of the UWB antenna provide band-pass filtering, further affecting the shape of the radiated signal. UWB devices can be used for precise measurement of distances or locations and for obtaining images of objects buried under ground or behind surfaces. UWB devices can also be used for wireless communications and, in particular, for short-range high-speed data transmissions suitable for broadband access to networks.

3. Several categories of UWB devices are permitted to be operated under the Part 15 regulations: imaging systems,[7] vehicular radars and indoor and outdoor communication systems. Because of their wide operating bandwidths, UWB devices operate in frequency bands that are allocated both to U.S. Government and to non-government operations.[8] In order to permit the operation of UWB devices, it was necessary to amend two standards in the former Part 15 rules: the prohibition against operation in the restricted frequency bands[9] and the limitation on peak power.[10] UWB devices must be permitted to operate in the restricted frequency bands in order to accommodate the extremely wide bandwidths employed by these devices.[11]

4. For non-UWB unlicensed devices, the regulations limit the total peak power produced by the unlicensed transmitter.[12] It was determined that the total peak power for UWB devices was not relevant; it is the power into a victim receiver that is important.[13] Thus, the Commission amended its rules to increase the peak power level measured in a 50 MHz band centered on the frequency at which the highest average emission level is produced by the UWB device.[14] This change increased the allowable

---

[6] Typical pulse widths used by UWB devices currently are on the order of 0.1-2 nanoseconds, or less, in width. The emission spectrum of these devices appears as a fundamental lobe with adjacent side lobes that can decrease slowly in amplitude. The rise time of the leading edge of the pulse and the passband of the radiating antenna are major factors in determining the bandwidth of the UWB emission.

[7] Imaging systems consist of GPRs, wall imaging systems, through-wall imaging systems, surveillance systems, and medical imaging systems.

[8] The operation of Government radio stations is regulated by the National Telecommunications and Information Administration (NTIA), while operation of stations by private industry, by state and local governments and by the public is regulated by the FCC.

[9] *See* 47 C.F.R. § 15.205. The restricted bands are frequency bands employed for safety of life applications and for use by radio services that must function, as a nature or their operation, using extremely low received signal levels. The latter systems may be passive, such as radio astronomy, or active, such as satellite down links and wildlife tracking systems. Unlicensed devices generally are not allowed to operate in these bands.

[10] *See* 47 C.F.R. § 15.35(b).

[11] There is sufficient spectrum between restricted bands to allow for the operation of non-UWB devices without having to permit such devices to operate in the restricted frequency bands. *See 1st R&O*, *supra*, at para. 30-32 for additional discussion on this issue.

[12] While 47 C.F.R. § 15.35(b) specifies that a minimum 1 MHz resolution bandwidth is employed for emission measurements above 1000 MHz, when pulse widths are narrower than the inverse of the resolution bandwidth employed by a spectrum analyzer it is necessary to apply a pulse desensitization correction factor ("PDCF") to the peak level measured on the spectrum analyzer in order to compensate for the analyzer's inability to respond fast enough to reflect the true peak power, *i.e.*, the spectrum analyzer does not have sufficient bandwidth to measure all of the energy in the pulsed signal.

[13] *See 1st R&O*, *supra*, at para. 214-220 for additional discussion on this issue.

[14] 47 C.F.R. §§ 15.509(f), 15.510(d)(5). 15.511(e), 15.513(f), 15.515(f), 15.517(e), and 15.519(e). *See*, also, 47 C.F.R. § 15.521(g) for measurements employing a bandwidth narrower than 50 MHz. There is no requirement for equipment operating below 960 MHz to measure peak emission levels since emissions below that frequency are based on measurements employing a quasi-peak detector function. There also is no requirement to apply a pulse desensitization correction factor to the peak measurement since the total peak power is not being measured.

peak power and modified the peak measurement procedure.

5. The authorization for UWB devices to operate in the restricted bands and the amendment to the peak power limit and peak measurement procedures raised concerns that harmful interference could be caused to critical safety systems. Several parties performed various analyses and tests to determine the interference potential from wideband sources.[15] In response to these interference concerns, the Commission, in cooperation with NTIA and other U.S. Government agencies, implemented the current UWB standards along with various operational restrictions on UWB devices. For example, UWB devices used outdoors for non-imaging applications are limited to hand-held devices that engage in two-way communications using the 3.1-10.6 GHz band.[16] No outdoor fixed use of non-imaging UWB devices is permitted. These operational restrictions, in combination with conservative technical standards, were established to ensure that UWB devices can coexist with the authorized radio services without the risk of harmful interference while we gain additional experience with this technology.

6. On February 13, 2003, the Commission adopted a *MO&O* and *FNPRM* in this proceeding. The *MO&O* portion of that action responded to fourteen petitions for reconsideration that were filed in response to the *1st R&O*. Several changes to the UWB regulations were adopted to facilitate the operation of UWB devices used as through-wall imaging systems by law enforcement, emergency rescue and firefighter personnel in emergency situations or as ground penetrating radar ("GPR") systems. The regulations also were clarified regarding the coordination requirements for imaging systems and the limits on emissions produced by digital circuits associated with UWB operation. Two issues raised by the petitioners and denied in the *MO&O* were addressed in the *FNPRM*. Multispectral Solutions, Inc. ("MSSI") requested that the Commission not restrict UWB operations in the 3.1-10.6 GHz band to hand-held devices but instead permit the operation of any type of device, including radar systems, as long as the device operated with a low pulse repetition frequency ("PRF"); Siemens VDO Automotive AG ("Siemens VDO") requested that the Commission permit the emission bandwidths and emission levels of a frequency hopping 22-29 GHz vehicular radar system to be measured while the transmitter is actively hopping. To obtain further comments, the Commission proposed the changes sought by MSSI and Siemens VDO in the *FNPRM* portion. In addition, on its own motion the Commission proposed: 1) to amend its peak power limits for Part 15 transmitters that employ wide operating bandwidths but do not operate under the UWB regulations; and 2) to eliminate the UWB definition[17] to permit any transmission

[15] These analyses and tests have been filed in the record for this proceeding. *See*, for example, NTIA Special Publication 01-43, *Assessment of Compatibility between Ultrawideband Devices and Selected Federal Systems*, January 2001; NTIA Special Publication 01-45, *Assessment of Compatibility between Ultrawideband (UWB) Systems and Global Positioning System (GPS) Receivers*, February 2001; NTIA Special Publication 01-47, *Assessment of Compatibility between Ultrawideband (UWB) Systems and Global Positioning System (GPS) Receivers (Report Adendum)*, November 2001; NTIA Report 01-383, *The Temporal and Special Characteristics of Ultrawideband Signals*, January 2001; NTIA Report 01-384, *Measurements to Determine Potential Interference to GPS Receivers from Ultrawideband Transmission Systems*, February 2001; NTIA Report 01-389, *Addendum to NTIA Report 01-384: Measurements to Determine Potential Interference to GPS Receivers from Ultrawideband Transmission Systems*, September 2001; *Final Report UWB-GPS Compatibility Analysis Project*, 8 March 2001, Strategic Systems Department, The Johns Hopkins University/Applied Physics Laboratory; the study submitted by NTIA on March 21, 2001, on behalf of the Department of Transportation regarding tests performed at Stanford University; *A Model for Calculating the Effect of UWB Interference on a CDMA PCS System*, September 12, 2000, Dr. Jay Padgett, Senior Research Scientist, Telcordia Technologies attached to the Sprint comments of September 12, 2000; measurements and analysis submitted by Qualcomm in its comments of March 5, 2001; the analyses submitted by the Satellite Industry Association in several of its comments; and multiple others.

[16] 47 C.F.R. § 15.519. Imaging systems consist of ground penetrating radars (GPRs) and wall imaging systems under 47 C.F.R. § 15.509, through-wall imaging systems under 47 C.F.R. § 15.510, surveillance systems under 47 C.F.R. § 15.511, medical imaging systems under 47 C.F.R. § 15.513, and vehicular radar systems under 47 C.F.R. § 15.515.

[17] 47 C.F.R. 15.503(d).

system, regardless of its bandwidth, to operate under the UWB standards. In response to the *NPRM*, six parties filed comments, eight filed reply comments, and NTIA submitted a late-filed comment.[18] Because of our desire to coordinate with NTIA any changes to the regulations that could impact spectrum allocated for U.S. Government operations, we are accepting NTIA's late filed comment. All comments filed in this proceeding were considered by the Commission in its decisions. A list of the commenting parties, along with the abbreviations used to identify them, is attached as Appendix B.

7. Two parties filed petitions for reconsideration of the actions taken by the Commission in the *MO&O*. Cingular, Inc. ("Cingular") objects to the presence and level of emissions from UWB devices that may appear in the frequency bands allocated for the Cellular Radiotelephone Service ("cellular") and for the Personal Communications Services ("PCS"), claiming that the Commission can not legally permit the unlicensed operation of radio frequency ("RF") devices except as specifically authorized by Congress under 47 U.S.C. 307(e). Cingular also believes that cellular and PCS licensees have exclusive use of the spectrum assigned to their respective operations and that any emissions from UWB devices undermine this exclusivity. The Satellite Industry Association ("SIA") argues that the UWB emission limits in the 3650-4200 MHz band used by C-band fixed satellite systems ("FSS") are excessive and will result in harmful interference. XSI filed comments in response to the Cingular petition and Cingular filed a reply comment.[19] XSI also filed comments in response to the SIA petition, the Coalition of C-Band Constituents filed a letter supporting SIA's petition,[20] and SIA filed a late reply comment along with a motion for an extension of the reply comment period. That motion is granted and SIA's reply comment is accepted.

III. SECOND REPORT AND ORDER

8. In the *FNPRM* the Commission proposed four amendments to Part 15 of its regulations. These amendments addressed: 1) the operation of low PRF systems in the 3.1-10.6 GHz band; 2) the measurement procedures applied to frequency hopping vehicular radar systems operating in the 22-29 GHz band; 3) the peak power limits applicable to wide-bandwidth, non-UWB Part 15 transmitters; and 4) the elimination of the UWB definition. These subjects are discussed below.

A. Low PRF systems in the 3.1-10.6 GHz band

9. Under the current regulations, UWB consumer devices, other than vehicular radar systems, are required to operate with their -10 dB bandwidth in the 3.1-10.6 GHz band and are limited to hand-held systems and to indoor-only systems.[21] In its petition for reconsideration of the *1st R&O*, MSSI requested that UWB systems employing a low pulse repetition frequency (PRF) be permitted to operate in the 3.1 GHz to 10.6 GHz band for any type of application.[22] MSSI argued that low PRF systems have less potential to cause interference than UWB devices operating at a high PRF. In the *FNPRM*, the Commission disagreed with MSSI that all low PRF systems have a low potential for causing interference, however, the Commission sought to develop a more complete record on this issue. In the *FNPRM*, the Commission specifically invited comment on whether to amend the rules to permit the operation of any UWB product under the UWB standards currently designated for hand-held devices[23] as long as the PRF

[18] Siemens VDO, Delphi, MS Sedco, M/A-COM and SARA filed *ex parte* comments to the *FNPRM*. Siemens VDO and Delphi also filed *ex parte* comments in response to the submission from NTIA.

[19] XSI filed *ex parte* comments in response to Cingular's reply comments.

[20] This letter was filed in the time frame for reply comments to SIA's petition.

[21] 47 C.F.R. §§ 15.517-15.519.

[22] MSSI Petition for Reconsideration of the *1st R&O* at pg. 10-11. MSSI specifically mentioned vehicular radar systems as an example of such equipment. MSSI defined a low PRF as being less than 100 kpps.

[23] 47 C.F.R. § 15.519.

does not exceed 200 kHz and the equipment employs a pulsed or an impulse modulation.[24] Comments were requested on whether a different PRF limit should be employed, if additional changes to the standards, including changes to the emission limits, are necessary to permit low-PRF outdoor applications, or if the expansion of outdoor UWB devices should be limited to include only low PRF vehicular radar systems. Specific technical analyses supporting the comments were requested.

10. Comments. MSSI comments that the restrictions on operating applications were implemented because the Commission was led to believe that UWB equipment must operate within the restricted frequency bands.[25] However, MSSI argues that it is practical to build UWB devices that can operate outside of the restricted bands, citing its indoor-only certified UWB radar system operating at 6.020-6.699 GHz and the non-restricted unlicensed availability of the 5.46-7.25 GHz band. MSSI is concerned that the restrictions placed on the use of UWB devices mean that its radar cannot be used in vehicles for collision avoidance and blind spot detection, nor can it be used onboard aircraft or ships. MSSI adds that it is not possible to certify its radar under the non-UWB regulations because the device would have to reduce its power to meet the peak power limit if the Commission were to apply a pulse desensitization correction factor ("PDCF").[26] In its reply comments, MSSI supplies a copy of a DARPA study[27] demonstrating that interference potential is in most cases determined by the average power of a UWB signal in the narrowest passband of a receiver and that UWB signals using very low PRFs are unlikely to cause interference to receivers of any kind.[28] MSSI requests that the Commission not limit the type or application of low-PRF UWB devices employed in the 3.1-10.6 GHz band, specifically citing vehicular radars and tagging systems[29] as examples of technologies that could operate in the 3.1-10.6 GHz band as a result of this change.

11. SARA supports expanding the permitted UWB usage in the 3.1-10.6 GHz band under the emission standards for hand-held devices.[30] Delphi also requests that the Commission amend the UWB rules to permit the operation of radar systems in the 3.1-10.6 GHz band and wants UWB transmitters employing any modulation type, including high PRF systems, to be permitted to operate outdoors in the 3.1-10.6 GHz band.[31] Delphi adds that permitting certain waveforms while excluding others constitutes an arbitrary, impermissible distinction unsupported by the technical characteristics of the signal and provides an unfair bias towards certain manufacturers. SIA opposes such a change, believing that high peak levels would expose fixed satellite service (FSS) receivers to harmful interference.[32] SIA opposes

---

[24] The current UWB regulations do not contain a limit on PRF nor do they restrict the type of modulation provided that the UWB emitter, at any point in time, has a fractional bandwidth of at least 0.20 or a -10 dB bandwidth of at least 500 MHz. *See* 47 C.F.R. § 15.503(a), (c) and (d).

[25] 47 C.F.R. § 15.205. MSSI comments of 7/21/03at pg. 1-2.

[26] The PDCF is a technique used to determine the true pulse amplitude based on measurements taken from a spectrum analyzer. If the pulse width is narrower than the inverse of the resolution bandwidth, the analyzer does not use sufficient bandwidth to measure all of the energy in the pulsed signal. Thus, when narrow pulses are employed it may be necessary to apply a PDCF to obtain the total peak emission level. The level obtained from the spectrum analyzer measurement of the peak emission can be considerably increased by the addition of the PDCF to obtain the true peak emission level.

[27] *UWB Parameters for EMC Coexistance* [sic] *with Legacy Systems*, Final Report, 31 June 2003, Defense Advanced Research Projects Agency ("DARPA"), NETEX Program.

[28] MSSI reply comments of 7/25/03at pg. 1-2.

[29] The tagging systems described by MSSI employ a transmitter incorporated into a "tag" that can be attached to persons or objects for tracking purposes.

[30] SARA comments of 7/21/03 at pg. 2-3.

[31] Delphi comments of 7/18/03at pg. 1-5: reply comments of 8/20/03 at pg. 1-2.

[32] SIA reply comments of 8/20/03 at pg. 1-3.

the elimination of a PDCF above 1 GHz and wants the PDCF to continue to be applied to UWB devices.[33] XM and Sirius also object to an expansion of the potential UWB applications until the proponents provide information regarding the technical configurations of their systems along with an analysis demonstrating how interference to the Satellite Digital Audio Radio Service (SDARS) can be avoided.[34] James Page states that the reason for a low PRF is to obtain a high peak level to achieve longer transmission ranges and that this results in larger noise increases to the licensed services.[35] James Page adds that the DARPA study only considers defense systems.

12. NTIA states that the emission limits applicable to hand-held UWB devices are adequate to protect Government systems from interference independent of the PRF or the application of the device.[36] NTIA adds that the modulation employed in these systems must be limited to impulse modulation or to high speed chipping rates with bandwidths that comply with the existing UWB requirements. NTIA further states that the Commission needs to retain its existing prohibition against fixed outdoor infrastructures and the use of UWB devices in toys.

13. Discussion. The interference potential of UWB devices is controlled by several factors. Limits on the average and peak emission levels produced by the devices are only one method of controlling potential interference. The potential for interference also can be reduced by limiting the proliferation of products, the applications for which the device may be employed and the manner in which the devices may be operated. While we determined that the emission limits established for UWB operation are sufficient to prevent interference to the authorized services, we also believe that our introduction of UWB devices should be conservative to further ensure that no interference will occur, especially to critical radio services operating in the restricted bands, from what could be widely prolific devices. For that reason, the Commission, in cooperation with NTIA, limited outdoor UWB operation to hand-held communication systems, severely curtailing outdoor proliferation. We find no evidence in the comments to support changing our UWB standards at this time. We note that UWB devices for consumer applications have not yet been placed on the market and, thus, we still have not gained the desired experience with these devices that we believe is necessary before it would be appropriate to consider whether the standards should be relaxed.

14. As previously stated by the Commission, low PRF UWB systems can have a higher potential for causing interference than high PRF UWB systems. Operation with a low PRF results in closer frequency spacing of the spectral emission lines. This, in turn, increases the probability that emissions will appear within the bandwidth of a victim receiver. Further, as the PRF decreases, the peak to average ratio increases. For UWB systems employing a low PRF, the peak emission limit becomes the defining standard and the average emission level decreases below the limit specified in the regulations. Accordingly, UWB devices employing a low PRF are constrained in their output levels by the limit on peak emission levels, not by the limit on average emission levels.[37] Further, if the pulse repetition frequency of the UWB signal is much greater than the bandwidth of a receiver, the emission may appear to be random noise or a continuous wave (CW) signal, the effect of which is proportional to the average power in the UWB signal within the receiver's bandwidth. However, if the PRF is much less than the

---

[33] *Id*. at pg. 4. It should be noted that a PDCF is not required to be used in the measurement of peak power from UWB devices since the peak power is based on the peak power density over a 50 MHz bandwidth and not on the total peak power produced by a UWB device.

[34] XM and Sirius reply comments of 8/20/03 at pg. 1, 7-8.

[35] James Page comments of 7/18/03 at pg. 1 and reply comments of 7/30/03 at pg. 1.

[36] NTIA comments of 1/15/04 at pg. iv and 4-5.

[37] Conversely, high PRF systems would be limited by the average limit established under the rules and not by the peak limit.

receiver's bandwidth, the UWB signal may appear to the receiver as impulsive noise and the effect is proportional to the peak power of the UWB signal unless some type of signal processing is incorporated in the victim receiver. The examples provided by MSSI demonstrating no harmful interference from low PRF UWB devices rely solely on receivers incorporating signal processing techniques, such as GPS receivers, and may not be applicable to many types of receivers in use today. The DARPA study submitted by MSSI does indeed demonstrate that radio receivers used in defense applications are not sensitive to peak emissions from UWB devices that operate with a PRF that is no greater than one percent of the victim receiver bandwidth.[38] However, this finding may not be generally applicable to all radio operations. As stated in the DARPA study, "error correction coding reduces the probability of interference even more. Receivers that respond to peak signals are more susceptible to interference from low PRF UWB devices, but even these can benefit from interference cancellation techniques." It is because of the incorporated signal processing that many systems are able to reject interference from low PRF emissions. Indeed, the analyses performed by NTIA regarding the susceptibility of Government systems to peak emission levels referenced possible mitigation effects from signal processing.[39]

15. The existing UWB rules limit outdoor consumer products in the 3.1 to 10.6 GHz range to hand-held devices that employ two-way communications.[40] Typically, such products are expected to employ high PRFs in order to maximize data through-put. Consequently, these products generally would be constrained primarily by the average emission limit and would have peak emissions well below the peak limit. Also, the PRF used in the UWB hand-held devices generally would be greater than the bandwidth of the receivers used in the authorized radio services, resulting in any interference impact being proportional to the average power in the UWB signal. The same is not true for UWB systems employing a low PRF. No measurement or other data has been submitted which demonstrates that high-proliferation systems operating outdoors at the UWB levels could be added anywhere within the 3.1-10.6 GHz without increased interference risks.[41] While some receivers may not be susceptible to interference from UWB systems that employ very low PRFs, this is dependent on both the bandwidth of the victim receiver and the error correction techniques employed in that receiver. There is not sufficient information to state that UWB devices, simply because they operate below some specified PRF, can not be a source of harmful interference to all receivers over a broad part of the spectrum. Accordingly, we do not agree that the UWB regulations should be amended at this time to permit any type of low PRF device to operate anywhere in the 3.1-10.6 GHz band under the standards for hand-held UWB devices. We do, however, believe that some relief may be possible in a limited portion of this frequency band. It appears that the primary goal of MSSI, SARA and Delphi is for the Commission to permit wide bandwidth systems to operate outdoors at the peak power limit permitted under the UWB regulations. As indicated above, the Commission also proposed in the *FNPRM* to increase the peak limit for non-UWB devices. We believe that changes to the non-UWB peak power level, as discussed in the following paragraphs, will accommodate the equipment designs sought by MSSI, SARA and Delphi.

---

[38] *UWB Parameters for EMC Coexistance* [sic] *with Legacy Systems*, *supra*, at pg. 20. The DARPA study also concluded that high PRF, non-dithered systems have a reduced potential for causing interference due to the lower probability that a spectral line will appear in the passband of the victim receiver but found that interference could occur if the spectral line did appear in the receiver passband more than one percent of the time.

[39] NTIA comments of 1/15/04 at pg. A-4, A-6, A-8, and B-3.

[40] 47 C.F.R. § 15.519(a)(1).

[41] For example, amending the rules to permit the UWB devices operating in the 3.1-10.6 GHz band to be use for vehicular radar systems, as requested by MSSI, could result in tens of millions of new UWB transmitters emitting outdoors.

B. Non-UWB peak power emission limits in the 5925-7250 MHz and 16.2-17.7 GHz bands

16. Unless otherwise specified, the emissions below 1000 MHz from Part 15 unlicensed devices, other than UWB devices, are measured using a CISPR quasi-peak detector and all emission limits at 1000 MHz and higher are based on average measurements.[42] When an average emission limit is specified, the rules also specify a limit on peak power that is 20 dB greater than the average limit.[43] For Part 15 devices other than UWB devices, the total peak output power of the transmission must be measured. In some cases, peak measurement by a spectrum analyzer requires the application of a pulse desensitization correction factor (PDCF) in order to compensate for the analyzer's inability to respond fast enough to measure the true peak for pulse widths narrower than the inverse of the resolution bandwidth. The level obtained from the spectrum analyzer measurement of the peak emission can be considerably increased by the addition of the PDCF to obtain the true peak emission level. This standard was implemented when Part 15 devices primarily employed narrowband emissions.

17. Throughout this proceeding, the Commission recognized that the peak emission limit specified in 47 C.F.R. § 15.35(b) was established based on the operation of narrowband transmission systems and may unfairly penalize some wideband operations, effectively prohibiting the operation of these devices.[44] Indeed, the Commission noted that the existing limit on the total peak power level is not well suited to measure the operation of, or represent the interference potential of, transmitters that employ extremely wide bandwidths. It is for that reason that the UWB standards permit the peak power to be measured over a bandwidth of 50 MHz, rather than over the entire bandwidth of the transmission. As stated in the *1st R&O*, the total peak power produced by the UWB device is not relevant to interference potential as there are no receivers employed in the authorized radio services that operate at the bandwidths used by UWB systems.[45] The widest bandwidth that normally would be employed by victim radio receivers is about 50 MHz. Thus, the Commission expressed its belief that the current limit on peak emissions from Part 15 intentional radiators could be amended to reflect a limit similar to that adopted in the *1st R&O* for UWB systems, eliminating the bias under the Part 15 regulations towards non-UWB wideband operations.

18. Under the UWB regulations, the EIRP limit on peak emissions is 0 dBm based on the use of a 50 MHz resolution bandwidth (RBW).[46] To facilitate testing, the rules permit the application of a lower RBW, down to as low as 1 MHz, provided the peak limit is similarly reduced to the level 20 log (RBW/50) dBm EIRP, where RBW is the resolution bandwidth in megahertz.[47] This peak limit applies to the 50 MHz bandwidth centered at the UWB highest radiated emission level. The Commission proposed to amend 47 C.F.R. § 15.35(b) to permit an equivalent peak limit for non-UWB wideband Part 15

---

42 47 C.F.R. § 15.35(a) and (b).

43 47 C.F.R. § 15.35(b).

44 For example, a wideband device that occupies a 1 GHz bandwidth with emissions that appear as Gaussian noise is permitted to operate at an average limit of –41.3 dBm/MHz which is equivalent to an average limit of -11.3 dBm/GHz; however, the transmitter also must comply with a total peak limit of –21.3 dBm. Thus, its average emission level may comply with the standards even though the average emission level exceeds the limit on peak emissions.

45 *1st R&O*, *supra*, at para. 214.

46 In order to accurately measure a peak signal, the video bandwidth must not be less than the RBW. Ideally, the video bandwidth should be at least 3 times the RBW.

47 While some types of emissions have a peak-to-average level that changes based on 10 log (RBW/50), others change at a rate of 20 log (RBW/50). The use of the (20 log) formula ensures that the peak level will not exceed the actual UWB standard, 0 dBm in a 50 MHz bandwidth, regardless of the type of modulation employed.

transmission systems.

19. For the peak emission measurement for wideband devices, the Commission proposed that the RBW may not exceed 10 percent of the -10 dB bandwidth of the emission. This proposal was based on the requirement that UWB emitters, which must employ a minimum -10 dB bandwidth of 500 MHz, have a peak limit based on a 50 MHz bandwidth, *i.e.*, they use a resolution bandwidth that is not greater than 10 percent of the minimum -10 dB bandwidth. Comments were requested on this proposal. Comments also were requested on the alternative proposal presented by MSSI, namely the rules should be amended to permit devices operating above 1000 MHz under the Part 15 general emission standards in 47 C.F.R. § 15.209 to comply with a peak emission limit of 5000 uV/m at 3 meters based on a measurement using a peak detector, a 1 MHz resolution bandwidth and a video bandwidth of no less than 1 MHz.[48] The Commission requested comments on any changes to the interference potential of wideband Part 15 devices that may occur as a result of these proposals and requested technical support for comments arguing interference concerns.

20. Comments. Delphi and Siemens VDO support the proposed change to permit wideband non-UWB devices to operate under the same limit as applied to UWB devices, agreeing that the current rules unnecessarily constrain non-UWB devices, but request that the peak emission level be measured using an RBW as wide as the -10 dB bandwidth of the emission.[49] Siemens VDO indicates that a peak limit based on a RBW that is 10 percent of the -10 dB bandwidth should apply only to the emissions in the restricted bands with the caveat that the total EIRP must be reduced by 20 log (50 MHz/instantaneously occupied bandwidth) dB.[50] Siemens notes that some systems would have as much as a 6 dB measurement penalty on the peak level by basing the power limit on the 20 log (RBW/50) proposed by the Commission, but states that this error would be reduced below 0.5 dB if the RBW is based on the -10 dB bandwidth of the emission.[51] Alternatively, Siemens VDO suggests that the Commission adopt a peak limit of -28 dBm/MHz. James Page states that peak signals can cause more interference in some systems and requests that all peak emissions be limited to -34 dBm/MHz.[52] Delphi opposes as inappropriate the proposal from MSSI to employ a 1 MHz bandwidth to measure peak power under current non-UWB rules, indicating that this change could allow extremely high peak emissions that are as much as 20 times greater for low PRF radars than what was contemplated by the Commission.[53] NTIA requests that the optional peak limit be established as -34 dBm/MHz instead of the 20 log (RBW/50) dBm proposed in the *FNPRM*. NTIA supplies extensive analyses to demonstrate that the peak power limit should not be increased to 5000 uV/m/MHz, as requested by MSSI, unless the duty cycle of the Part 15 emitter is one percent or less than the bandwidth of the victim receiver.[54] MSSI expresses an interest in manufacturing low power, unlicensed radar systems, tracking devices and other equipment in the 5460-7250 MHz band, citing its UWB radar imaging system that operates in the 6020-6699 MHz band.[55] Delphi expresses a similar interest in manufacturing high-PRF radar systems in the

[48] A field strength limit of 5000 uV/m, as measured at 3 meters, is equivalent to an EIRP of –21.3 dBm.

[49] Delphi comments of 7/18/03 at pg. 2 and 7; Siemens VDO comments of 7/21/03 at pg. 15-16.

[50] In other words, systems employing a bandwidth of less than 50 MHz would be required to operate at a peak power level that is reduced below 0 dBm by an amount that is dependent on the actual emitted bandwidth.

[51] Siemens VDO comments of 7/21/03 at pg. 28-30. Siemens VDO conditions this statement on the specific case where the PRF is equal to or greater than the RBW, referencing NTIA Report 01-383, *supra*, at figure 8.86 on pg. 8-46 through 8-48.

[52] James Page comments of 7/18/03 at pg. 1.

[53] Delphi comments of 7/18/03 at pg. 7-8; Delphi reply comments at pg. 3.

[54] NTIA comments of 1/15/04 at pg. 6-13 and at Appendices A and B.

[55] MSSI comments of 7/2103 at pg. 1-2. MSSI also has obtained certification for an indoor-only UWB tracking system operating in the 5751-7001 MHz band.

5460-7250 MHz band[56] and also requests that a higher peak power level be applied to its vehicular Back-Up Aid radar system operating in the 16.2-17.7 GHz band.[57] No objections were raised in the comments regarding operation within these frequency bands.

21. Discussion. We continue to believe that the current rules unnecessarily discriminate against the use of wideband unlicensed systems. For example, a transmission system operating above 1000 MHz with more than a 1 GHz bandwidth and a white Gaussian noise energy distribution is subject to an average emission limit of -41.3 dBm/MHz which is equivalent to an average emission level of -11.3 dBm/GHz. However, the total peak power limit for this emission is only -21.3 dBm. Thus, the average signal in this 1 GHz bandwidth complies with the standards but is, by itself, already 10 dB greater than the limit on the total peak power from the device. As already demonstrated by the Commission, the total peak power of such a wideband system is not relevant to the interference potential of the device. Rather, it is the potential power in the bandwidth of the victim receiver that is relevant. Recognizing that the widest receiver bandwidths generally encountered are less than 50 MHz,[58] we determine that this discrimination against wideband systems can be eliminated by amending the rules to specify the peak power from a wideband Part 15 device based on the power density in a 50 MHz bandwidth, as specified for UWB devices. However, we also recognize that allowing increased peak power levels could have an impact on some radio services. Further, we are concerned that allowing higher peak power levels could result in a significant increase in the number of consumer products along with a corresponding increase in interference potential. We conclude that some cautious constraints on the permitted frequency bands of operation and the standards for operation within those bands are necessary while we gain this experience.

22. As noted earlier, if the pulse repetition frequency of the UWB signal is much greater than the bandwidth of a receiver, the emission may appear to be random noise or a CW signal, the effect of which is proportional to the average power in the UWB signal within the receiver's bandwidth. However, if the PRF is much less than the receiver's bandwidth, the UWB signal may appear to the receiver as impulsive noise and the effect is proportional to the peak power of the UWB signal. Further, interference effects can be mitigated if error correction techniques are incorporated in the victim receiver. As noted earlier, receivers that employ error encoding techniques have some immunity to peak power levels, responding instead to the average emission levels.[59]

23. We conclude that higher peak emission levels can be permitted in the 5925-7250 MHz band without a corresponding increase in the potential that harmful interference would be caused.[60] The fixed, fixed-satellite, and mobile systems employed in this band likely incorporate a sufficient level of signal processing to reduce, if not eliminate, their vulnerability to increased peak emission levels,[61] or it is expected that such authorized systems would generally be located in remote areas or with the receiving antennas situated in such a manner that they would not be routinely subject to emissions from nearby Part

---

[56] Delphi comments of 7/18/03 at pg. 2-5. While the levels of the emissions from high-PRF systems would be constrained based on our average emission limits under the standards adopted for UWB devices, the current non-UWB peak limit prevents such systems from being employed.

[57] Delphi *ex parte* comments of 4/13/04 at pg. 2.

[58] EESS passive receivers were cited by NTIA as an exception to this specification.

[59] The examples provided by MSSI demonstrating no harmful interference from low PRF UWB devices were based on receivers incorporating signal processing techniques, such as GPS receivers and U.S. Government receivers used in defense applications.

[60] Operation in this frequency band currently is permitted under the Part 15 general emission limits in 47 C.F.R. § 15.209.

[61] This, of course, requires that the peak emission levels be low enough that the front ends of the receivers are not saturated.

15 devices. While the comments request that we also permit higher peak emission limits in the 5460-5925 MHz band, we determine that it is not prudent to do so until we have gained more experience with the unlicensed devices that may be developed. Authorized services in the 5460-5925 MHz band include the Amateur Radio Service and the Intelligent Transportation Systems, both of which could be operating in close proximity to, and susceptible to interference from, unlicensed devices.

24. We also conclude that higher peak emission levels can be permitted in the 16.2-17.7 GHz band, as requested by Delphi. However, it is not clear that sufficient signal processing would be employed to negate the increase in peak emission levels to radiolocation and Earth Exploration Satellite Systems ("EESS") operating in this band.[62] Thus, we determine that a more cautious approach should be employed. Limiting operation in the 16.2-17.7 GHz band to vehicular back-up assistance radars that operate only when the vehicle is in reverse will significantly limit the proliferation of such devices which should ensure that harmful interference does not occur to the authorized radio services. In addition, potential equipment manufacturers should be forewarned that the 17.3-17.7 GHz portion of the 16.2-17.7 GHz band has been allocated in Region 2 and the United States for the Broadcast Satellite Service, effective April 1, 2007. Once this allocation becomes effective, there is a possibility that the 17.3-17.7 GHz band may become designated as a restricted band[63] and that Part 15 fundamental emissions will be prohibited in this portion of the spectrum.

25. Based on the above, we are adopting a peak limit for the 5925-7250 MHz and 16.2-17.7 GHz bands that is equal to 20 log (RBW/50) dBm EIRP with RBW, the resolution bandwidth of the measurement instrument, being 1 to 50 MHz, as proposed in the *FNPRM*. This peak level is consistent with the peak limit applied to UWB operation. As with UWB devices, this peak limit would apply to the 50 MHz band centered at the frequency at which the highest average emission level occurs. We agree with the commenting parties that a RBW not wider than the -10 dB bandwidth of the emission should be permitted, instead of an RBW based on 10 percent of the -10 dB bandwidth as was proposed in the *FNPRM*. If frequency hopping or stepped frequency modulation is employed, the frequency hop or step function shall be disabled and the transmitter shall operate continuously on a fundamental frequency to measure the -10 dB bandwidth that is used to determine the maximum RBW that may be employed for the peak emission level.

26. We recognize that the above actions will increase the proliferation of unlicensed devices operating in the 5925-7250 MHz band. Thus, we conclude that a cautious approach to the emission standards is appropriate. As discussed above, we also conclude that a cautious approach is necessary for the emission standards adopted for vehicular back-up assistance radars operating in the 16.2-17.7 GHz band. Operation currently is permitted within the 5925-7250 MHz and 16.2-17.7 GHz bands at an emission level of -41.3 dBm/MHz based on a linear average.[64] However, we note that the UWB technical standards, established based on several interference analyses, represent a cautious approach to preventing harmful interference.[65] The UWB standards permit lower fundamental emissions and unwanted

---

[62] We believe that the satellite systems operating in the 17.3-17.7 GHz band will employ sufficient signal processing techniques to demonstrate some immunity to increased peak signal levels.

[63] 47 C.F.R. § 15.205.

[64] 47 C.F.R. § 15.209. The maximum specified emission limit in these frequency bands is 500 uV/m, as measured at 3 meters using a 1 MHz resolution bandwidth. This field strength level is equivalent to an EIRP of -41.25 dBm/MHz.

[65] Emissions above 960 MHz from UWB devices are based on the use of an RMS average. Emissions above 1000 MHz from non-UWB devices are based on a linear average. As previously indicated by NTIA, RMS levels are proportional to the measurement bandwidth and the spectral power density, irrespective of pulse rate or modulation. *See* NTIA Report 01-383, *supra*, at pg. 8-44. Agilent also states that an RMS detector reports the true average power for each part of the measurement span which is particularly useful when measuring non-continuous waveforms such as those produced by frequency switching or packet based transmissions. Agilent adds that the (continued....)

emissions than those currently permitted for non-UWB devices. Further, NTIA requests that unwanted emissions from transmitters operating in the 5925-7250 MHz be subject to the emission limits applicable to hand-held UWB devices and that unwanted emissions from transmitters operating in the 16.2-17.7 GHz band be subject to the unwanted limits applicable to UWB vehicular radars.[66] Accordingly, we are adopting the more stringent specifications requested by NTIA, requiring that emissions from unlicensed transmitters operating within these bands comply with the same average emission limit and measurement standards that were established for UWB communication systems.[67] The level of the fundamental emission shall not exceed an EIRP emission limit of –41.3 dBm/MHz and emissions above 960 MHz shall be based on the RMS average signal level. Emissions below 960 MHz shall be subject to the Part 15 general emission limits. For equipment operating in the 5925-7250 MHz band, emissions outside of this band and within the 3.1-10.6 GHz band shall not exceed an EIRP of -51.3 dBm/MHz, and emissions outside of the 3.1-10.6 GHz band and above 960 MHz shall not exceed the limits applicable to handheld UWB devices.[68] For transmitters operating in the 16.2-17.7 GHz band, emissions between 960 MHz and 16.2 GHz shall not exceed the limits applicable to UWB vehicular radars; emissions above 17.7 GHz shall not exceed an EIRP of –61.3 dBm/MHz. As with UWB devices, emissions from digital circuitry will be subject to the Part 15 general emission limits[69] or to the limits for digital devices,[70] as appropriate, provided those emissions are not intended to be radiated from the antenna.

27. In keeping with our cautious approach, we are implementing several additional requirements to further protect the authorized radio services. First, we are requiring that the -10 dB bandwidth of the transmission be contained within the 5925-7250 MHz or the 16.2-17.7 MHz band, as appropriate, under all conditions of modulation and effects from frequency stability. We recognize that the levels of the emissions generally will continue to decrease as displacement from these bands increases and that this decrease will further reduce the interference potential to other radio services.[71] Second, we

(...continued from previous page)
RMS average detector is well behaved when measuring noise-like signals. *See* Agilent APP Note 1488, *Ultra-Wideband Communication RF Measurements*, at pg. 43. We also observe that measurements made on the same equipment using an RMS detector generally may be slightly higher than similar measurements obtained using a linear detector, particularly for noise-like emissions. Thus, the requirement to use an RMS detector can be a more stringent specification than emission limits based on the use of a linear average detector.

66 47 C.F.R. §§ 15.515 and 15.519. These comments from NTIA were stated verbally to the Commission's staff on December 2, 2004, and on subsequent dates. We do not believe that such stringent limits are necessary to prevent harmful interference. The emission levels requested by NTIA are extremely conservative, being based on multiple worst case conditions at detection levels below what may be considered harmful interference. Further, as stated in the *1st R&O*, the analyses and standards applied to UWB are unique to that proceeding and will not be considered as a basis for determining or revising standards for other radio frequency devices, including other Part 15 devices.

67 As described above, we also are adopting the same peak emission limit that applies to UWB operations.

68 Normally, transmission systems operating under the general emission limits are not required to reduce their emissions below the limits specified in 47 C.F.R. § 15.209, and instead are subject to a requirement that the spurious emissions not exceed the level of the fundamental emission. *See* 47 C.F.R. § 15.209(c). The requirement in 47 C.F.R. § 15.215(c) to attenuate emissions outside of the operating band by at least 20 dB was established for transmitters that operate at signal levels greater than those specified in 47 C.F.R. § 15.209.

69 47 C.F.R. § 15.209.

70 47 C.F.R. § 15.109.

71 We believe that emissions appearing within the frequency bands below 3.1 GHz, which are of particular concern to NTIA, will consist solely of emissions from digital circuitry and, thus, will be subject to the standards in 47 C.F.R. § 15.209. For this reason, the more stringent limits requested by NTIA should have a minimal impact on equipment designed to operate under these provisions.

are requiring that the -10 dB bandwidth of the transmission be at least 50 MHz for systems operating in the 5925-7250 MHz band and at least 10 MHz for systems operating in the 16.2-17.7 GHz band. If frequency hopping or stepped frequency modulation is employed, these minimum bandwidth limits shall be determined with the frequency hop or step function disabled and the transmitter operating continuously on a fundamental frequency. These minimum bandwidth standards should accommodate existing product designs and will assure that devices operating at the higher peak power limits are indeed wideband devices that could be penalized by the current Part 15 restriction on peak power levels.[72] No provision is provided to permit transmitters employing swept frequency modulation to perform measurements with the sweep stopped; these devices must continue to comply with the standards following the provisions of 47 C.F.R. § 15.31(c).[73] Third, as noted above we are restricting operation in the 16.2-17.7 GHz band to vehicular back-up assistance radars that only operate upon engagement of the vehicle in reverse. We also are restricting operation in the 5925-7250 MHz band to terrestrial and to maritime applications and, like UWB devices, are prohibiting the use of these devices onboard aircraft or satellites or for the operation of toys. Operation onboard aircraft or satellites would result in much greater signal propagation distances and an increased likelihood of alignment with the receiving antennas of the authorized services. The operation of toys under these provisions could cause a significant increase in the proliferation of devices along with a corresponding increase in interference potential. There are ample provisions elsewhere in the regulations that permit the operation of toys and we see no need to expand their operation to include this frequency band. While we do not believe that the power levels being permitted in the 5925-7250 MHz band are sufficient to permit the establishment of wide-area communication systems, we also want to ensure that such systems cannot develop until greater experience is gained with unlicensed operation in this band. To ensure that this does not occur, as requested by NTIA[74] we are prohibiting the use of fixed outdoor infrastructures in the 5925-7250 MHz band under the rules we are adopting herein with one exception: operation onboard a ship or within a terrestrial transportation vehicle shall not be considered a fixed infrastructure.[75] This should be sufficient to prevent the establishment of wide area communication systems, yet will not prevent the use of these devices for vehicular radar and maritime applications, as desired by the commenting parties.

28. We do not agree with Siemens VDO that a 10 log ratio should be used to determine the applicable peak power level for unlicensed devices. While we agree that, under certain conditions, *e.g.*, noise-like signals, a 10 log ratio is appropriate for determining the peak power with changes in RBW, this is not always the case. Indeed, the study by NTIA concluded that peak power follows a 20 log relationship for pulse-like emissions.[76] We recognize that NTIA's proposed peak limit of -34 dBm/MHz

---

[72] Devices that operate with an emission bandwidth in excess of 500 MHz would not be required to operate under the UWB regulations but may operate under the provisions being adopted herein. Separate standards were implemented for UWB devices because these extremely wideband devices, by necessity, must operate within the restricted frequency bands. That is not the case here. The parameters for wideband operation are being designed only for use within frequency bands where unlicensed non-UWB Part 15 operation currently is permitted.

[73] Frequency hopping, stepped frequency and gated transmissions have relatively similar interference profiles. The interference potential for swept frequency has not been evaluated nor have measurement procedures been proposed in this proceeding.

[74] NTIA comments of 1/15/04 at pg. 5.

[75] Operation in the 16.2-17.7 GHz band is limited to field disturbance sensors that are used only on terrestrial transportation vehicles for back-up assistance. Terrestrial use is limited to earth surface-based, non-aviation applications. Thus, there is no need to prohibit the use of fixed infrastructures.

[76] *See* NTIA Report 01-383, *supra*, at figure 8.86 on pg. 8-46 through 8-48. This report states that the peak relationship follows a 20 log ratio when the RBW is much greater than the PRF and that the non-dithered average and the peak signal levels are equal when the RBW is much lower than the PRF, *i.e.*, when the output level of the system would be constrained by our limit on average emission levels, not by our limit on peak emission levels. For a non-dithered UWB emission, when RBW is much lower than the PRF the emissions appear to be discrete CW (continued....)

was based on the possible operation of non-UWB systems through the entire 3.1 – 10.6 GHz band. We conclude that it is not necessary to adopt this more stringent limit, particularly given the limited frequency bands where we are allowing such operation. Further, as discussed throughout this proceeding, we are concerned with the level of the peak power that appears in the bandwidth of a victim receiver. Our intent is to ensure that the total peak power emitted over a 50 MHz bandwidth does not exceed an EIRP of 0 dBm, as we required for UWB devices. Because of the difficulty in measuring peak output levels based on a 50 MHz RBW, we permit the use of a lower RBW with proper adjustment of the peak limit. Because many systems attenuate the power measurement with reductions in the RBW based on a 20 log ratio, we apply this ratio to all cases, ensuring that the peak power over a 50 MHz bandwidth will never exceed 0 dBm. MSSI, Delphi and others are permitted to employ a wider RBW, up to 50 MHz or up to the –10 dB bandwidth of the emission or, for frequency hopping or stepped frequency systems, up to the –10 dB bandwidth of an individual hopping or stepped channel, whichever is less, to obtain a higher peak power level. It may be to their advantage to do so if a noise-like emission is employed. For pulse-like systems, the peak level being implemented is equivalent to -34 dBm/MHz, the level requested by NTIA and by James Page. For noise-like systems with a PRF less than 50 MHz, the relationship of peak power in a 50 MHz bandwidth to the RBW corresponds to 10 log (RBW/50) dBm and a peak power as high as -17 dBm/MHz could be achieved, depending on what value is used for RBW. We are not implementing the -28 dBm/MHz limit requested by Siemens VDO as this could, depending on the exact modulation characteristics, result in a peak level of up to +6 dBm in a 50 MHz bandwidth.

C. Vehicular radar systems in the 22-29 GHz band

29. The UWB regulations permit the operation of vehicular radar systems in the 22-29 GHz band.[77] UWB vehicular radar systems are required to operate with a minimum instantaneous bandwidth of 500 MHz and may employ any modulation technique that results in this minimum bandwidth.[78] The Commission concluded that it was necessary to establish a minimum UWB bandwidth to prevent narrowband Part 15 devices from operating in the restricted frequency bands, as is currently allowed for UWB devices.[79] In the *1st R&O*, the Commission specifically precluded the operation of swept frequency systems, stepped frequency systems, and frequency hopping systems under the UWB rules unless the transmissions comply with the minimum bandwidth requirement and the emission limits when measured

(...continued from previous page)
lines and further reductions in the RBW do not result in any change to the measured values. Dithered peak emissions follow a 10 log ratio only when the RBW is much less than the PRF. Thus, the maximum 6 dB "error" cited by Siemens VDO occurs only when the RBW is much lower than the PRF and the UWB impulses are dithered. The situation where RBW and PRF are approximately equal, as cited by Siemens VDO, represents a transition region between a Gaussian probabilistic region and a deterministic impulsive environment and does not follow a precise mathematical model. In *Assessment of Compatibility between Ultrawideband Devices and Selected Federal Systems*, NTIA Special Publication 0-43, January 2001, at pg. D-1 and D-2, NTIA employed a 10 log ratio to represent the peak power in a 50 MHz bandwidth when RBW is less than or equal to 0.45 PRF (non-dithered) and when RBW is less than or equal to 2.0 PRF (dithered).

[77] 47 C.F.R. § 15.515. Non-UWB vehicular radar systems are permitted to operate under 47 C.F.R. § 15.245 in the 24.075-24.175 GHz band, under 47 C.F.R. § 15.249 in the 24.0-24.25 GHz band, or under 47 C.F.R. § 15.209 in the 24.0-31.2 GHz band.

[78] 47 C.F.R. § 15.503 defines a UWB transmitter as an intentional radiator that, at any point in time, has a fractional bandwidth equal to or greater than 0.2 or has a UWB bandwidth equal to or greater than 500 MHz, regardless of the fractional bandwidth.

[79] 47 C.F.R. § 15.205. *See*, also, *1st R&O*, *supra*, at para. 30-32. As noted by the Commission, there are sufficient spaces between the restricted bands to permit the operation of Part 15 systems employing bandwidths narrower than 500 MHz. Accordingly, unlike UWB devices, there is no necessity to permit narrowband systems to operate in the restricted bands.

with the sweep, step function or hopping sequence stopped.[80] The Commission indicated that this was necessary as no measurement procedure had been established to permit the emission levels from such devices to be determined while the transmitter is sweeping, stepping or hopping. Further, the interference aspects had not been evaluated based on the different emission level results that would be obtained if measurements were taken with the sweep, step function or hopping active.[81]

30. In its petition for reconsideration of the *1st R&O*, Siemens VDO requested that we allow pulsed frequency hopping vehicular radars to be included under the definition of a UWB device under a plan that would permit such transmitters to occupy the minimum required bandwidth within any 10 millisecond period rather than at any instantaneous point in time.[82] This change would require a reversal of the decision that frequency hopping systems must be measured with the frequency hop stopped.[83] Siemens VDO also requested that the Commission revise its rules to permit emissions to be averaged over a 10 millisecond period, with the hopping sequence active, instead of over a one millisecond period.[84] Siemens VDO argued that it must operate with a center frequency of 24.125 GHz, necessitating operation in the 23.6-24.0 GHz restricted band, and that operation at a higher frequency would increase cost and hardware complexity.[85] Siemens VDO added that the Earth Exploration Satellite Service (EESS) systems at 23.6-24.0 GHz were the only identified potential interference victims of UWB radar systems operating in the 22-29 GHz band and that these systems employ integration times which are too long to distinguish between pulsed and pulsed frequency hopping modulation types.[86] Siemens VDO provided a technical analysis to support its request to permit measurements of emission levels averaged over a 10 millisecond period with the system hopping in frequency.

31. As detailed in the *MO&O*, the type of modulation requested by Siemens was not considered in the notice and comments leading to the adoption of the UWB regulations, and there was no opportunity for the public to comment on Siemens VDO's proposal.[87] Accordingly, the Commission denied Siemens VDO's petition for reconsideration as being beyond the scope of the issues addressed in this proceeding. However, the Commission agreed that the type of operation sought by Siemens VDO merited consideration. Accordingly, the Commission indicated that it would address Siemens VDO's proposal in the *FNPRM* to obtain public comment. In addition, the Commission's Office of Engineering and Technology issued a waiver of the UWB rules to permit the operation of Siemens VDO's vehicular radar system under technical criteria different from those requested in its petition for reconsideration.[88]

---

80 *See 1st R&O*, *supra*, at para. 32 and *MO&O*, *supra*, at para. 45 and 48. *See*, also, 47 C.F.R. § 15.31(c).

81 The Commission expressed similar concerns in the *Notice of Proposed Rule Making* ("*Notice*") in this proceeding, and declined to include transmitters employing swept frequency and similar modulation types from consideration as UWB devices. *See Notice of Proposed Rule Making* in ET Docket No. 98-153, 65 Fed. Reg. 37332, June 14, 2000, at para. 21.

82 Siemens VDO Petition for Reconsideration of the *1st R&O* at pg. 5-6.

83 *Id.* at pg. 6-8. Also, *1st R&O*, *supra*, at para. 32 and 47 C.F.R. § 15.31(c).

84 *Id.* at pg. 4 and 8-10. The "averaging time" actually refers to the integration period employed by each sampling bin in a spectrum analyzer. For a 1 ms averaging period, the sweep time divided by the number of bins must be less than 1 millisecond, *i.e.*, if the analyzer employs 601 bins, the minimum sweep time is 601 milliseconds.

85 *Id.* at pg. 10-11.

86 *Id.* at pg. 13-14. It should be noted that there is a wide range of integration times possible for space borne passive sensors. For example, the AMSR sensor has a 2.6 millisecond integration time in the 23.6-24.0 GHz band. However, the AMSU-A sensor has an integration time of 158-165 milliseconds.

87 *See MO&O*, *supra*, at para. 48.

88 A waiver was issued to Siemens VDO on June 25, 2003, by letter under delegated authority of the Chief, Office of Engineering and Technology. That waiver, based on an agreement between NTIA and Siemens VDO, (continued....)

32. In the *FNPRM*, the Commission proposed to adopt Siemens VDO's proposal. The Commission stated that its primary concern was not that the Siemens VDO equipment does not comply with the definition of a UWB system. Rather, its concern was that the Siemens VDO radar system does not comply with the UWB standards using the measurement procedures currently employed for frequency hopping systems [89] and the possible interference aspects of this type of operation. For example, a UWB vehicular radar system that complies with the existing regulations will place a low level emission on a frequency at any given time. However, the Siemens VDO system momentarily can place a much higher level emission on that frequency. The measurement procedure requested by Siemens VDO entails the emissions being measured in the investigated frequency band over a time period where the transmitter is both active and quiescent within that band, resulting in an additional time averaging being applied to the RMS average measurement. For that reason, the Commission indicated that a victim receiver with a fast transient response may be more susceptible to interference from the Siemens VDO system than from other UWB systems. On the other hand, Siemens VDO argued that EESS systems operating in the 23.6-24.0 GHz band will not be able to tell the difference between a distributed number of frequency hopping systems operating under the standards it has requested and a similarly distributed number of wideband radars complying with existing vehicular radar standards. The Commission also noted that there is a potential impact on terrestrial users which may be exposed to relatively few, but nearby, vehicular radars as well as the impact to EESS operations. It requested comments on whether the higher instantaneous power delivered by a frequency hopping system would cause harmful interference to these systems.[90]

33. The interference potential of a transmitter can vary significantly due to slight differences in modulation techniques or changes in the frequency of operation where the victim receivers may have different susceptibility characteristics. Because of this, the Commission indicated that the proposed changes to the rules to accommodate frequency hopping systems would apply only to vehicular radar systems operating in the 22-29 GHz band. Further, the Commission did not propose to change any of the emission limits currently applied to UWB vehicular radar systems. Rather, it proposed new measurement techniques to accommodate frequency hopping UWB vehicular radar systems. Specifically, it proposed to permit frequency hopping systems to operate under the provisions for UWB vehicular radar systems provided the minimum UWB bandwidth is achieved in no greater than 10 milliseconds and the transmitter complies with all other technical standards for UWB operation in the 22-29 GHz band. Compliance with the average emission limit would be based on measurements using a one megahertz resolution bandwidth

---

(...continued from previous page)
specified operation under different technical standards than those requested by Siemens VDO in its petition for reconsideration of the *1st R&O* and from those proposed by the Commission in the *FNPRM*. For example, the waiver limits the emissions from the Siemens vehicular radar transmitter to a -34 dBm peak EIRP limit and to a -61.3 dBm RMS average EIRP limit in the 23.6-24.0 GHz band with lower emission levels permitted for elevation angles above 30 degrees, bases RMS average emission limits on a one millisecond integration period, and includes a requirement that the -10 dB bandwidth be contained within the 24-29 GHz frequency band with the center frequency located above 24.075 GHz. NTIA also specified the measurement procedures that would be used to determine the bandwidth and emission levels.

[89] As noted in para. 32 of the *1st R&O*, *supra*, the emissions from transmitters employing frequency hopping modulation are measured with the frequency hop stopped. *See* 47 C.F.R. § 15.31(c). While this regulation specifically addresses swept frequency devices, having been established prior to frequency hopping systems being permitted under the regulations, it also has been applied to frequency hopping systems. *See* Public Notice of March 30, 2000, *Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems*, DA 00-705. At the time of the *1st R&O*, no other measurement procedures had been proposed or established for frequency hopping systems.

[90] At any point in time, there would be fewer hopping channel radars transmitting on the same frequency, but there would be a higher output level from these devices. Our concern for interference to terrestrial services is based on nearby vehicular radars rather than a general cumulative impact.

(RBW), a video bandwidth equal to or greater than the RBW, an RMS detector function, and a maximum 10 millisecond averaging period. The peak measurement would be performed as currently specified in the rules using a peak hold detector applied over a sufficiently long period that the measured levels cease increasing. Comments were requested on these proposed measurement procedures. For example, should the peak measurement be performed with the hopping sequence stopped; should a different averaging time be employed; should the averaging time be based on the number of hops and the dwell time of the hops; and should a maximum time be specified within which all hopping channels must be used?

34. Comments also were sought on the measurement procedure to be used to demonstrate compliance with the UWB minimum bandwidth standard.[91] Siemens VDO requested that the bandwidth be measured based on two procedures described in the appendix to its petition.[92] Both of the procedures suggested by Siemens are performed with the frequency hopping system active. However, the Commission expressed its concern that those procedures may not indicate the actual bandwidth employed by the system and the corresponding distribution of RF energy, depending on various technical parameters of the actual hopping system, *e.g.*, the distribution of the hopping channels, the dwell times for the hops, the number of hopping channels, the separation of the channels, the bandwidth of a single hopping channel, the number of hops in a specified time period, etc. Thus, the Commission proposed to require that the bandwidth be determined by first measuring the -10 dB bandwidth of a single hopping channel based on use of a peak hold detector and a 1 MHz resolution bandwidth and multiplying this value by the number of non-overlapping hops that occur within a 10 millisecond period. Comments were requested on this proposed measurement procedure as well as the procedures described by the petitioner. Comments also were requested on any interference concerns that arise from this modulation type or its method of measurement. Comments were requested on: the adequacy of the measurement results for the purpose of quantifying the impact to systems that could receive interference from frequency hopping vehicular radar systems operating under the proposed rules; any limits that should be applied regarding the number of hopping channels; the maximum occupancy time permitted for a hopping channel during any full hopping sequence; the maximum time it takes to complete a full hopping sequence; and any other pertinent technical characteristics.

35. Comments. In its comments, Siemens reiterates the opinion from its petition for reconsideration of the *1st R&O* that its frequency hopping system poses no greater risk of harmful interference than UWB systems generated by pulsed emissions, stating that the power level and distribution of each discrete spectral line component within the passband of a victim receiver are identical for these different emitters.[93] Siemens VDO argues that the Commission's statement that the frequency hopped emission levels were similar to time averaged emissions is unsupported, stating that the frequency hopping duty cycle acts as a "blanking" interval that occurs when the emission does not appear within the victim receiver's bandwidth.[94] Siemens VDO states that this does not influence the RMS measurement adding that the distribution of individual emissions over the observation (or integration) time is not important as the main purpose of an RMS measurement is to compare the energy content of different wave forms in a given time period. Siemens VDO requests that frequency hopping vehicular radar systems be permitted in the 22-29 GHz band with measurements made with the hopping active and a 10 millisecond averaging period.[95] Siemens VDO argues that a 10 millisecond averaging period is

[91] The Commission also proposed to eliminate the minimum UWB bandwidth standards which could make this issue moot.

[92] Siemens VDO Petition for Reconsideration of the *1st R&O* at Appendix A, pg. 16-17. These measurement procedures were incorporated by reference into the *FNPRM*.

[93] Siemens VDO comments of 7/21/03 at pg. 3.

[94] *Id*. at pg. 7-8.

[95] *Id*. at pg. 10-11.

necessary to avoid measurement errors, stating that a 1 millisecond integration period is not long enough to permit an accurate RMS power measurement of pulsed frequency hopping systems that require a longer period to complete a hopping cycle and that too short an averaging time results in inaccurately high power readings.[96] Siemens VDO agrees that a 1 millisecond period can be applied to emissions in the 23.6-24.0 GHz band. It provides a comparison of the emission levels produced by a frequency hopped system to that of a non-hopped UWB system.[97] Siemens VDO states that the emissions from its system will be limited by the peak emission standard because of the low duty cycle associated with the frequency hopping rate.[98] Further, Siemens VDO believes that the aggregate power averaged over a large geographical area would make it impossible for an EESS sensor in the 23.6-24.0 GHz band to distinguish between emissions from a hopped system and a pulsed UWB system.[99] Siemens also states that SARA commissioned an interference study by a third party, CETECOM ICT Services, which concluded that there is no increased interference to amateur or to police radar operation, assuming "real" road conditions.[100] As in its earlier petition for reconsideration, Siemens VDO recommends measurement procedures for determining peak and average emission levels, noting that it does not matter if the peak measurement is made with the frequency hop active or stopped.[101] However, Siemens VDO believes that it is necessary to make RMS measurements with the hop active to obtain accurate readings, citing NTIA's statement that the radiated emissions from a pulsed frequency hopping radar can be accurately measured in the frequency hopping mode.[102] SARA supports the comments of Siemens VDO, indicating that a 10 millisecond averaging taken with the hopping sequence active is necessary to obtain an accurate reading.[103]

36. CORF opposes permitting frequency hopping systems to operate in the 22-29 GHz band, arguing that these devices are an interference threat to EESS remote sensing instruments.[104] CORF indicates that the 22-24 GHz band is of particular concern, citing the allocation of the 23.6-24.0 GHz band to passive observations including EESS and radio astronomy as well as the EESS allocation at 22.21-22.5 GHz.[105] CORF argues that the averaging time of the emissions must be shorter than the integration time of the victim receivers, citing EESS integration times as low as 1.2 milliseconds and the possibility of shorter integration periods in future equipment.[106] Because of possible future short integration periods, CORF requests that a 0.1 millisecond averaging period be applied.[107] CORF states that a preferred method of measurement would be through the use of a fast response (0.1 millisecond or faster) power detector measurement with the signal entering the power detector head filtered to define the

---

96 *Id*. at pg. 8-11.

97 *Id*. at pg. 6.

98 *Id*. at pg. 11-12.

99 *Id*. at pg. 12-13.

100 *Id*. at pg. 13-15 and the attachment to these comments summarizing the Cetecom interference study.

101 *Id*. at pg. 16-27.

102 *Measurements of Siemens Pulsed Frequency Hopping Vehicular Radar Prototype*, NTIA, March 20, 2003, at pg. 37, as cited in Siemens VDO comments of 7/21/03 at pg. 25. This report exists in draft form only and has not been released by NTIA. Neither Siemens VDO nor NTIA has submitted this test report into the record for this proceeding.

103 SARA comments of 7/21/03 at pg. 4.

104 CORF comments of 7/16/03 at pg. 1.

105 *Id*. at pg. 2-3.

106 *Id*. at pg. 5-6.

107 *Id*. at pg. 7.

passband of interest.[108] Northrop Grumman and Raytheon oppose allowing frequency hopping systems in the 23.6-24.0 GHz band absent strict limits to reduce the potential for interference.[109] They support the measurement intervals and techniques suggested by CORF to prevent frequency hopping devices from momentarily emitting at much higher levels.[110] Siemens VDO responds that it has already indicated its willingness to accept a one millisecond integration period in the 23.6-24.0 EESS band, a limit that is less than the integration time of any EESS receiver in existence.[111] However, Siemens VDO also notes that as integration times decrease, so does the receiver's sensitivity to interference so that a receiver with a 0.1 ms integration time will experience a decrease in sensitivity of 5 dB.[112] Siemens VDO adds that spatial integration due to the aggregate power from multiple emitters being averaged over a large geographic area results in a smoothing of individual pulses and makes it impossible for the sensor to distinguish individual modulation techniques.[113] Finally, Siemens VDO states that it is not practical to use a fast response power detector, as proposed by CORF, as it is not aware of any such commercially available device.[114]

37. In its comments, NTIA states that frequency hopping transmitters must not be permitted to operate in the 23.6-24.0 GHz restricted band.[115] NTIA adds that frequency hopping transmitters are not UWB devices and are capable of avoiding operation in the restricted bands. NTIA also requested that the transmitters comply with the emission limits applicable to UWB devices along with an average RMS EIRP emission limit of -61.3 dBm/MHz for the 23.6-24.0 GHz band. NTIA states that its interference analysis applies only to EESS operations in the 23.6-24.0 GHz band and can not be applied to ground based receivers where a single frequency hopping transmitter would be dominant.[116] For ground based receivers NTIA notes that the establishment of power limits in a narrow frequency range is a primary concern. NTIA also states that the emission characteristics of the frequency hopped pulsed emissions will vary with pulse width, pulse repetition frequency, frequency hopping bandwidth, frequency hopping pattern, number of frequency hopping channels, hopping channel frequency separation, and the time duration of the hopping sequence. However, NTIA does not provide any suggestions as to the values that should be established for these parameters.

38. Discussion. The UWB regulations were implemented to permit systems that, because of their extremely wide bandwidths, are unable to avoid operation within the restricted bands.[117] A UWB transmitter must operate with a fractional bandwidth of at least 0.20 or a -10 dB emission bandwidth of at least 500 MHz.[118] The Commission implemented this minimum bandwidth requirement recognizing that transmitters that operate with less bandwidth could do so without having to transmit in the restricted

---

108 *Id*.

109 Northrop Grumman and Raytheon reply comments of 8/20/03 at pg. 1.

110 *Id*. at pg. 5-6.

111 Siemens VDO reply comments of 8/20/03 at pg. 3.

112 *Id*. at pg. 4.

113 *Id*.

114 *Id*. at pg. 5.

115 These comments were stated verbally to the Commission's staff on December 2, 2004, and on subsequent dates. These comments replace the 1/15/04 comments NTIA filed formally in this proceeding indicating that interference impact to EESS passive receivers from frequency hopped pulsed radar systems is comparable to that of impulse radars operating under the current UWB regulations.

116 NTIA comments of 1/15/04 at pg. 13-19.

117 47 C.F.R. § 15.205.

118 47 C.F.R. §§ 15.503(d).

bands.[119]

39. Systems that employ frequency hopping modulation are required to demonstrate compliance with the UWB bandwidth limit when measured with the frequency hopping stopped.[120] Unlike conventional UWB devices, frequency hopping systems have greater flexibility in determining which frequency bands will be employed and which will not. As indicated above, a waiver was issued earlier to Siemens VDO to permit the introduction of its vehicular radar system. As a condition of that waiver, the Commission, in cooperation with NTIA, required that the -10 dB bandwidth of the system be located between 24-29 GHz, avoiding all restricted bands. Siemens VDO agreed that its equipment can function in compliance with this condition. Thus, Siemens has already demonstrated that its equipment can be designed to function without having to operate within the restricted bands. We are unwilling at this time to classify as a UWB device a frequency hopping transmitter that emits relatively narrowband signals. We determine that changes to the UWB definition at this nascent stage in its development would be disruptive and could further delay the introduction of devices. Accordingly, we do not conclude that the Siemens VDO frequency hopping system should be classified as a UWB device. However, we continue to believe that the type of operation proposed by Siemens VDO merits authorization. Vehicular radar systems have the potential to enhance collision avoidance techniques and should be accommodated under the rules if this can be accomplished without increasing the potential for harmful interference to the authorized services. We believe that the Siemens VDO system can be accommodated as a non-UWB Part 15 device under the proposal in the *FNPRM* to allow the operation of wideband systems at the peak power level permitted for UWB operation. However, as requested by NTIA, this will not permit the fundamental emission from the Siemens VDO radar to operate in the restricted bands. Thus, the frequency band of operation that is being established for this vehicle radar system is 23.12-29.0 GHz, exclusive of the restricted band at 23.6-24.0 GHz.

40. *Emission standards*. Emission limits capable of preventing harmful interference to the authorized radio services were developed in the *1st R&O* for the operation of UWB vehicular radar systems in the 22-29 GHz band. We conclude that similar standards should continue to apply to wideband, but not necessarily UWB, vehicular radar systems operating in this band. Accordingly, we are implementing a fundamental EIRP RMS average emission limit of -41.3 dBm/MHz for such devices. We also are implementing our proposal for a peak limit of 20 log (RBW/50) dBm EIRP where RBW is the resolution bandwidth of the measuring instrument.[121] RBW shall not be less than 1 MHz or greater than 50 MHz. In addition, RBW shall not be greater than the -10 dB bandwidth of the device under test, as supported by the comments. If frequency hopping or stepped frequency modulation is employed, the frequency hop or step function shall be disabled and the transmitter shall operate continuously on a fundamental frequency to measure the -10 dB bandwidth that is used to determine the maximum RBW that may be employed for the peak emission level. Further, we are requiring that the -10 dB bandwidth of the fundamental emission be contained within the 23.12-29 GHz band under all conditions of modulation and effects from frequency stability and that the frequency at which the highest level emission appears be greater than 24.075 GHz. As requested by NTIA, we will require that emissions outside of the operating band comply with the emission standards applicable to UWB vehicular radar systems.[122] The limit

---

119 *1st R&O*, *supra*, at para. 30-31.

120 *1st R&O*, *supra*, at para. 32.

121 In performing a peak measurement, there is no need to stop the hopping function as long as the measurement is taken for a sufficiently long time period to ensure that all of the energy that will appear in that frequency band is measured.

122 47 C.F.R. § 15.515. As with the emission standards for operation in the 6 GHz and 17 GHz band, we do not believe that such stringent limits are necessary to prevent harmful interference. The emission levels requested by NTIA are extremely conservative, being based on multiple worst case conditions at detection levels below what may be considered harmful interference. Further, as stated in the *1st R&O*, the analyses and standards applied to (continued....)

applicable to the 22-23.12 GHz and to the 23.6-24.0 GHz bands shall be the same as that applied to UWB emissions below 22 GHz, *i.e.*, an EIRP of -61.3 dBm/MHz.[123] As with UWB devices, emissions from digital circuitry will be subject to the Part 15 general emission limits[124] or to the limits for digital devices,[125] as appropriate. Emissions below 960 MHz will be subject to the Part 15 general emission limits.

41. As with operation in the 5925-7250 MHz and 16.2-17.7 GHz bands, we conclude that a minimum bandwidth should be required to ensure that systems operating under the higher peak limit are wideband systems that could be penalized by the current Part 15 restriction on peak power levels. Siemens VDO states that its system occupies a bandwidth that is greater than 10 MHz for a single hopping channel. We believe that this is a reasonably wide bandwidth. Based on this, we are implementing a requirement that the -10 dB channel bandwidth of a system operating in the 23.12-29.0 GHz band under these new provisions be at least 10 MHz. If frequency hopping or stepped frequency modulation is employed, this 10 MHz minimum bandwidth limit shall be determined with the frequency hop or step function disabled and the transmitter operating continuously on a fundamental frequency. We determine that this limit is sufficient to provide protection to existing authorized services while permitting the implementation of the Siemens VDO and other possible vehicular radar systems. We also are retaining our current requirement that these vehicular radar systems be used only for ground-based applications.

42. *Methods of measurement.* We agree with Siemens VDO that its frequency hopping vehicular radar system should be permitted under the Part 15 regulations based on measurements performed with the frequency hopping active. However, we also believe that we must be cautious in this approach due to the paucity of interference data. Siemens VDO and SARA cite a statement from NTIA that the emissions from a frequency hopping system can be accurately measured with the hop active. However, this statement means only that emission levels can be detected and measured on a repeatable basis; it can not be inferred that such measurements provide emission levels with comparable interference potential. As previously stated by the Commission, the interference aspects of frequency hopping systems have not been thoroughly evaluated based on the different results that would be obtained from measurements made with the hopping active.[126] While NTIA performed an analysis demonstrating that there is no increased impact to EESS operations below 24 GHz, no information has been submitted in this proceeding regarding the impact frequency hopping emissions may have on any other radio service.[127] As

(...continued from previous page)
UWB are unique to that proceeding and will not be considered as a basis for determining or revising standards for other radio frequency devices, including other Part 15 devices.

123 Normally, transmission systems operating under the general emission limits are not required to reduce their emissions below the limits specified in 47 C.F.R. § 15.209, and instead are subject to a requirement that the spurious emissions not exceed the level of the fundamental emission. *See* 47 C.F.R. § 15.209(c).

124 47 C.F.R. § 15.209. As with transmisison systems operating in the 6 and 17 GHz bands being implemented in this order, we believe that emissions appearing within the frequency bands below 3.1 GHz, which are of particular concern to NTIA, will consist solely of emissions from digital circuitry and, thus, will be subject to the standards in 47 C.F.R. § 15.209. For this reason, the more stringent limits requested by NTIA should have a minimal impact on equipment designed to operate under these provisions.

125 47 C.F.R. § 15.109.

126 *1st R&O*, *supra*, at para. 32.

127 While Siemens VDO makes reference to a study demonstrating that there is no interference to Amateur and radar applications under "real" road conditions, Siemens VDO does not provide a copy of this study nor does it describe the "real" road conditions it indicates are necessary to demonstrate a lack of interference. We are unable to determine whether this study addresses interference based on the instantaneous vehicular radar emission levels or the time averaged levels nor can we determine the emission levels and other modulation characteristics that were (continued....)

stated by NTIA, the establishment of power limits in a narrow frequency range is a primary concern for ground based receivers.[128] Further, the emission characteristics of the frequency hopped pulsed emissions will vary with pulse width, pulse repetition frequency, frequency hopping bandwidth, frequency hopping pattern, number of frequency hopping channels, hopping channel frequency separation, and the time length of the hopping sequence.

43. We note that the instantaneous average emission levels of the hopping channels could be considerably higher than the levels permitted under our rules if measurements are made with the frequency hop active, as requested by Siemens VDO. Because the transmission hops to a different frequency range during the measurement, the time that the signal is not transmitted on a frequency is averaged with the time that the transmission occurs. This time averaging is in addition to the RMS average of the active signal.[129] Further, any increase to the time over which signals are averaged, *e.g.*, from 1 millisecond to 10 milliseconds, would permit a greater number of hopping channels to be included within the averaging with a corresponding increase in the instantaneous emission levels.[130] No information or interference evaluation has been provided to justify the use of an averaging period longer than the 1 millisecond already adopted for UWB operations. Accordingly, we do not agree with Siemens VDO that the averaging period should be extended from 1 millisecond to 10 milliseconds.

44. The interference aspects of a transmitter employing frequency hopping, stepped frequency modulation or gating are quite similar, as viewed by a receiver, in that both appear to the receiver to emit for a short period of time followed by a quiet period.[131] Gating the transmitter on and off produces the same effect on the measured data as would hopping the transmitter to a frequency outside of the measurement range. If emissions are permitted to be measured with the gating active, no emissions would be produced on the frequency being measured during the time the transmitter is gated off and the measured emission level would be reduced just like what occurs when a frequency hopping transmitter is measured with the hopping active. Conversely, requiring the emissions to be measured with the system operating continuously and the gating disabled produces the same results as measuring a frequency hopping system with the hopping stopped, *i.e.*, the "instantaneous" emission levels are determined. Consequently, permitting the emissions from frequency hopping systems to be measured with the hopping active could give such systems a competitive advantage by permitting higher instantaneous average power levels than what are allowed for gated systems. Since hopped, stepped and gated systems have similar interference effects and we have concluded that hopped systems may be measured with the hopping active, we also are eliminating the requirement that gated or stepped systems be tested with the

(...continued from previous page)
employed for the vehicular radar. In particular, we have no information to demonstrate whether the victim receivers are sensitive to potential interference from the instantaneous vehicular radar emission levels or from the time-averaged levels. CORF and Northrop Grumman and Raytheon continue to argue against allowing devices to operate in the 22-24 GHz band, but these comments are akin to late filed petitions for reconsideration of the decisions made in the *1st R&O* and present no new information to justify changes to the Commission's earlier decisions.

[128] EESS receivers are satellite receivers located orbiting the earth and, obviously, are not ground-based.

[129] As an example, depending on the averaging time of the measuring instrument and the hopping rate a frequency hopping system employing 50 hopping channels could, through time averaging of the emission levels, increase its signal level by as much as 17 dB above the average limit.

[130] With a 1 millisecond averaging period, any hopping rate in excess of 1 kHz could permit a higher instantaneous average signal level on the individual hopping channels. With a 10 milliseconds averaging period, a higher instantaneous signal level could occur for any hopping rate in excess of 100 Hz. However, any increase in the instantaneous average level also could be limited by the peak UWB emission limit.

[131] Gating refers to the transmitter's emission being turned on and off.

gating or step function turned off.[132] We concur that stepped frequency, frequency hopped and gated systems can be permitted to operate under the same standards and measurement procedures. As with operation in the 5925-7250 MHz band, no provision is provided to permit transmitters employing swept frequency modulation to perform measurements with the sweep stopped; these devices must continue to comply with the standards following the provisions of 47 C.F.R. § 15.31(c).

45. We also recognize that the UWB regulations for operation in the 22-29 GHz band require vehicular radar systems that employ gating to be measured with the transmitter gated on.[133] The interference potential of a UWB gated system is similar to that of a wideband gated system. We see no reason that these similar systems should not be subject to the same measurement procedures. Thus, we are amending the UWB regulations to permit the emissions from gated vehicular radar systems to be measured with the gating active. However, as requested by NTIA we do not agree that similar provisions should be applied to UWB systems that employ frequency hopping, stepped frequency or similar modulation techniques. Provisions were made in the regulations to permit UWB vehicular radars to operate within the 22.10-23.12 GHz and 23.6-24.0 GHz restricted bands because their extremely wide bandwidths combined with their operation centered near 24.125 GHz resulted in the transmitters not being able to avoid operation within those restricted bands. However, frequency hopping and frequency stepped transmitters have direct control over where they operate in the radio spectrum. Further, there is sufficient spectrum to support their operation in the 22-29 GHz band without having to operate within the restricted bands. Accordingly, these transmitters must continue to be measured with the frequency hop or step function disabled and with the transmitter operating in a continuous mode if they are authorized under the UWB regulations.[134] However, any vehicular radar employing frequency hopping, stepped frequency or similar modulation methods may be authorized to operate in the 23.12-29 GHz band, exclusive of the 23.6-24.0 GHz band, with the emission levels determined based on the transmitter's normal operating mode, under the non-UWB provisions being adopted in this order.

46. One of the primary reasons for requiring frequency hopping systems to be measured with the hop stopped was to ensure that the emissions are detected by the spectrum analyzer during the time period that the analyzer swept the frequency. In its comments, NTIA proposed a measurement procedure to ensure that the signal is detected at the proper level. Under this procedure, the RMS average and peak emission measurements are to be repeated with the analyzer in the maximum hold mode until there is no significant increase, *i.e.*, less than 3 dB, in any of the maximum hold values. We concur with the use of these measurement procedures and are implementing them in our regulations. Additional measurement guidance is expected to be provided by our Laboratory in the near future.

47. *Operation in the restricted bands.* As noted earlier, NTIA argues that there is no basis for permitting non-UWB devices to operate in the restricted bands. We concur and are not amending our regulations to permit such operation. Instead, we are specifying a frequency band of operation from 23.12-29 GHz, except for the 23.6-24.0 GHz band. This is comparable to what was provided to Siemens in its earlier waiver.[135]

48. *Additional modulation types.* Based on the above, we are establishing a new rule section under Subpart C of Part 15 that permits the operation of vehicular radar systems in the 23.12-29 GHz

---

[132] SARA and M/A-COM, in their *ex parte* filings, requested that UWB vehicular radar systems operating in the 22-29 GHz band be tested with the gating active.

[133] The requirement to measure gated UWB transmitters with the gating disabled is contained in 47 C.F.R. § 15.521(d).

[134] The requirement to stop the frequency hopping or step function is contained in the UWB measurement procedures, as stated in the *1st R&O*, *supra*, at para. 32.

[135] Under the conditions of its waiver, Siemens VDO vehicular radars had to operate in the 24-29 GHz band.

band, except for 23.6-24.0 GHz, under similar emission limits that are applicable to UWB vehicular radar systems. This action resolves the request from Siemens VDO to permit the operation of frequency hopping vehicular radar systems in the 22-29 GHz band. However, we note that Delphi also requests that our regulations accommodate in the 22-29 GHz band non-hopping vehicular radar systems that employ a bandwidth less than the 500 MHz required for operation under the UWB standards.[136] We see no reason that modulation types other than frequency hopping should be prohibited from operating under the same standards. Accordingly, we are amending the regulations to permit the operation of vehicular radar systems in the 23.12-29 GHz band, except for 23.6-24.0 GHz, regardless of the type of modulation that is employed. As noted above, transmitters employing swept frequency modulation must continue to be measured with the frequency sweep stopped at the frequency of measurement. We believe that these changes to the rules are consistent with our earlier UWB decisions to remain conservative in our implementation of the technical standards while we gain additional experience with this technology.

49. *Disposition of the waiver previously granted to Siemens VDO.* Siemens VDO was granted a waiver on June 23, 2003, under delegated authority of the Chief, Office of Engineering and Technology. The standards associated with that waiver were implemented in cooperation with NTIA. Among other things, these standards reflect compliance with the emission limits applicable to UWB vehicular radar systems. Any device that was designed to comply with the provisions of the waiver also will comply with the standards being adopted in this proceeding. For this reason, the termination of the existing waiver will not have any impact on Siemens VDO. Accordingly, the waiver previously issued to Siemens VDO to permit the operation of its frequency hopping vehicular radar in the 24-29 GHz band shall expire upon the effective date of these regulations.

D. Clarification of existing non-UWB peak power emission limits

50. In its petition for reconsideration of the *1st R&O*, MSSI requested that the peak emission measurements of its pulsed emission system operating under the non-UWB Part 15 regulations, *i.e.*, Subpart C of Part 15, be performed using a 1 MHz resolution bandwidth without the application of a pulse desensitization correction factor (PDCF).[137] While the Commission denied MSSI's request in the *MO&O*, it agreed with MSSI that the existing rule should be clarified rather than continue to rely on the spectrum analyzer operating instructions to indicate when a PDCF must be applied. Accordingly, the Commission in the *FNPRM* proposed to clarify that the peak emission limit for non-UWB operation is based on the total peak energy radiated by the device and that a PDCF may be needed to obtain the actual total peak emission level.

51. Comments/discussion. MSSI requests an interpretation of Section 15.35(b) of the Commission's rules that a PDCF does not apply above 1 GHz, stating that this would permit it to commercially deploy its wideband devices.[138] As proposed in the *FNPRM*, we are amending Section 15.35(b) to clarify that the peak power requirement applies to the total peak power produced by the device and may necessitate the use of a PDCF. This clarification does not result in any changes to the current Part 15 standards.

52. The PDCF originally was designed for measuring the peak output level of pulsed radar transmissions. The PDCF is a technique used to determine the true pulse amplitude based on measurements taken from a spectrum analyzer. The analyzer is unable to respond fast enough and therefore does not use sufficient bandwidth to measure all of the energy in the pulsed signal. Thus, when pulse widths are narrower than the inverse of the resolution bandwidth employed by a spectrum analyzer

136 Delphi Comments of 7/18/03 at pg. 8.

137 MSSI Petition for Reconsideration of 6/14/2002 at pg. 9.

138 MSSI comments of 7/21/03 at pg. 1-2.

in a peak emission measurement it is necessary to apply a PDCF to obtain the total peak emission level.[139] The requirement to apply a PDCF was contained within the Commission's specified measurement procedure, ANSI C63.4.[140]

53. The Commission amended its regulations to change the reference to ANSI C63.4-1992 to a more recent version, ANSI C63.4-2001.[141] The Commission adopted this revision stating that ANSI C63.4-2001 provides clarifications to the measurement procedure and to the configuration of the equipment under test but does not contain any significant changes. However, a subsequent examination of the 2001 version of ANSI C63.4 reveals that the reference to HP Application Note 150-2, as contained in ANSI C63.4-1992, has been replaced with a reference to ANSI C63.22, a procedure that exists only in a draft format and does not appear to address PDCF. While this change in ANSI C63.4 has further obscured when a PDCF must be applied, it does not negate the need to apply a PDCF under certain measurement conditions. The requirement to employ a PDCF continues to be part of the operating instructions on the proper use of a spectrum analyzer. Our clarification to the regulations should eliminate any confusion on the need to apply a PDCF under certain modulation and measurement conditions.

54. We are denying the request from MSSI for an interpretation of Section 15.35(b) of the Commission's rules that a PDCF does not apply above 1 GHz. MSSI made a similar request for interpretation in its Petition for Reconsideration of the *1st R&O*.[142] However, the Commission was clear in the *MO&O* that a PDCF does apply to the measurement of peak emission levels from non-UWB devices.[143] The existing requirement to apply a PDCF in determining the peak power associated with the measurement of narrow pulsed emissions was discussed throughout the UWB rule making proceeding.[144] Further, the Commission has been clear that the measurement of a peak emission for a non-UWB device, as specified under Section 15.35(b), could require the use of a PDCF depending on the technical parameters of the pulsed emission. The requirement to apply a PDCF is irrespective of the frequency at which the measurement is performed.[145] We agree with the statement submitted by MSSI from Synergent Technologies that a PDCF is not required to determine the potential interference effects of a wideband

---

139 For a Fourier line spectrum, *i.e.*, where the resolution bandwidth (RBW) is less than 0.3 times the pulse repetition frequency (PRF), the pulse desensitization factor is equal to 20 log [(effective pulse width)(PRF)] dB.

140 47 C.F.R. § 15.31(a). *See*, also, *American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz*, ANSI C63.4-1992, at pg. 62 and 90. This measurement procedure specified that HP Application Note 150-2 should be employed to determine the PDCF, as necessary. *See* Hewlett-Packard Co. Application Note 150-2, *Spectrum Analysis – Pulsed RF*, November 1971.

141 *See Second Report and Order and Memorandum Opinion and Order* in ET Docket No. 01-278, 18 FCC Rcd 14741 (2003). The Commission recently amended its regulations to reference ANSI C63.4-2003. *See Report and Order* in ET Docket 03-201, 19 FCC Rcd 13539 (2004). ANSI C63.4-2003 has the same text regarding PDCF that was contained in ANSI 63.4-2001.

142 MSSI Petition for Reconsideration of 6/14/02 at pg. 2-9.

143 *MO&O*, *supra*, at para. 146.

144 *Notice of Inquiry* in ET Docket No. 98-153, 13 FCC Rcd 16376 (1998), at para. 5 and 13; *Notice of Proposed Rule Making* in ET Docket No. 98-153, 15 FCC Rcd 16376 (2000), at para. 4, 35, 48, 51 and 53; *1st R&O*, *supra*, at para. 8 and 236; *MO&O*, *supra*, at para. 143-146. As previously explained by the Commission, the requirement to apply a PDCF is not contained in Section 15.35(b) of the rules. Rather, this requirement is specified in HP Application Note 150-2, *supra*, which contains the instructions on how to measure pulsed emissions using a spectrum analyzer. *See* 47 C.F.R. §§ 15.31(a)(3) and 15.35(b).

145 On frequencies where the emission limit is based on the use of a quasi-peak detector, there is no requirement to apply a peak emission limit and, consequently, no requirement to apply a PDCF.

pulsed waveform[146] but we do not agree to MSSI's characterization that this comment means HP Application Note 150-2 is not applicable.[147] Synergent's statement means only that the total peak power of a UWB emission is not required to determine the potential interference, as previously recognized by the Commission; it is the level of the undesired power in the bandwidth employed by a victim receiver that is important. This is the reason that the Commission applied the UWB peak measurement only to a relatively narrow, 50 MHz wide portion of the UWB emission. Accordingly, we do not agree that the rules should be interpreted in the manner requested by MSSI. As proposed in the *FNPRM*, we are clarifying the rules by stipulating that the peak emission limit for non-UWB devices is based on the total peak energy radiated by the device, unless specifically stated otherwise, and that, depending on the characteristics of the signal, it may be necessary to apply a pulse desensitization correction factor to the peak measurement of a non-UWB emission.

E. UWB definition

55. UWB definition. In the *FNPRM*, the Commission indicated that it was sympathetic to the concerns expressed by MSSI, Siemens and others throughout this proceeding regarding the changes in operational standards for unlicensed devices that may apply simply due to the bandwidth of the transmission system. It added that the Commission's standards in Part 15 need to reflect emission limits that reduce the potential for causing harmful interference to authorized radio services. While the emission limits applied to UWB operations ensure a low probability of causing harmful interference, they also require that the transmissions occupy a minimum bandwidth of 500 MHz or a minimum fractional bandwidth of 0.20.[148] The Commission indicated that this minimum bandwidth requirement could cause a manufacturer to design transmitters that occupy more bandwidth than is operationally necessary or transmitters that inject noise to increase the occupied bandwidth simply to permit operation under the UWB regulations. The Commission was concerned that such systems would place greater energy in frequency bands where operation is not necessary for the system to function. Thus, the Commission concluded that a minimum bandwidth standard could be counterproductive to reducing the potential for harmful interference and proposed to eliminate the definition of an ultra-wideband transmitter in 47 C.F.R. § 15.503(d).[149] The Commission proposed to permit the operation of any transmission system, regardless of its bandwidth, as long as it complies with the standards for UWB operation set forth in Subpart F of 47 C.F.R. Part 15 and to base the resolution bandwidth used for the peak power measurement to 10 percent of the -10 dB bandwidth of the emission. Comments were requested on these proposals as well as on any potential increase or decrease in interference potential to authorized radio services that could be caused. The commenters were requested to address the interference potential from narrowband systems operating under the UWB regulations. The comments also were asked to address whether additional standards, such as a spectral power density limit based on a bandwidth narrower than 1 MHz, are needed.

56. Comments. Delphi, SARA and Siemens VDO support elimination of the minimum bandwidth requirements.[150] Delphi states that the minimum bandwidth specification is an unnecessary

[146] MSSI comment of 7/21/03, at Attachment 6.

[147] MSSI Request for Immediate Clarification of Section 15.35(b), February 12, 2003, at pg. 2 and 5, attached to MSSI comment of 7/21/03.

[148] The fractional bandwidth, as defined in 47 C.F.R. § 15.503(c), is equal to the -10 dB bandwidth of the emission divided by the center frequency. In simple terms, a fractional bandwidth of 0.20 means that the -10 dB bandwidth is 20 percent of the center frequency.

[149] It is the limit on emission levels, particularly the limit on spectral power density, that primarily controls interference potential.

[150] Delphi comments of 7/18/03 at pg. 2 and 8; SARA comments of 7/21/03 at pg. 2-3; Siemens VDO comments of 7/21/03 at pg. 15-22.

constraint that hampers spectrum use without added interference protection and adds that some applications require a variable bandwidth. SARA and Siemens VDO support the bandwidth measurement procedures proposed by Siemens VDO if the minimum bandwidth is not eliminated. SIA believes that this change to the rules should be made only on a case-by-case basis stating that UWB is at an early stage of development and the technology is likely to change significantly.[151] SIA expresses particular concern that eliminating the minimum bandwidth requirement will increase aggregate interference to FSS receivers. XSI opposes elimination of the UWB minimum bandwidth stating that this would increase the threat of interference without promoting flexibility.[152] XSI notes that there is ample spectrum outside of the restricted bands to accommodate devices with less than the minimum UWB bandwidth. XSI believes that changing the rules at this time will result in increased uncertainty and confusion and will further delay commercial availability of UWB devices. NTIA opposes eliminating the bandwidth requirements, stating that the supporting comments offer no technical support and expressing concern that such a change would permit operation in the restricted bands regardless of the bandwidth of the unlicensed emission.[153] NTIA adds that all of the interference analyses it performed were based on the use of wideband, impulsive emissions and did not address narrowband signals.

57. Discussion. We have accommodated the narrowband operations sought by Delphi, SARA and Siemens VDO through our amendments to the peak power levels for unlicensed operation in the 5925-7250 MHz, 16.2-17.7 GHz and 22.0-29.0 GHz bands while, at the same time, keeping any further expansion of equipment applications out of the sensitive restricted bands. Because of these changes, we see no necessity at this time to eliminate the UWB minimum bandwidth requirements. We agree with XSI that such changes could be disruptive and could further delay the introduction of UWB devices. Further, we continue to believe that any operation in the restricted bands should be subject to the additional technical standards and operational parameters specified in the UWB regulations. Accordingly, we see no reason to change the minimum bandwidth requirements for UWB devices until additional experience has been gained with this equipment.

F. Other issues raised in the comments

58. Delphi, with support from SARA, requested that the Commission amend its rules to permit the operation of UWB devices above 10.6 GHz.[154] Northrop Grumman and Raytheon requested the Commission to "clarify" that the sale of UWB vehicular radars is limited to original equipment manufacturer installed units or to qualified dealer retrofits to other vehicles where the manufacturers can show that the standards, *e.g.*, the attenuation of emissions in the 23.6-24.0 GHz band above the horizontal plane, are met, adding that under no circumstances should these devices be permitted for retail sale.[155] These issues are effectively untimely requests for reconsideration of issues that were already addressed by the Commission in the *1st R&O*. Accordingly, they are denied.

IV. SECOND MEMORANDUM OPINION AND ORDER

59. In the *MO&O* and *FNPRM*, the Commission responded to fourteen petitions for reconsideration that were filed in response to the *1st R&*O, including petitions from Cingular and SIA. In general, the Commission denied the petitions for reconsideration, adopting changes to its regulations only

151 SIA reply comments of 8/20/03 at pg. 5.

152 XSI reply comments of 8/20/03 at pg. 1-5.

153 NTIA comments of 1/15/04 at pg. 23-25.

154 Delphi comments at pg. 1, 5-6.

155 Northrop Grumman and Raytheon reply comments of 8/20/03 at pg. 1-2 and 8.

to facilitate the operation of UWB devices used as ground penetrating radar ("GPR") systems[156] or as through-wall imaging systems operated by law enforcement, emergency rescue or firefighter personnel in emergency situations. The regulations also were clarified regarding the coordination requirements for imaging systems and the limits on emissions produced by digital circuits associated with UWB operation. No changes were made to the type of UWB devices permitted to operate under the regulations. The frequency bands within which UWB devices are constrained to operate were not changed except as follows: GPRs were allowed to operate on any frequency and through-wall imaging systems were permitted to operate with a center frequency between 1990 MHz and 10,600 MHz. The emission limits applicable to UWB devices were not changed except as follows: the emissions from through-wall imaging systems were relaxed by 7 dB, to an RMS average limit of -46.3 dBm/MHz EIRP, within the band 960-1610 MHz and by 10 dB, to an RMS average limit of -41.3 dBm/MHz EIRP, within the band 1610-1990 MHz.

60. Petitions for reconsideration of the *MO&O* were filed by Cingular and by SIA.[157] Cingular objects to the presence and level of emissions from UWB devices that may appear in the frequency bands allocated for the Cellular Radiotelephone Service ("cellular") and for the Personal Communications Services ("PCS"), claiming that the Commission can not legally permit the unlicensed operation of radio frequency ("RF") devices except as specifically authorized by Congress under 47 U.S.C. 307(e). Cingular also believes that cellular and PCS licensees have exclusive use of the spectrum and that any emissions from UWB devices undermine this exclusivity. SIA argues that the emission limits in the 3650-4200 MHz band used by C-band FSS stations are excessive and will result in harmful interference. XSI filed comments in response to the Cingular petition and Cingular filed a reply comment.[158] XSI also filed comments in response to the SIA petition, the Coalition of C-Band Constituents filed a letter supporting SIA's petition,[159] and SIA filed a late reply comment along with a motion for an extension of the reply comment period. That motion is granted and SIA's reply comment is accepted.

A. Interference to PCS and Cellular

1. Background

61. On June 17, 2002, Cingular filed a Petition for Reconsideration of the *1st R&O*. In that petition, Cingular claimed that the cellular and PCS spectrum are exclusive bands; that there was no reasonable basis for the Commission to allow UWB operations when such operations were not permitted under the previous Part 15 rules; that the UWB decision was not based on an adequate analysis of the interference that would be posed to cellular and PCS operations; that the Commission rejected all evidence concerning the operating levels used by PCS systems; that the UWB emission limits would cause interference to CDMA PCS systems; that there was no evidence that the Commission considered signal levels used by TDMA or GSM systems; that UWB interference to PCS jeopardizes E-911 operations; that lower emission limits are needed for indoor UWB devices to protect PCS operations; and that UWB imaging systems must provide site-by-site coordination with cellular and PCS licensees. The

156 The reference to GPRs also includes wall imaging systems. Wall imaging systems are the same as a GPR except a GPR is used to look down into the ground while a wall imaging system may be used to look into a wall or ceiling. The wall or ceiling must be a physical structure that is dense enough and thick enough to absorb the majority of the signal transmitted by the device. Examples include the walls in a mine and concrete structures.

157 A third petition for reconsideration was filed by MSSI. As noted earlier, this petition was dismissed under the delegated authority of the Chief, Office of Engineering and Technology, by letter dated August 4, 2003.

158 XSI filed *ex parte* comments responding to Cingular's response.

159 This letter was filed in the time frame for reply comments to SIA's petition.

Commission rejected these claims in the *MO&O*.[160]

62. On February 12, 2003 after the close of the filing window for petitions for reconsideration for the *R&O* and on the day before the Commission adopted the *MO&O*, Cingular filed a "Supplement to Petition for Reconsideration." In the supplement, it argued that Section 301 of Act precluded the widespread deployment and operation of UWB devices without a license. The Commission dismissed the filing for procedural violations of the rules.[161]

63. On May 22, 2003, Cingular filed the instant Petition for Reconsideration ("petition") of the *MO&O* forwarding arguments that were raised in its past petition and filings. In the petition, Cingular requests reconsideration claiming that the Commission's rule making proceeding was deficient in three respects. First, Cingular reiterates its claim that the authorization of Part 15 devices on an unlicensed basis violates Section 301 of the Communications Act of 1934, as amended (hereafter referred to as "the Act").[162] Second, Cingular again raises its claim, as previously argued in its Petition for Reconsideration of the *1st R&O*,[163] that the Commission's authorization of UWB devices was performed without an adequate record to demonstrate that harmful interference would not be caused to cellular, PCS and E911 operations.[164] Third, Cingular also repeats the claim forwarded in its Petition for Reconsideration of the *1st R&O* that the rules adopted fail to adequately protect the rights of incumbent commercial mobile radio service ("CMRS") licensees, *i.e.*, cellular and PCS licensees, by undermining the exclusivity rights of the licensees, by failing to include these licensees in a coordination process with UWB operators, and by failing to lower the emission limits for indoor UWB devices.[165]

2. Unlicensed Part 15 operation and 47 U.S.C. 301

64. Cingular argues that the authorization of UWB devices on an unlicensed basis violates Section 301 of the Communications Act. Cingular notes that one of the central reasons for creating the Commission was Congress' intent to reduce interference among spectrum users, and that by enacting Section 301, Congress prohibited wireless transmissions without a license. In particular, Cingular asserts that Section 301 requires that any person who uses or operates "any apparatus for the transmission of energy or communications by signals by radio" must do so by virtue of a "license granted under the provisions of the Act."[166] Cingular further argues that Congress established detailed procedures in the Act for obtaining a license and notes that the threshold requirement for obtaining a license, which is

---

160 *MO&O*, *surpa*, at para. 55-97.

161 *MO&O*, *supra*, at para. 151. The Commission concluded that the statutory argument was a new argument, not contained in Cingular's original reconsideration petition and thus constituted a new petition that was untimely filed under Section 1.106(f) of our rules. The Commission also noted that, even if the filing could be considered a supplement to the original petition, Cingular did not file a motion for leave to accept the late-filed pleading as required by Section 1.106(f) of our rules nor serve the pleading on other parties to the proceeding.

162 *See* 47 U.S.C. 301. While Cingular worded its petition to apply only to UWB devices, a ruling that Part 15 unlicensed operation is in violation of Section 301 of the Act would affect all Part 15 unlicensed transmission systems and would not be limited to only UWB devices.

163 Cingular Petition for Reconsideration of 6/17/02 at pg. 5-7, 10-14 and 20-21.

164 The Cellular Radiotelephone Service operates at 824-849 MHz and 869-894 MHz; PCS operates at 1850-1910 MHz and 1930-1990 MHz; and GPS operates at 1164-1240 MHz and 1559-1610 MHz. The actual GPS frequencies are 1575.42 $\pm$ 12 MHz for the L1 band, 1227.60 $\pm$ 12 MHz for the L2 band, and 1176.45 $\pm$ 12 MHz for the L5 band.

165 Cingular Petition for Reconsideration of 6/17/02 at pg. 7, 14-20, and 21-24.

166 47 U.S.C. § 301; *see also* Cingular Petition for Reconsideration of 5/22/03 (citing the Act).

contained in Section 308(a), requires the submission of an application.[167] Acknowledging that the Commission first established rules for unlicensed devices in 1938, Cingular points out that the Commission allowed unlicensed operations because it believed that the statutory requirement for licensing only applied to interstate operations, *i.e.*, radiation from operating certain devices would be kept to low limits and would not cause interference to interstate communications which would otherwise bring such operations within the licensing requirement of Section 301.[168] Cingular notes that Congress amended Section 301 in 1982 to clarify that the Commission's authority applies to intrastate and interstate communications, and thus Cingular argues the Commission lost its purported basis for allowing certain devices to operate without a license.

65. Cingular also argues that Section 301, as well as several other relevant provisions of the Act discussed below, are not ambiguous and that the Commission is not entitled to deference in construing their terms. In opposition to XSI's assertion that unlicensed operations are authorized under Section 302(a) of the Act, Cingular argues that Section 302(a) was enacted in 1968 to give the Commission authority to prohibit the manufacture of equipment that is capable of causing interference but does not contravene the Commission's authority under Section 301 to authorize the operation of equipment.[169] Cingular further rebuts XSI's assertion regarding Section 302(a) by noting that Congress has directed that only four services may operate without site-specific licenses pursuant to Section 307(e) of the Act,[170]and that to accept XSI's assertion regarding Section 302(a) would render Section 307(e) meaningless.[171] Also, Cingular rejects XSI's argument that Congress was aware of unlicensed operations and tacitly accepted them when it enacted Section 302(a) and took other legislative actions,[172] arguing that the "doctrine of legislative acquiescence" is only an auxiliary tool that is used in interpreting ambiguous statutory provisions and that Section 302(a) was added to the Act approximately 30 years after the Commission first adopted rules for unlicensed operations. Likewise, Cingular rejects XSI's attempts to rely on subsequent legislative history to infer Congressional intent regarding Section 302(a), arguing that there is no need to resort to legislative history when a statute is clear. Thus, Cingular rejects XSI's assertion that the Commission is entitled to deference in construing its authority under Section 302(a) and that the Commission can "fill in the gaps" of a statute.[173]

---

167 47 U.S.C. § 308(a); *see also* Cingular Petition for Reconsideration of 5/22/03 at pg. 10 (citing the Act and discussing the submission of an application as a prerequisite to obtaining a license under Section 308(a)).

168 Communications Amendments Act of 1982, P.L. 97-259; H.R. Conf. Rep. No. 97-765 at 31-32 (1982), reprinted in 1982 U.S.C.C.A.N. 2261, 2275-76 (citing Fisher's Blend Station, 297 U.S. 650, 655 (1936)) (discussing Congress' intent that the amendment make Section 301 consistent with prior judicial decisions finding that all radio signals are inherently interstate).

169 47 U.S.C. § 302a; Cingular reply comments of 9/17/03.

170 Cingular Petition for Reconsideration of 5/22/03 at pg. 12

171 *See* Cingular reply comments of 9/17/03 at pg. 8. Cingular also notes that Section 307(e) was added to the Act in 1982, when Congress amended Section 301 to clarify the Commission's intrastate jurisdiction over radio.

172 *See* XSI comments of 9/4/03 at pg. 14-15. XSI points to three legislative actions in support. Enacting Section 302a Congress specifically discussed the need for proper regulation of garage door openers, a category of Part 15 device; enacting the Electronic Communications Privacy Act of 1986, Congress noted that cordless telephones operate under Part 15 of the Commission's rules "and are not licensed;" Congress instructed the Commission in the Balanced Budget Act of 1997 to auction off certain frequency bands which, among other criteria, had not then been allocated or authorized for unlicensed use pursuant to part 15 of the Commission's regulations (47 C.F.R. Part 15). *See* P.L. 90-379, S. Rep. 1276, reprinted at 1968 U.S. Code Cong. & Admin. News 2486, 2488; 41 P.L. 99-508, H. Rep. 99-647, 99th Cong., 2d Sess. at 33 (June 19, 1986); P.L. 105-33 Section 3002(c)(1)(C)(v), 11 Stat. 261. (1997).

173 *See* Cingular reply comments of 9/17/03 at pg. 8.

66. We observe at the outset that the legal arguments Cingular raises here with respect to decisions in the R&O were addressed by the M&O and properly dismissed due to three clear procedural violations.[174] Given the last minute attempt by Cingular to interject the legal arguments into the reconsideration of the R&O (the pleading was filed the day before the Commission adopted the M&O) it hardly appears that the procedural violations were inadvertent, but rather were intended to perhaps deprive the Commission of adequate time to consider them, possibly giving Cingular an advantage in any appeal.[175] This circumstance provides added support for our decision that Cingular's repetitious legal arguments need not be considered under the Commission's rules.[176]

67. Nonetheless, we address here the substance of Cingular's arguments in order to underscore the lawfulness of the actions taken in this docket and the reasonableness of the regulatory approach the Commission has devised to meet its statutory obligations to control the use of spectrum. We conclude that the language of Section 301 of the Communications Act does not mandate the type of licensing that Cingular suggests is required. Cingular's reading of the statute, moreover, ignores the practical realities that inform any reasonable reading of the statute and the nearly 70 years of "unlicensed" operations authorized by the Commission under Part 15. Congress is entirely familiar with this regulatory structure and for many years has indicated its acceptance of the Commission's approach.[177]

68. Cingular's reading would require the Commission to apply Section 301's licensing requirement to any apparatus that transmits any amount of energy, no matter how negligible.[178] The statute does not compel that interpretation. Although Congress referred to "any apparatus," the statute is not phrased in terms of "any" energy, "any degree" of energy, or "any level" of energy. If we read such limiting language into the statute, the Commission would be required to individually license all devices that are designed to transmit any amount of energy for any purpose, with or without effect on the use of the spectrum for communications purposes. As discussed in greater detail below, such a result would lead to irrational results and stand at odds with Congress's recognition and tacit acceptance over the years of the Commission's Part 15 "unlicensed" regime. A more reasonable reading of Section 301, consistent with Congress's intent and subsequent legislation, would limit the licensing requirement to any apparatus that transmits enough energy to have a significant potential for causing harmful interference. Under our reading of the statute, the UWB transmission systems – because of their operating limits as prescribed in

---

174 *See* fn 161 *supra*.

175 Courts have considered the problem raised by last minute arguments that are submitted to an agency in ways that may deprive the agency of a fair opportunity to consider them, and then see a petitioner challenge the agency's failure to consider the arguments on appeal. The Court in MCI Worldcom, Inc. *v.* FCC, 760 F. 3d 760 (D.C. Cir. 2000) considered the Commission's failure to respond to a subtle suggestion in a single paragraph in an AT&T *ex parte* filed after the comment period had ended. The petitioners had challenged the failure to respond on appeal. The Court ultimately held that the argument was presented—if barely—to the Commission. *Id.* at 765. But the Court's holding was undoubtedly influenced by the fact that the ex parte was "suitably filed." *Id*. Here, the legal arguments by Cingular clearly were not suitably filed. Cingular's only defense to its action is that another party had raised the same Section 301 issue before the Commission. *See* Cingular Petition for Reconsideration of 5/22/03 at pg. 11. However, the party Cingular speaks of, ARRL, did not raise the issue in this proceeding. It had raised the issue in another proceeding, but has since abandoned the argument. *See*, *Amendment of Part 15 of the Commission's Rules to allow certification of equipment in the 24.05-24.25 GHz band at field strengths up to 2500 mV/m*, ET Docket No. 98-156, *Memorandum Opinion and Order*, 18 FCC Rcd 15, 944 (2003).

176 47 C.F.R. § 1.429(d)(i).

177 *See Hernstadt v. FCC*, 677 F.2d 893, 902 n.22 (D.C. Cir. 1980) (Congress presumed to be cognizant of and legislate against background of existing agency interpretation of law); *Sweet Home v. Babbitt*, 17 F.3d 1463, 1471 (D.C. Cir. 1994) (same), *rev'd on other grounds*, 55 U.S. 687 (1995).

178 Section 301 imposes a licensing requirement on a person who uses or operates "any apparatus for the transmission of energy or communications or signals by radio." 47 U.S.C. § 301.

this proceeding – are properly classified as Part 15 devices and are not required to be licensed on a formal basis.

69. The Commission first adopted rules for unlicensed operation of low power radio devices in 1938, and the basic construct of this regulatory regime continues to apply today.[179] The Commission took this action because it concluded that lower power radio frequency devices could be used on a widespread unlicensed basis, consistent with the public interest, if the Commission regulated their technical capabilities to ensure that they did not interfere with the orderly operation and development of radio communications.[180] The requirements for unlicensed operation are codified in Part 15 of the Commission rules and apply to a wide variety of emissions and devices, including intentional, unintentional and incidental radiators.[181] These requirements ensure that such "apparatus" do not transmit energy in a way that has a significant detrimental effect on the operation or development of the nation's communications network.

70. In setting up the Part 15 regime, the Commission realized that any attempt to license *all* transmitters of radio frequency energy would be infeasible and contrary to Congress's intent in establishing a "rapid, efficient, Nation-wide, and world-wide wire and radio communication service."[182] In this regard, the Commission has long recognized that numerous devices emit radio frequency energy, often at very low levels, and that such devices may be operated by numerous individual users, making

---

[179] The Commission issued in August 1938 a notice for an informal conference with the Chief Engineer on proposed rules and regulations for low power radiofrequency devices, which it described as those, primarily used by the public, that use radiofrequency current as essential to their operation (*e.g.*, radio control devices, record players) and that may cause interference to radio communications. Following a hearing held in September 1938 with various companies and associations representing both low power radiofrequency devices and radio communications services (*e.g.*, National Association of Broadcasters, Philco Radio and Television Corp, AT&T, Electro Medical Equipment Manufacturers, Westinghouse Electric Co.), the Commission issued a press release on November 21, 1938 (No. 30678) announcing the adoption of rules and regulations for low power radiofrequency electrical devices. The Commission decided that if a low power device did not exceed the adopted field strength limit and did not cause interference to radio reception, the device would not have to be licensed. The original rules also provided that the Commission would inspect and test devices to determine whether they met the adopted field strength limits and issue a certificate specifying conditions of operations to any party making such a request. As the number of radiofrequency devices has increased, technical knowledge has expanded, and measurement procedures have improved, the Commission has modified the rules for the operation of unlicensed operations over the years, including an equipment approval program. The rule modifications over time in Part 15 have had the consistent goals of protecting licensed operator rights and benefits, and protecting the licensees themselves from any harmful interference. At the same time the rules promote benefits to the mass consumer market through the availability of desirable and affordable low power radiating devices of many types, used in daily life, that can best be provided on an unlicensed (but not on an unregulated) basis.

[180] *Id.*

[181] 47 C.F.R. § 15.3 defines three classes of radio frequency emitters as follows:

> (n) Incidental radiator. A device that generates radio frequency energy during the course of its operation although the device is not intentionally designed to generate or emit radio frequency energy. Examples of incidental radiators are dc motors, mechanical light switches, etc.
>
> (o) Intentional radiator. A device that intentionally generates and emits radio frequency energy by radiation or induction.
>
> (z) Unintentional radiator. A device that intentionally generates radio frequency energy for use within the device, or that sends radio frequency signals by conduction to associated equipment via connecting wiring, but which is not intended to emit RF energy by radiation or induction.

[182] 47 U.S.C. § 151.

individual licensing of users impractical.[183] Recognizing that the identification and individual licensing of all devices that affected or relied upon radio frequency energy was not practical, the Commission, very early in its existence, interpreted Section 301 not to require the licensing of devices that did not transmit energy in a manner that had any real potential to affect the Nation's communications network adversely. In adopting this reading of the statute, the Commission recognized that many devices that operate at very low power levels and at very short distances are unlikely to cause harmful interference and thus would not need to be individually licensed.

71. The requirements that apply to Part 15 devices ensure that emissions from such unlicensed apparatus do not rise to the level that would require licensing. For example, relying on its authority under Section 301 to prohibit certain radio uses ("No person shall use or operate any apparatus for the transmission of energy or communications or signals by radio…except under and in accordance with this Act and with a license in that behalf granted under the provisions of this Act."), and under Section 303(f) to make "regulations not inconsistent with law as it may deem necessary to prevent interference between stations and to carry out the provisions of this Act,"[184] the Commission prescribes technical requirements which, if exceeded, would require the user of a device to acquire an individual license or to cease operation. Thus, although certain devices are unlicensed, they are still subject to appropriate regulation to ensure that they do not cause harmful interference to authorized users of the spectrum. Further, it is expressly stated in Part 15 of the Commission's rules that this rule part sets out the regulations under which one may operate without an individual license, and that any operation that is not in accordance with the Part 15 regulations must be licensed under Section 301 unless exempted elsewhere in the rules.[185] Rather than require all users to be individually licensed initially, the Commission has put users on notice that, under certain circumstances, it will require an individual license or prohibit their operations. This approach has proven to be an effective means for the Commission to achieve the stated purposes of the Act ("…to maintain the control of the United States over all the channels of radio transmission; and to provide for the use of such channels…by persons for limited period of time, under licenses granted by Federal authority…")[186] without imposing a licensing requirement on all individual users of all devices that emit radio frequency energy.[187]

---

183 The Commission recognized in 1938 that many different kinds of devices produced electromagnetic or induction fields at radio frequencies, even if they did not employ radio frequency current or the fields generated as essential to the functioning or purpose of the device's operation (*e.g.*, switch contacts, automobile ignitions, diathermy machines, induction furnaces, oscillators in certain radio receivers). *See supra* footnote 179. Today, the use of unlicensed devices has become pervasive. For example, the Consumer Electronics Association estimates that there is an installed base of more than 348.23 million Part 15 consumer electronic devices. That is more than one for every US citizen. *See* OSP Working Paper Series Number 39, *Unlicensed and Unshackled: A Joint OSP-OET White Paper on Unlicensed Devices and Their Regulatory Issues*, May 2003, at pg. 22 (this report includes additional data on the increase in the use of various unlicensed devices, such as cordless telephones, wireless local area networks, spread spectrum devices, and WiFi).

184 47 U.S.C. §§ 301, 303(f).

185 *See* 47 C.F.R. § 15.1(a) (providing that Part 15 sets out the regulations under which an intentional, unintentional, or incidental radiator may be operated without an individual license); 47 C.F.R. § 15.1(b) (requiring operation of an intentional or unintentional radiator operate in conformity with the regulations of Part 15 or be otherwise licensed or exempted).

186 47 U.S.C. § 301.

187 *See*, *generally*, *In The Matter Of Revision Of Part 15 Of The Rules Regarding The Operation Of Radio Frequency Devices Without An Individual License*, GEN. Docket No. 87-389, *Report and Order,* FCC 89-103, 66 Rad. Reg. 2d (P & F) 295 (Apr. 18, 1989) (weighing benefits of non-licensed operations and concerns for interference potential under Part 15 rules); *Amendment of Part 15 of the Commission's Rules Governing Restricted Radiation Devices Concerning Low Power Communication Devices*, Docket No. 9288, *Memorandum Order and Opinion*, FCC 57-1311, 13 RR 1546h, para. 12 (July 31, 1957) (weighing the adopting of licensing schemes that (continued....)

72. Further, we disagree with Cingular that the Commission – which had concluded in its early decisions that devices operating at very low emission levels would not cause interference and thus would not be interstate communications requiring individual licensing under Section 301 – no longer has a statutory basis upon which to allow unlicensed operation. After Section 301 was amended in 1982 to clarify that the Commission's authority also covers intrastate communications, the Commission has continued to rely on the harmful interference criteria as the basis for allowing unlicensed operations under Part 15, consistent with reading Section 301's reference to "apparatus for the transmission of energy" not to include devices that have no such interference potential.[188] We hereby explicitly adopt that construction of Section 301.

73. Various amendments to the Communications Act demonstrate that Congress has been well aware that the Commission permits users to operate approved unlicensed devices without a formal "license," but has not disapproved that practice. Just the opposite. For example, in 1992, when Congress amended Section 302 to add subsection (d)(1), it expressly acknowledged the Commission's Part 15 unlicensed operations within the statutory scheme. This subsection states, in pertinent part, that "the Commission shall prescribe and make effective regulations denying equipment authorization (under part 15 of title 47, Code of Federal Regulations, or any other part of that title) for [certain] scanning receiver[s]."[189] Scanning receivers are unlicensed devices, and Congress wanted to ensure that they would not receive transmissions in frequencies allocated to the cellular radio service, which is a licensed service and entitled to protection under the Act.[190]

74. As a further example of Congress's acknowledgment of the Commission's unlicensed regulatory regime, in 1996, Congress amended Section 332 of the Act to recognize State and local authority over the placement and construction of certain wireless facilities, including "unlicensed wireless service." Section 332(c)(7)(C)(iii) defines "unlicensed wireless service" as "the offering of telecommunications services using duly authorized devices which do not require individual licenses."[191] Reference to these types of devices includes those operating under Part 15, which are "duly authorized"

(...continued from previous page)
would be infeasible and much more burdensome to the public with the Part 15 approach of technical limits and a non-interference requirement).

188 In the matter of Modification of Parts 2 and 15 of the Commission's Rules for unlicensed devices and equipment approval, ET Docket No. 03-201, Report and Order, FCC 04-165 (July 12, 2004); In The Matter Of Amendment Of Parts 2, 15, 18 And Other Parts Of The Commission's Rules To Simplify And Streamline The Equipment Authorization Process For Radio Frequency Equipment, ET 97-94, Report and Order, FCC 97-84, 12 FCC Rcd. 8743 (Mar 27, 1997); Amendment of Part 2 of the Rules to simplify the equipment authorization procedures, Gen. Docket No. 82-242, Report and Order, FCC 83-3, 48 FR 3614-01 (Jan. 26, 1983).

189 47 U.S.C. § 302(d)(1).

190 House Report for Federal Communications Commission Authorization Act Of 1991, H.R. REP. 102-207, 31 (Sep. 17, 1991) (reporting on Pub.L. 102-556, Title IV, § 403(a)). Indeed, one of the primary reasons Congress added Section 302 to the Communications Act in 1968 was to address interference concerns by strengthening the Commission's power to impose limits on the manufacture of unlicensed Part 15 devices, not by resorting to a formal licensing process to control the interference potential of such devices. Thus, Congress recognized that compliance by manufacturers and others with the Commission's technical rules for unlicensed devices is critical. *See* S. Rep. No. 1276, 90th Cong., 2d Sess. 1968, 1968 U.S.C.C.A.N. 2486 (1968 Senate Report). As a prominent example of the seriousness of RFI involving unlicensed devices and the need for additional statutory authority for the Commission to strengthen this regulatory approach, the Report cited interference caused to air-safety-related emergency communications frequencies and homer frequencies at a California facility by 58 garage door openers, which were then, as well as now, unlicensed devices subject to technical standards in Part 15 of our rules. Congress discussed the need for statutory change in the legislative history to properly address the increasing popularity of such Part 15 regulated devices as garage door openers. *Id*. at 2488.

191 47 U.S.C. § 332(c)(7)(C)(iii).

pursuant to the Commission's equipment approval program. Similarly, in Section 3002(c) of the Balanced Budget Act of 1997, which directs the Commission to make additional spectrum available by auction, Congress acknowledged the Commission's unlicensed regulatory regime by expressly protecting those frequency bands that the Commission had already authorized for unlicensed use pursuant to Part 15.[192] Finally, in enacting the Electronic Communications Privacy Act of 1986, Congress noted in the legislative record that cordless telephones "are regulated under Part 15, Subpart E of the rules of the Federal Communications Commission (FCC), and are not licensed."[193]

75. We acknowledge that there is a gray area between those "unlicensed" devices that transmit energy but are clearly beyond any reasonable application of Section 301's licensing requirement[194] and those operations that are clearly subject to Section 301. As explained above, we do not believe it necessary to subject all devices in the gray area to the licensing requirements of Section 301. In the alternative, however, our Part 15 requirements provide a sufficient degree of regulatory oversight, individualized review and approval to constitute a "licensing" process that satisfies Section 301 requirements. While we do not apply the term "license" to the Part 15 approvals that are required to manufacture and distribute Part 15 devices, such approvals (*e.g.*, certifications for intentional radiators) constitute agency authorization for the manufacture, distribution and use of devices that have passed individualized requirements. As such, there is little to distinguish in a practical or legal sense Part 15 approvals of devices from the more overt Section 301 "licenses."

76. Section 301 does not limit the types of licenses that the Commission may grant, and the Commission has exercised discretion in developing a diverse regulatory scheme. Section 3 of the Act defines "station license," "radio station license," or "license" broadly to mean "that instrument of authorization required by this Act or the rules and regulations of the Commission made pursuant to this Act, for the use or operation of apparatus for the transmission of energy, or communications, or signals by radio by whatever name the instrument may be designated by the Commission."[195] The Commission's licensing regime includes, in addition to "license by rule" and site-specific licensing, blanket and wide-area licensing schemes. The typical blanket or wide-area licensing scheme allows individual customers/users to operate within a network without benefit of individual licenses, and the network operator is the sole licensee, as is done, for example, in the cellular wireless service. Because the network operator can control system design and access, and because the Commission has maintained through an individualized approval process the ability to control the use of spectrum, individual users' rights can be identified and interference between users can be avoided; thus, these licensing schemes are a reasonable exercise of the Commission's authority under Sections 4(i), 303(f) and 303(r) of the Act. Similarly, while the Commission does not inspect and test each individual Part 15 device, the Commission's review of a representative device for approval before it can be used is sufficiently individualized to cover all identical devices. Thus, unlicensed devices under Part 15 of the rules may not be operated or marketed without prior Commission authorization (certification, declaration of conformity or verification) to ensure that they operate consistent with the Part 15 technical rules, unless expressly exempted.[196]

---

192 Balanced Budget Act of 1997, P.L. 105-33 Section 3002(c)(1)(C)(v), 11 Stat. 261 (1997). More specifically, Congress excluded these bands from the Section 3002(c) auction requirement, to the extent that an auctioned service would interfere with the operation of Part 15 devices there. *Id*.

193 P.L. 99-508, H. Rep. 99-647, 99th Cong., 2d Sess. at 33 (June 19, 1986).

194 This category is comprised of pervasively used devices whose energy output has no significant effect on the communications use of the spectrum (*e.g.*, automobile ignitions).

195 47 U.S.C. § 3(42). Likewise, the Administrative Procedures Act defines license as "the whole or a part of an agency permit, certificate, approval, registration, charter, membership, statutory exemption or other form of permission." 5 U.S.C. § 551(8).

196 47 C.F.R. § 15.1.

77. Moreover, the individualized nature of the Part 15 approval process distinguishes this type of review from the "license by rule" approach used for Section 307(e) services that are exempted from Section 301's licensing requirement. Thus, we disagree with Cingular that Section 307(e) is inconsistent with our reading of Section 301. Under the licensing exemptions of Section 307(e), certain higher power communications services may be provided without any Commission review of the provider or of the specific operation that the provider intends to provide. Rather, the Commission adopts a set of rules that prescribe parameters of operation, and anyone may operate the service in any manner within those parameters. In contrast, to rely on a Part 15 approval, a Part 15 device cannot differ in any significant regard from the exact device that has garnered Part 15 approval.[197]

78. Cingular has argued throughout this proceeding that UWB transmission systems should be permitted solely on a formal, licensed basis, and now in its second petition for reconsideration attacks our statutory authority to adopt rules permitting UWB or any other similar operation on a Part 15, "unlicensed" basis.[198] We discussed at length in the *1st R&O* the merits of permitting UWB operations on a licensed or unlicensed basis, and have otherwise responded to the merits of Cingular's various arguments on different aspects of the unlicensed rules adopted.[199] We therefore deny the Petitioner's request for reconsideration and affirm our decisions in the *1st R&O* and *MO&O*, respectively.

3. Harmful interference to cellular, PCS and E911 operations

79. Cingular claims that the Commission's authorization of UWB devices was performed without an adequate record to demonstrate that harmful interference would not be caused to cellular, PCS and E911 operations. This claim addresses decisions made in the *1st R&O* and could be considered an untimely filed petition. Cingular also addresses arguments that were raised by Cingular, Qualcomm and Sprint in their petitions for reconsideration of the *1st R&O* and thoroughly discussed in the *MO&O*.[200] Cingular presents no new information or data and this portion of its petition could be dismissed as repetitious. Cingular raises only one issue that addresses the *MO&O* stating that the Commission made contradictory statements regarding the record.

80. With regard to contradictory statements regarding the record, Cingular indicates that it requested reconsideration of the *1st R&O* because the Commission failed to consider the interference impact to cellular, TDMA and GSM systems.[201] Cingular states that the Commission rejected its request because no data was provided. Cingular adds that the Commission, later in the *MO&O*, refused to reconsider its standards pending the completion of additional testing stating that there had been

---

197 Moreover, to the extent that Part 15 devices fall outside of the Section 301 licensing requirement (a proposition that is particularly apparent for such energy-transmitting apparatuses as automobile ignitions and induction furnaces), we note another reason why the Commission's unlicensed regime of equipment authorization is consistent with Congress's creation of the Section 307(e) individual license exceptions: the Section 307(e) services could never have been authorized under Part 15, because they use power levels that are too high. Thus, Section 301 would require them to be licensed, but for Congress's decision to exempt them.

198 *See*, *e.g.*, Cingular comments of 12/5/01 at pg. 4, 11/13/01 at pg. 3, 10/12/01 at pg. 3-4, 8/20/01 at pg. 3, 8/20/01 at pg. 5, 2/23/01 at pg. 2-3. *See*, also, Alloy LLC (Cingular's former name) comments of 2/23/00 at pg. i, 6-8 and 17 (urging the Commission to adopt rules permitting UWB on a licensed basis and arguing against allowing unlicensed UWB operation).

199 *See 1st R&O*, *supra*, at para. 12-19; *see*, also, *MO&O*, *supra*, at para. 95 (discussing the Commission's conclusion that the registered coordination of UWB imaging devices, as requested by Cingular in its 6/17/02 Petition for Reconsideration of the *1st R&O*, was not justified as there was no reason to believe that the devices, operating in compliance with the rules, would cause interference).

200 *See MO&O*, *supra*, at para. 55-97.

201 Cingular petition of 5/23/03 at pg. 22-23.

considerable analysis on every possible aspect of interference. However, Cingular argues that there is no record support for this statement by the Commission. Cingular argues that if no data had been provided regarding cellular interference, the Commission could not have considered every possible aspect. To demonstrate that there was no discussion in the *1st R&O* regarding interference to cellular systems, Cingular asserts that the term "cellular" does not appear in the *1st R&O*.[202] Cingular believes that this contradiction constitutes unreasoned decision making. Cingular also states that it had provided data regarding signal and interference levels for TDMA cellular and for TDMA and GSM PCS but that the Commission ignored all of this evidence.[203] Cingular argues that the Commission, in the *MO&O*, incorrectly stated that Cingular had not provided any additional information on other types of modulation techniques that could be employed for cellular or for PCS and asserts that this statement acknowledges that the Commission failed to consider record evidence supplied by Cingular. Based on this, Cingular claims that the Commission's decision is subject to reversal.[204]

81. Cingular mischaracterizes the actions taken by the Commission in its *1st R&O* and its *MO&O* and presents several misstatements of fact. For example, Cingular claims that the *1st R&O* contained no discussion regarding the UWB interference potential to cellular applications and that the Commission dismissed or ignored all data. However, the *1st R&O* does indeed contain a discussion of cellular interference susceptibility at paragraph 192.[205] Cingular also misquotes the statement from the Commission to reach the conclusions in its current petition. In its *MO&O*, the Commission stated that "[w]hile Cingular objects to our not providing similar analyses for TDMA and GSM modulation types, we based our analysis on the specifications provided by the proponents. We note that Cingular has not provided any additional information on other types of modulations that could be employed for cellular or for PCS." [emphasis added][206]

82. We recognize that Cingular, on October 12, 2001, submitted an *ex parte* letter specifying values for the sensitivity for TDMA cellular and PCS receivers and for GSM PCS receivers.[207] In that letter, Cingular also supplies carrier-to-interference specifications for these receivers. It is unclear if these values were based on test data or, as indicated in Cingular's letter, if they only reflect performance specifications. Cingular's reference to measurement data only stated that recent measurements in an urban area showed that signals were at acceptable levels. Cingular added that in cases of severe blockage and/or shadowing that signal levels were as low as the minimum stated sensitivity levels. Cingular did not indicate whether or not operation was possible at these "severe blockage and/or shadowing" levels. Cingular did not supply any data regarding co-cell and adjacent-cell noise levels, receiver processing gains, or other parameters which would enable a complete interference analysis. Cingular simply claimed that its systems operated at the minimum specified receiver sensitivities.

83. The Commission concentrated its discussion on interference potentials to CDMA PCS operations since this constituted the majority of analyses and data submitted in this proceeding and there appeared to be a lack of actual test data regarding TDMA and GSM systems. While the discussion on the impact to cellular operations is considerably less than the amount of discussion on the potential impact to PCS operations, it must be recognized that, with limited exceptions, the Commission did not authorize

---

202 Cingular petition of 5/23/03 at pg. 16-17.

203 *Id*. at pg. 15, 16-17.

204 *Id*. at pg. 18.

205 Contrary to Cingular's claim, cellular systems also are addressed in paragraphs 200, 233, and 271 of the *1st R&O*.

206 *MO&O*, *supra*, at para. 86.

207 *See ex parte* letter of October 12, 2001, from Jim Bugel of Cingular to Julius Knapp, Deputy Chief of the Commission's Office of Engineering and Technology.

UWB devices to operate in the cellular bands or in the PCS frequency bands.[208] Consumer UWB devices are not permitted to operate below 3100 MHz. Thus, consumer UWB devices are so far removed from the spectrum used for cellular applications that it is unlikely that measurable emissions from the fundamental component will even appear the cellular bands. Rather, it is likely that that any emissions appearing within the cellular bands will be random spurious emissions from associated digital circuitry and that any potential impact to cellular operations will be less than that caused by existing digital devices. Further, the CDMA PCS systems, according to information submitted by Sprint and Qualcomm, appeared to be at least as sensitive to harmful interference as the receivers specified by Cingular. Thus, the Commission concentrated its analysis on the test data it had on hand. This was a reasonable approach and produced interference analysis results that similarly apply to TDMA and GSM systems. When Cingular requested reconsideration of the decision in the *1st R&O*, it supplied no additional data that could be used by the Commission to come to a different conclusion. Since, as stated in the *MO&O*, Cingular did not file any additional data in this proceeding, no further analysis of cellular, TDMA or GSM systems was possible. Accordingly, there is no contradiction in the statements in the *MO&O* that are cited by Cingular. The Commission did consider the interference aspects to all types of cellular and PCS operations using the best data it had before it.

84. There was only one change in the *MO&O* that affected the level of emissions appearing within the PCS frequency bands and no changes that affected the levels of emissions appearing within the cellular frequency bands. Prior to the *MO&O*, the equivalent isotropically radiated power (EIRP) limit produced in the PCS bands by through-wall imaging systems operating above 1990 MHz was limited to -51.3 dBm/MHz. The Commission, in the *MO&O*, increased this emission limit to -41.3 dBm and explained why such an increase would not result in harmful interference.[209] However, the petition from Cingular does not address, much less object to, any of the rule changes implemented in the *MO&O*. Instead, Cingular continues to argue against actions taken by the Commission in the *1st R&O*. Cingular has provided no new information, presenting the same arguments it employed in its petition for reconsideration of the *1st R&O*. Those arguments already were addressed in the *MO&O*. As noted by XSI, Cingular states repeatedly that the Commission "rejected" or "dismissed" or "ignored" or "disregarded" or "discounted" arguments Cingular (and others) placed in the record.[210] However, a reading of the *1st R&O* and the *MO&O* clearly shows that the Commission considered the views and data submitted by the commenting parties. The Commission simply disagreed with some of these submissions and explained the basis for its disagreement within the *1st R&O* and again in the *MO&O* in response to the first petitions for reconsideration. The Commission fully considered the comments, test data, interference analyses and other material filed in this proceeding. Full opportunity for all affected parties to comment has been afforded.

85. Petitions for reconsideration are not granted for the purpose of altering our basic findings or debating matters that have been fully considered and substantively settled.[211] Absent new facts and information, we find Cingular's arguments about the interference potential of UWB devices to be repetitive and without merit. Accordingly, the portion of Cingular's petition for reconsideration claiming

---

208 GPRs and technically similar wall-imaging systems are permitted to operate in the cellular and PCS frequency bands. As discussed in the *1st R&O*, these devices do not present a threat of harmful interference to cellular or to PCS operations. *See 1st R&O*, *supra*, at para. 185, 189 and 192 as examples.

209 *MO&O*, *supra*, at para. 12-16. While the analysis described in these paragraphs is directed towards GPS reception, it is equally applicable to PCS operation.

210 XSI comments of 9/4/03 at pg. 4.

211 *See*, *e.g.*, Regulatory Policy Regarding the Direct Broadcast Satellite Service, *Memorandum Opinion and Order*, 94 FCC 2d 741, 747-748 (1983) (citing, *e.g.*, *WWIZ, Inc.*, 37 FCC 685, 686 (1964), aff'd sub nom., *Lorain Journal Co. v FCC*, 351 F 2d 824 (D.C. Cir. 1965), cert denied, 383 U.S. 967 (1966), *Florida Gulfcoast Broadcasters, Inc., Broadcasting*, 4 Rad Reg 2d (P&F) 503 (1965)).

that the Commission's authorization of UWB devices was performed without an adequate record to demonstrate that harmful interference would not be caused to cellular, PCS and E911 operations, including Cingular's claim that the Commission made contradictory statements in its *MO&O* regarding the record in this proceeding, is denied.

4. Rights of incumbent cellular and PCS licensees

86. Cingular claims that the *MO&O* fails to adequately protect the rights of incumbent cellular and PCS licensees by undermining the exclusivity rights of the licensees, by failing to include these licensees in a coordination process with UWB operators, and by failing to lower the emission limits in the PCS and cellular frequency bands for indoor UWB devices.[212] These claims by Cingular were raised in its petition for reconsideration of the *1st R&O* and were denied by the Commission in its *MO&O*.[213] Cingular presents no new evidence or information to support its claims. Thus, Cingular's claims amount to a petition for reconsideration of the *1st R&O* and should be considered an untimely filed petition that can be dismissed as repetitious.

87. Cingular also argues that the Commission, in the *MO&O*, mischaracterized a recent court opinion, *AT&T Wireless v. FCC*, [214] when it stated that the Court "affirmed the Commission's decision that even an exclusive licensee cannot object to secondary use of its spectrum as long as no harmful interference results."[215] Cingular argues that there was no affirmation, as such, but instead that the court was remanding certain issues to the Commission. Cingular also contends that the court never endorsed all secondary spectrum use in the absence of harmful interference asserting that the premise of the case was that there would be no degradation of service. Cingular adds that the court did not endorse secondary users causing objectionable interference and argues that the court's decision was specifically subject to the harmful interference issue being resolved in the remand.[216]

88. In its decision in the *AT&T Wireless v. FCC* case, the Court, *inter alia*, dismissed various claims by the petitioners,[217] but found that in rejecting a report advocating a specific interference criterion, the Commission was unclear as to its choice of the appropriate interference threshold supporting its conclusion that AirCell's operations would not cause harmful interference to terrestrial cellular systems. Specifically, where the Commission concluded that the report had relied on "unrealistic assumptions, including the use of an unrealistically low interference threshold," the court remanded for the Commission to clarify the justification for its view that use of the petitioner's proposed threshold of minus 124 dBm was too conservative and that an interference threshold of minus 117 dBm was more realistic.[218] The court notes, however, that it remanded so that the Commission could explain why it considered one interference threshold preferable to another, but not to defend the threshold ultimately

---

212 Cingular petition of 5/23/03 at pg. 23-25.

213 *MO&O*, *supra*, at para. 56, 74, 86, and 95.

214 *AT&T Wireless Services, Inc. v. F.C.C.*, 270 F.3d 959, 348 U.S.App.D.C. 135 (D.C.Cir. Nov 09, 2001) ("*AirCell I*") (NO. 00-1304), *on Remand to*, Aircell, Inc., 2003 WL 261920, 18 F.C.C.R. 1926, 18 FCC Rcd. 1926 (F.C.C. Feb 10, 2003) ("*AirCell Remand Order*"), *petition for review denied by*, *AT&T Wireless Services, Inc. v. F.C.C.*, 365 F.3d 1095 (D.C.Cir. May 04, 2004) ("*AirCell II*").

215 Cingular petition of 5/23/03 at pg. 23; *MO&O*, *supra*, at para. 74 and at footnote 188.

216 Cingular petition of 5/23/03 at pg. 23.

217 The Court found that the Commission adequately explained why it rejected the July 11, 1997, Texas-Oklahoma test data and the September 22, 1998, Florida test data upon which petitioners relied. *See* [*AirCell I*] at 968-69.

218 *See* [*AirCell I* at 968-69] *id.*

selected.[219]

89. We find that Cingular's objection is without merit. The Commission correctly noted in the *MO&O* and the *AirCell Remand Order* that the court had remanded the Commission to explain the selection of the interference criterion, and that the court had affirmed the Commission's finding that absent harmful interference the petitioner's rights as a licensee were not changed by the AirCell waiver.[220] On remand, the Commission found no interference to the wireless carrier's operations, which is the case here.[221] The court also found that Commission rules proscribe only harmful interference within a given carrier's cellular geographic service area ("CGSA"), and that AirCell's new system did not infringe upon petitioners' rights as exclusive licensees to be protected from harmful interference.[222] The court specifically referred to "harmful interference" and not degradation of service or objectionable interference as cited by Cingular.

90. With the exception of GPRs and wall imaging systems, UWB devices do not operate within the PCS or cellular bands although they may produce emissions within these bands. Cingular's claim of exclusivity would prohibit the Commission from allowing any emissions to fall within a licensee's cellular or PCS bands, even if those emissions are sufficiently attenuated to not cause harmful interference to the operation of the cellular or PCS systems. Thus, Cingular's interpretation of the exclusivity provided to a cellular or PCS license also would preclude the Commission from licensing additional PCS or cellular stations, as well as public safety and other radio operations, in different frequency bands since those stations produce emissions outside of their licensed band of operation.[223] Clearly, this is not the case. We also note that the operation of unlicensed devices in the PCS and cellular bands has been permitted under Part 15 at higher emission levels than those produced by UWB devices since before the allocation of the cellular and PCS services.[224] We disagree with Cingular's concern about the Commission's characterization of the Court's opinion in *AT&T Wireless v. FCC*. The Court affirmed, in the AirCell waiver proceeding, that an exclusive licensee could not object to the Commission's policy decision to permit secondary use rights where such secondary use did not cause harmful interference.[225]

91. The Commission has already fully considered the issues presented by Cingular and the comments. Cingular has provided no new information but, with one exception, continues to present the

---

219 *See* [*AirCell II*] at 1102.

220 *MO&O*, *supra*, at footnote 188.

221 The Commission's review on remand of the July 10 test flight data showed that AirCell's mean signal strength exceeded –117 dBm only on one of the 24 test flights, and then only by .62 decibels, a trivial amount. It concluded, therefore, that AirCell was unlikely to cause harmful interference. *See* [*Aircell II*] at 1102; *see also* [*AirCell Remand Order*] at 1937.

222 *See* [*AirCell I*] at 964. The Court also stated that "absent harmful interference, AirCell's new system does not trammel upon petitioners' rights as licensees." *Id.*

223 A radio frequency device can generate unwanted emissions that may appear in any part of the radio spectrum.

224 47 C.F.R. § 15.209 of the current rules permits operation within the PCS bands at a higher level than that allowed from UWB devices and within the cellular bands at the same level as that allowed from UWB devices. 47 C.F.R. § 15.231 allows operation within the PCS and cellular frequency bands at considerably higher emission levels than those produced by UWB devices. Prior to June 23, 1989, 47 C.F.R. §§ 15.120, 15.122, 15.181-15.187, and 15.201-15.215 permitted unlicensed operation within the PCS and cellular bands at the higher power levels currently permitted under 47 C.F.R. § 15.231.

225 The term "exclusivity" as used in the case refers to "geographic exclusivity and protection from interference." *See* [*AirCell*] at 963-64.

same arguments it employed in its petition for reconsideration of the *1st R&O* that were addressed in the *MO&O*. The statement in the *MO&O* addressing XSI's comment that the court had affirmed a decision[226] does not constitute reversible error especially since the Commission correctly referenced this case as a remand and since the reference to this case does not constitute the Commission's sole argument for the denial of Cingular's claim. Full opportunity for all affected parties to comment has been afforded and we have fully considered all relevant matters in the record. Absent new facts and information, we find Cingular's arguments about protecting the rights of incumbent cellular and PCS licensees to be repetitive and without merit. According, this portion of Cingular's petition for reconsideration is denied.

B. Interference to C-Band Fixed Satellite Service

92. Background. On June 17, 2002, SIA filed a Petition for Reconsideration of the *1st R&O*. In this petition, SIA argued that the Commission's analysis in the *1st R&O* regarding the interference potential to FSS operation in the 3.7-4.2 GHz band was inconsistent because it developed a protection criteria based on indoor UWB operation but also permitted these devices to operate outdoors. SIA argued that the Commission relied on a building to serve as a buffer between the UWB emitter and the FSS earth station but that this attenuation can not be assumed for outdoor UWB devices. It requested that emissions from outdoor UWB devices be reduced in the FSS band. SIA also argued that the Commission did not meaningfully address the minimum separation distances specified in the NTIA report for protecting FSS stations from UWB emissions, indicating that the required separation distances extended up to tens of kilometers. On January 10, 2003, SIA submitted a technical analysis demonstrating that the peak level emissions from a single UWB device could cause harmful interference to FSS reception at a distance of up to 4.4 km. The Commission denied the SIA petition, along with the later technical analysis, adding that appropriate action would be taken to protect FSS stations should tests or other sources provide any indication that its standards are not adequate to protect the authorized services from harmful interference.[227]

93. On May 22, 2003, SIA filed a Petition for Reconsideration of the *MO&O*. SIA argues that the 0 dB interference-to-noise ratio (I/N) used by the Commission in its analysis in the *1st R&O* will result in FSS stations receiving harmful interference.[228] SIA requests that an I/N of -10 dB be applied. SIA also argues that the assumptions used in its technical arguments contained in its technical analysis of January 10, 2003, are appropriate and are necessary to evaluate the UWB interference to FSS receivers.[229] Specifically, SIA states that the Commission was in error in characterizing its analysis as being overly conservative, citing five areas that it believes were incorrectly addressed by the Commission: 1) the low elevation angles of the FSS antenna; 2) the presence of natural and man made structures resulting in attenuation of the UWB emissions; 3) the probability that UWB devices would emit at the maximum peak emission level; 4) the low relative heights of the FSS and UWB antennas; and 5) the Commission's denial in the *1st R&O* of the use of a -10 dB I/N. SIA states that the Commission questioned that FSS receivers will operate with antennas directed low towards the horizon, indicating that such low elevation angles are commonplace and necessary. SIA also states that it did not assume that there would be no intervening objects in the calculated separation distances between the UWB emitter and the FSS receiving antenna but only demonstrated that a UWB device that was visible to an FSS receiving antenna and within 4.4 km would result in interference. SIA indicates that it assumed that UWB devices may operate at the maximum peak power levels permitted under the rules and that, as omnidirectional devices, would transmit their signals in the direction of the FSS receiving antenna. SIA adds that if the Commission is

---

226 *MO&O*, *supra*, at para. 74.

227 *MO&O*, *supra*, at para. 124-131.

228 SIA petition of 5/22/03 at pg. 3.

229 *Id*. at pg. 3-8.

confident that outdoor UWB devices will not radiate at the peak limit then it should lower the limit.[230] SIA also states that the relative heights of the UWB and FSS antenna have a *de minimus* impact on the required separation distances. SIA states that the Commission criticized SIA's reliance on a -10 dB I/N but that SIA can demonstrate a basis for requiring an I/N of -10 to -12.2 dB. Finally, SIA states that FSS antennas can be pointed at buildings and still have ample clearance for line-of-sight satellite reception, arguing that the 10 dB isolation claimed by XSI due to offset from the satellite antenna does not exist.[231] SIA provides an attached engineering statement.

94. Comments/Discussion. XSI states that the SIA petition offers no facts or laws that were not previously available, adding that the Commission has already dealt with all of the arguments raised by SIA, including the I/N, peak versus average levels, and earth station geometries.[232] XSI adds that the petition should be dismissed as repetitious since the bulk of the petition does nothing more than dispute the findings in the *MO&O* without adding newly available fact or analysis. We concur with this assessment. The Commission did not make any changes in the *MO&O* that affect the levels of the emissions that may appear in the FSS frequency bands. Rather, SIA continues to dispute the issue of a relative I/N ratio that was addressed in the *1st R&O*. The time is long past for filing a petition for reconsideration of that decision. SIA also disputes the Commission's statement in the *MO&O* that the interference scenario employed by SIA in its technical analysis is overly conservative. SIA continues to argue the unlikely scenario that UWB emissions are subject to a propagation loss that is applicable only when there is a clear line-of-sight between the UWB emitter and the FSS receiving antenna,[233] that the UWB devices will operate at relatively low pulse repetition frequencies producing high level peak emissions, and that the FSS receiver will respond fully to the peak level emissions from the UWB emitter. SIA does not address the Commission's statement that low elevation FSS systems generally are mounted in secured areas that are not readily accessible to the public nor has it ever provided any evidence that FSS receivers will respond fully to the peak emission levels from UWB devices. Indeed, SIA presents no new information to substantiate its claims but only continues to argue against the Commission's decision. Accordingly, SIA's current Petition for Reconsideration can be considered repetitious of its earlier Petition for Reconsideration of the *1st R&O* and this petition therefore is dismissed.

95. Alion analysis. Since the filing of the SIA Petition for Reconsideration, the Coalition of C-Band Constituents ("Coalition") contracted with Alion Science and Technology ("Alion") to determine what, if any, interference potential exists to FSS reception from UWB operation. A test report on this matter was submitted to the Commission on February 11, 2004.[234] The Alion study concludes that FSS receivers will experience "complete reception failure at currently regulated UWB power levels assuming emitter densities currently found in the environment of common wireless-based consumer units."[235]

---

230 *Id*. at pg. 8-9.

231 *Id*. at pg. 3 and 9.

232 XSI comments of 9/4/03 at pg. 1 and 2-4.

233 SIA based the propagation attenuation on the square of the inverse distance, *i.e.*, the propagation loss in decibels is equal to 20 log (DF) – 147.6 where D is the distance in meters and F is the frequency in Hertz. At 4 GHz, this formula becomes 20 log (D) + 44.5 dB.

234 *Evaluation of UWB and Lower Adjacent Band Interference to C-Band Earth Station Receivers*, Alion Science and Technology, February 11, 2004. ("Alion report") In the *MO&O*, the Commission stated that it would take appropriate action to protect the authorized services if tests or other sources provide any indication that its standards are not adequate. *See MO&O*, *supra*, at para. 131. For this reason, we are accepting this report as a late filing in this proceeding. Written *ex parte* comments responding to this study were filed on April 9, 2004, by Motorola, Inc., on April 12, 2004, by the Multiband OFDM Alliance, and on June 4, 2004, by the Coalition of C-Band Constituents.

235 Alion report at pg. 6-7.

Based on this report, the Coalition, in its cover letter of February 18, 2004, concludes that the Commission must reduce the level of emissions permitted in the 3700-4200 MHz band by 21 dB.

96. The Alion study is based on multiple worst-case assumptions, most of which simply are not realistic. For example, this study is founded on the premise that a large number of UWB devices will be near the FSS receiver and will contribute significantly to the aggregate interference level. Specifically, the study assumes that ninety percent of the UWB devices distributed within 1000 meters of the FSS station, 70 percent between one and two km, 50 percent within two and three km, etc. have a direct line-of-sight propagation path into the FSS receive antenna without attenuation from any intervening objects.[236] In addition, it is assumed that UWB transmitters may be located as close as 30 meters to the FSS antenna, that all UWB emitters within a 5 km radius are pointed directly at the FSS antenna, and that all UWB emitters operate at a 100 % activity factor. Further, the Alion analysis assumes that every UWB device operating within 5 km of the FSS station produces the maximum permissible power spectral density (PSD) level within the pass band of the FSS receiver. The Coalition has further exacerbated the worst-case results from the Alion study by applying unsupported and unreasonable projections with respect to UWB device proliferation. The Coalition assumes that UWB devices will replace all existing Part 15 cordless telephones, wireless security applications, and wireless data communications and will be used for communications within and between vehicles, resulting in an estimated 64 UWB devices per acre or 1.24 million UWB devices, all operating continuously, within 5 km of an FSS receiver.[237]

97. The current UWB regulations severely restrict what types of devices may be operated outdoors. Outdoor usage is limited to hand-held, very short range, peer-to-peer operations that likely will be of extremely short duration. This hand-held restriction precludes the mounting of UWB devices in transportation vehicles.[238] Because of these restrictions, only a small percentage of UWB devices, likely much less than 5 percent, will be operated outdoors and these will have extremely low activity factors. In addition, the hand-held requirement essentially ensures that a large percentage of UWB units operated outdoors will be subject to attenuation from head and body shielding from the user.[239] Further, outdoor UWB devices would be operated close to the ground and the resulting multipath interactions will result in the emissions from these devices attenuating at a much faster rate than was calculated by Alion using free space propagation. All non-hand-held UWB devices must be located indoors where their emissions would be subject to an average 12 dB attenuation from shielding provided by the building.[240] The emissions from indoor UWB devices also would be subject to a propagation attenuation factor much greater than the free space model.[241] Several ranges of activity factors have been hypothesized for indoor

[236] Under this condition, Alion calculated the path loss using free space propagation, *i.e.*, based on the square of the inverse of the distance, where the propagation loss in dB is equal to 20 log (DF) – 147.6 where D is the distance in meters and F is the frequency in Hertz. At F = 4 GHz, this formula becomes 20 log (D) + 44.5 dB.

[237] On March 5, 2004, the Coalition submitted a letter to the Commission stating that it now believes that a higher density and a higher UWB operating duty cycle should be applied, based on the number of USB computer ports available within the U.S. and its speculation that UWB devices would be attached to these ports.

[238] The limited transmission range also would effectively preclude the use of hand-held UWB devices for vehicle-to-vehicle communications.

[239] While no data is available for the attenuation caused to outdoor UWB devices due to hand-held operation, Sprint found that PCS handsets operating at 1900 MHz suffered a 12 dB to 15 dB attenuation due to "head loss," *i.e.*, signal blockage by the user. *See* Sprint comments of 9/12/00 at Attachment 2, pg. 2-3. It is expected that the attenuation from the hand and body shielding at the 4 GHz FSS frequency would be at least as high, if not more, as that in the 1.9 GHz PCS band.

[240] The average building attenuation at 4 GHz is 12 dB, as determined by NTIA. *See* NTIA Special Publication 01-43, *Assessment of Compatibility between Ultrawideband Devices and Selected Federal Systems*, January 2001, at pg. 5-30 to 5.31.

UWB applications and these are well below the 100 percent level employed in the Alion study.

98. In addition to the above, UWB devices separated from the FSS site by any appreciable distance, regardless of whether they are operated outdoors or indoors, are likely to encounter multiple intervening objects that provide considerable additional attenuation to the emissions.[242] Because FSS receive sites are outdoors, and are usually located to avoid radio noise from other sources, it is highly unlikely that any UWB devices will be operated within 30 meters unless those devices are operated by FSS personnel. Further, we anticipate that many UWB transmitters will employ directional patch antennas and would not necessarily direct their signals toward the FSS site. In addition, not all UWB devices will operate with their emissions centered at 4 GHz nor will all UWB devices produce spectral lines that appear in the passband of an FSS receiver. It is expected that UWB operations, along with their associated maximum power density levels, will be distributed over several portions of the entire authorized frequency band (3.1-10.6 GHz) and not concentrated only within a single 500 MHz (3.7-4.2 GHz) sub-band. Finally, we disagree that UWB devices will operate at the density levels speculated by the Coalition. Because our current standards effectively limit UWB to a transmission range of only 10 meters, UWB technology is not expected to be used as cordless telephones or security systems. We expect that most consumer devices will continue to operate using technologies that can operate in other frequency bands available under Part 15.

99. The Commission was able to duplicate the Alion study, obtaining similar results when using the same assumptions Alion employed. The Commission then recalculated this analysis based on more realistic operating conditions, assuming that many UWB devices would be located indoors where the building would provide additional path loss to the outdoor satellite receive antennas, and obtained results that more than offset the 21 dB of attenuation requested by the Coalition.[243] The Commission also found that the large majority of the interference potential is caused by the UWB device that is near the main beam of the FSS receiving station. The aggregate contribution from the remainder of the assumed UWB devices is negligible. As evaluated by Alion, the calculation for increasing the aggregate contribution from 1000 continuously operating UWB transmitters to 1.24 million transmitters accounts for 31 dB of the 21 dB additional attenuation requested by the Coalition. Based on these two offsets to the Coalition's requested protection criteria, we find no justification to reduce the UWB emission levels in the FSS frequency band. However, we will continue to monitor this situation and will take whatever appropriate action is necessary to ensure that UWB operation does not result in harmful interference to FSS receivers. If a Part 15 device causes interference it is required to remedy the interference or to cease operation.[244] The remedy could be as simple as relocating the UWB device away from a window. In any

(...continued from previous page)

241 Propagation loss, after accounting for the 12 dB building attenuation, should approach inverse distance to the fourth or, with F = 4 GHz, a loss of 40 log (D) + 44.5 dB.

242 At a frequency of 1.5 GHz, NTIA found that "aggregate interference from uniformly distributed emitters at distances of less than 1 km would decrease by at least 15 dB in suburban areas and 20 dB in urban areas, as compared with a smooth Earth propagation loss" and that emissions from emitters beyond one km were reduced by 30 dB in suburban environments and 40 dB in urban environments, virtually eliminating any aggregate effects from UWB devices beyond 1 km. NTIA added that these signal losses increase at frequencies above 1.5 GHz. See NTIA Special Publication 01-43, *supra*, at pg. 5-28 and 5-29.

243 The Commission's analysis only varied the percentages of devices that were operated indoors and outdoors along with the application of a 12 dB building attenuation factor for indoor UWB transmitters. If the Commission had assumed even more realistic operating conditions by applying intervening objects and a more reasonable propagation factor to outdoor UWB transmitters, multiple intervening objects to indoor UWB transmitters, the possibility that the UWB emitter and the satellite antenna are not line-of-sight with each other, and an activity factor, the results would have been even lower.

244 47 C.F.R. § 15.5.

event, the Commission will investigate any interference complaints from UWB devices to the authorized radio services, will take steps to ensure that harmful interference is corrected, and will take whatever enforcement actions may be deemed necessary.

V. ADMINISTRATIVE PROVISIONS

100. Paperwork Reduction Act of 1995 Analysis. This document contains modified information collection requirements subject to the Paperwork Reduction Act of 1995 (PRA), Public Law 104-13. It will be submitted to the Office of Management and Budget (OMB) for review under Section 3507(d) of the PRA. OMB, the general public, and other Federal agencies are invited to comment on the new or modified information collection requirements contained in this proceeding.

101. The Commission will send a copy of this Second Report & Order and Second Memorandum Opinion and Order in a report to be sent to Congress and the General Accounting Office pursuant to the Congressional Review Act, *see* 5 U.S.C. 801(a)(1)(A).

102. Final Regulatory Flexibility Certification. The Regulatory Flexibility Act of 1980, as amended (RFA),[245] requires that a regulatory flexibility analysis be prepared for notice-and-comment rule making proceedings, unless the agency certifies that "the rule will not, if promulgated, have a significant economic impact on a substantial number of small entities."[246] The RFA generally defines the term "small entity" as having the same meaning as the terms "small business," "small organization," and "small governmental jurisdiction."[247] In addition, the term "small business" has the same meaning as the term "small business concern" under the Small Business Act.[248] A "small business concern" is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the Small Business Administration (SBA).[249]

103. In this Second Report and Order and Second Memorandum Opinion and Order, we are implementing a change to the rules to facilitate the operation of wideband unlicensed transmitters. We also are responding to two petitions for reconsideration regarding rules that permit the marketing and operation of products incorporating ultra-wideband ("UWB") technology. UWB devices operate by employing very narrow or short duration pulses that result in very large or wideband transmission bandwidths. With appropriate technical standards, UWB devices can operate on spectrum occupied by existing radio services without causing interference, thereby permitting scarce spectrum resources to be used more efficiently. Further, as noted in the text we have continued to apply conservative limits to the standards applicable for UWB operation, until such time as we gain additional experience, to ensure that harmful interference would not be caused to other radio spectrum users. Further, the changes adopted in this proceeding will not affect any party legally manufacturing or marketing UWB devices. Thus, we expect that our actions do not amount to a significant economic impact. Accordingly, we certify that the rules being adopted in this Memorandum Opinion and Order will not have a significant economic impact on a substantial number of small entities.

---

245 The RFA, *see* 5 U.S.C. § 601 – 612, has been amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), Pub. L. No. 104-121, Title II, 110 Stat. 857 (1996).

246 5 U.S.C. § 605(b).

247 5 U.S.C. § 601(6).

248 5 U.S.C. § 601(3) (incorporating by reference the definition of "small-business concern" in the Small Business Act, 15 U.S.C. § 632). Pursuant to 5 U.S.C. § 601(3), the statutory definition of a small business applies "unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register."

249 15 U.S.C. § 632.

104. The Commission will send a copy of the Second Report and Order and Second Memorandum Opinion and Order, including a copy of this Final Regulatory Flexibility Certification, in a report to Congress pursuant to the Congressional Review Act.[250] In addition, the Second Report and Order and Second Memorandum Opinion and Order and this final certification will be sent to the Chief Counsel for Advocacy of the SBA, and will be published in the Federal Register.[251]

105. Ordering Clauses. IT IS ORDERED that the Petition for Reconsideration from Cingular, Inc. IS DENIED. IT IS ORDERED that the Petition for Reconsideration from Satellite Industry Association IS DISMISSED. IT ALSO IS ORDERED that Part 15 of the Commission's Rules and Regulations IS AMENDED as specified in Appendix A, effective 30 days after publication in the Federal Register. This action is taken pursuant to Sections 4(i), 302, 303(e), 303(f), 303(r), 304 and 307 of the Communications Act of 1934, as amended, 47 U.S.C. Sections 154(i), 302, 303(e), 303(f), 303(r), 304 and 307.

106. IT IS FURTHER ORDERED that the Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, SHALL SEND a copy of this Second Report and Order and Second Memorandum Opinion and Order, including the Final Regulatory Flexibility Certification, to the Chief Counsel for Advocacy of the Small Business Administration.

107. IT IS FURTHER ORDERED that this proceeding IS TERMINATED.

108. For further information regarding this Second Report and Order and Second Memorandum Opinion and Order, contact John A. Reed, Office of Engineering and Technology, (202) 418-2455, john.reed@fcc.gov.

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch
Secretary

[250] *See* 5 U.S.C. § 801(a)(1)(A).

[251] *See* 5 U.S.C. § 605(b).

Appendix A
Changes to the Regulations

Title 47 of the Code of Federal Regulations, Part 15, is amended as follows:

1. The authority citation for Part 15 continues to read as follows:

AUTHORITY: 47 U.S.C. 154, 302, 303, 304, 307, 336 and 544A.

2. Section 15.35 is amended by revising paragraph (b) to read as follows:

Section 15.35 Measurement detector functions and bandwidths.

* * * * *

(b) Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz. When average radiated emission measurements are specified in this part, including average emission measurements below 1000 MHz, there also is a limit on the peak level of the radio frequency emissions. Unless otherwise specified, *e.g.*, see §§ 15.250, 15.252, 15.255, and 15.509-15.519 of this part, the limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device, *e.g.*, the total peak power level. Note that the use of a pulse desensitization correction factor may be needed to determine the total peak emission level. The instruction manual or application note for the measurement instrument should be consulted for determining pulse desensitization factors, as necessary.

* * * * *

3. Section 15.215 is amended by revising paragraph (c), to read as follows:

Section 15.215 Additional provisions to the general radiated emission limitations.

* * * * *

(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

4. A new Section 15.250 is added to read as follows:

Section 15.250 Operation of wideband systems within the band 5925-7250 MHz.

(a) The -10 dB bandwidth of a device operating under the provisions of this section must be contained within the 5925-7250 MHz band under all conditions of operation including the effects from stepped frequency, frequency hopping or other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage.

(b) The -10 dB bandwidth of the fundamental emission shall be at least 50 MHz. For transmitters that employ frequency hopping, stepped frequency or similar modulation types, measurement of the -10 dB minimum bandwidth specified in this paragraph shall be made with the frequency hop or step function disabled and with the transmitter operating continuously at a fundamental frequency following the provisions of Section 15.31(m) of this part.

(c) Operation on board an aircraft or a satellite is prohibited. Devices operating under this section may not be employed for the operation of toys. Except for operation onboard a ship or a terrestrial transportation vehicle, the use of a fixed outdoor infrastructure is prohibited. A fixed infrastructure includes antennas mounted on outdoor structures, *e.g.*, antennas mounted on the outside of a building or on a telephone pole.

(d) Emissions from a transmitter operating under this section shall not exceed the following equivalent isotropically radiated power (EIRP) density levels:

(1) The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following RMS average limits based on measurements using a 1 MHz resolution bandwidth:

Frequency in MHz	EIRP in dBm
960-1610	-75.3
1610-1990	-63.3
1990-3100	-61.3
3100-5925	-51.3
5925-7250	-41.3
7250-10600	-51.3
Above 10600	-61.3

(2) In addition to the radiated emission limits specified in the table in paragraph (d)(1) of this section, transmitters operating under the provisions of this section shall not exceed the following RMS average limits when measured using a resolution bandwidth of no less than 1 kHz:

Frequency in MHz	EIRP in dBm
1164-1240	-85.3
1559-1610	-85.3

(3) There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs and this 50 MHz bandwidth must be contained within the 5925-7250 MHz band. The peak EIRP limit is 20 log (RBW/50) dBm where RBW is the resolution bandwidth in megahertz that is employed by the measurement instrument. RBW shall not be lower than 1 MHz or greater than 50 MHz. The video bandwidth of the measurement instrument shall not be less than RBW. If RBW is greater than 3 MHz, the application for certification filed with the Commission shall contain a detailed description of the test procedure, calibration of the test setup, and the instrumentation employed in the testing.

(4) Radiated emissions at or below 960 MHz shall not exceed the emission levels in Section 15.209 of this part.

(5) Emissions from digital circuitry used to enable the operation of the transmitter may comply with the limits in Section 15.209 of this chapter provided it can be clearly demonstrated that those emissions are due solely to emissions from digital circuitry contained within the transmitter and the emissions are not intended to be radiated from the transmitter's antenna. Emissions from associated digital devices, as defined in Section 15.3(k) of this chapter, *e.g.*, emissions from digital circuitry used to control additional functions or capabilities other than the operation of the transmitter, are subject to the limits contained in Subpart B of Part 15 of this chapter. Emissions from these digital circuits shall not be employed in determining the -10 dB bandwidth of the fundamental emission or the frequency at which the highest emission level occurs.

(e) Measurement procedures:

(1) All emissions at and below 960 MHz are based on measurements employing a CISPR quasi-peak detector. Unless otherwise specified, all RMS average emission levels specified in this section are to be measured utilizing a 1 MHz resolution bandwidth with a one millisecond dwell over each 1 MHz segment. The frequency span of the analyzer should equal the number of sampling bins times 1 MHz and the sweep rate of the analyzer should equal the number of sampling bins times one millisecond. The provision in Section 15.35(c) of this part that allows emissions to be averaged over a 100 millisecond period does not apply to devices operating under this section. The video bandwidth of the measurement instrument shall not be less than the resolution bandwidth and trace averaging shall not be employed. The RMS average emission measurement is to be repeated over multiple sweeps with the analyzer set for maximum hold until the amplitude stabilizes.

(2) The peak emission measurement is to be repeated over multiple sweeps with the analyzer set for maximum hold until the amplitude stabilizes.

(3) For transmitters that employ frequency hopping, stepped frequency or similar modulation types, the peak emission level measurement, the measurement of the RMS average emission levels, and the measurement to determine the frequency at which the highest level emission occurs shall be made with the frequency hop or step function active. Gated signals may be measured with the gating active. The provisions of Section 15.31(c) of this part continue to apply to transmitters that employ swept frequency modulation.

(4) The -10 dB bandwidth is based on measurement using a peak detector, a 1 MHz resolution bandwidth, and a video bandwidth greater than or equal to the resolution bandwidth.

(5) Alternative measurement procedures may be considered by the Commission.

5. A new Section 15.252 is added to read as follows:

Section 15.252 <u>Operation of wideband vehicular radar systems within the bands 16.2-17.7 GHz and 23.12-29.0 GHz</u>.

(a) Operation under this section is limited to field disturbance sensors that are mounted in terrestrial transportation vehicles. Terrestrial use is limited to earth surface-based, non-aviation applications. Operation within the 16.2-17.7 GHz band is limited to field disturbance sensors that are used only for back-up assistance and that operate only when the vehicle is engaged in reverse.

(1) The -10 dB bandwidth of the fundamental emission shall be located within the 16.2-17.7 GHz band or within the 23.12-29.0 GHz band, exclusive of the 23.6-24.0 GHz restricted band, as appropriate, under all conditions of operation including the effects from stepped frequency, frequency hopping or other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage.

(2) The -10 dB bandwidth of the fundamental emission shall be 10 MHz or greater. For transmitters that employ frequency hopping, stepped frequency or similar modulation types, measurement of the -10 dB minimum bandwidth specified in this paragraph shall be made with the frequency hop or step function disabled and with the transmitter operating continuously at a fundamental frequency following the provisions of Section 15.31(m) of this part.

(3) For systems operating in the 23.12-29.0 GHz band, the frequencies at which the highest average emission level and at which the highest peak level emission appear shall be greater than 24.075 GHz.

(4) These devices shall operate only when the vehicle is operating, *e.g.*, the engine is running. Operation shall occur only upon specific activation, such as upon starting the vehicle, changing gears, or engaging a turn signal. The operation of these devices shall be related to the proper functioning of the transportation vehicle, *e.g.*, collision avoidance.

(b) Emissions from a transmitter operating under this section shall not exceed the following equivalent isotropically radiated power (EIRP) density levels:

(1) For transmitters operating in the 16.2-17.7 GHz band, the RMS average radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following EIRP limits based on measurements using a 1 MHz resolution bandwidth:

Frequency in MHz	EIRP in dBm
960-1610	-75.3
1610-16,200	-61.3
16,200-17,700	-41.3
Above 17,700	-61.3

(2) For transmitters operating in the 23.12-29.0 GHz band, the RMS average radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following EIRP limits based on measurements using a 1 MHz resolution bandwidth:

Frequency in MHz	EIRP in dBm
960-1610	-75.3
1610-23,120	-61.3
23,120-23,600	-41.3
23,600-24,000	-61.3
24,000-29,000	-41.3
Above 29,000	-61.3

(3) In addition to the radiated emission limits specified in the tables in paragraphs (b)(1) and (b)(2) of this section, transmitters operating under the provisions of this section shall not exceed the following RMS average EIRP limits when measured using a resolution bandwidth of no less than 1 kHz:

Frequency in MHz	EIRP in dBm
1164-1240	-85.3

1559-1610	-85.3

(4) There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs and this 50 MHz bandwidth must be contained within the 16.2-17.7 GHz band or the 24.05-29.0 GHz band, as appropriate. The peak EIRP limit is 20 log (RBW/50) dBm where RBW is the resolution bandwidth in MHz employed by the measurement instrument. RBW shall not be lower than 1 MHz or greater than 50 MHz. Further, RBW shall not be greater than the -10 dB bandwidth of the device under test. For transmitters that employ frequency hopping, stepped frequency or similar modulation types, measurement of the -10 dB minimum bandwidth specified in this paragraph shall be made with the frequency hop or step function disabled and with the transmitter operating continuously at a fundamental frequency. The video bandwidth of the measurement instrument shall not be less than RBW. The limit on peak emissions applies to the 50 MHz bandwidth centered on the frequency at which the highest level radiated emission occurs. If RBW is greater than 3 MHz, the application for certification shall contain a detailed description of the test procedure, the instrumentation employed in the testing, and the calibration of the test setup.

(5) Radiated emissions at or below 960 MHz shall not exceed the emission levels in Section 15.209 of this part.

(6) Emissions from digital circuitry used to enable the operation of the transmitter may comply with the limits in Section 15.209 of this chapter provided it can be clearly demonstrated that those emissions are due solely to emissions from digital circuitry contained within the transmitter and the emissions are not intended to be radiated from the transmitter's antenna. Emissions from associated digital devices, as defined in Section 15.3(k) of this chapter, *e.g.*, emissions from digital circuitry used to control additional functions or capabilities other than the operation of the transmitter, are subject to the limits contained in Subpart B of Part 15 of this chapter. Emissions from these digital circuits shall not be employed in determining the -10 dB bandwidth of the fundamental emission or the frequency at which the highest emission level occurs.

(c) Measurement procedures:

(1) All emissions at and below 960 MHz are based on measurements employing a CISPR quasi-peak detector. Unless otherwise specified, all RMS average emission levels specified in this section are to be measured utilizing a 1 MHz resolution bandwidth with a one millisecond dwell over each 1 MHz segment. The frequency span of the analyzer should equal the number of sampling bins times 1 MHz and the sweep rate of the analyzer should equal the number of sampling bins times one millisecond. The provision in Section 15.35(c) of this part that allows emissions to be averaged over a 100 millisecond period does not apply to devices operating under this section. The video bandwidth of the measurement instrument shall not be less than the resolution bandwidth and trace averaging shall not be employed. The RMS average emission measurement is to be repeated over multiple sweeps with the analyzer set for maximum hold until the amplitude stabilizes.

(2) The peak emission measurement is to be repeated over multiple sweeps with the analyzer set for maximum hold until the amplitude stabilizes.

(3) For transmitters that employ frequency hopping, stepped frequency or similar modulation types, the peak emission level measurement, the measurement of the RMS average emission levels, the measurement to determine the center frequency, and the measurement to determine the frequency at which the highest level emission occurs shall be made with the frequency hop or step function active. Gated signals may be measured with the gating active. The provisions of Section 15.31(c) of this part continue to apply to transmitters that employ swept frequency modulation.

(4) The -10 dB bandwidth is based on measurement using a peak detector, a 1 MHz resolution bandwidth, and a video bandwidth greater than or equal to the resolution bandwidth.

(5) Alternative measurement procedures may be considered by the Commission.

6. Section 15.515 is amended by adding a new paragraph (g), to read as follows:

Section 15.515 Technical requirements for vehicular radar systems.

* * * * *

(g) The emission levels from devices operating under the provisions of this section that employ gated transmissions may be measured with the gating active. Measurements made in this manner shall be repeated over multiple sweeps with the analyzer set for maximum hold until the amplitude stabilizes.

7. Section 15.521 is amended by revising paragraph (d), to read as follows:

Section 15.521 Technical requirements applicable to all UWB devices.

* * * * *

(d) Within the tables in Sections 15.509, 15.511, 15.513, 15.515, 15.517, and 15.519, the tighter emission limit applies at the band edges. Radiated emission levels at and below 960 MHz are based on measurements employing a CISPR quasi-peak detector. Radiated emission levels above 960 MHz are based on RMS average measurements over a 1 MHz resolution bandwidth. The RMS average measurement is based on the use of a spectrum analyzer with a resolution bandwidth of 1 MHz, an RMS detector, and a 1 millisecond or less averaging time. Unless otherwise stated, if pulse gating is employed where the transmitter is quiescent for intervals that are long compared to the nominal pulse repetition interval, measurements shall be made with the pulse train gated on. Alternative measurement procedures may be considered by the Commission.

* * * * *

Appendix B
Comments and Reply Comments Filed in Response to the Further Notice of Proposed Rule Making

Comments:

1. Delphi Automotive Systems Corporation ("Delphi")
2. James Page
3. Multispectral Solutions, Inc. ("MSSI")
4. National Academy of Sciences' Committee on Radio Frequencies ("CORF")
5. Short Range Automotive Radar Frequency Allocation Group ("SARA")
6. Siemens VDO Automotive AG ("Siemens VDO")

Reply Comments:

1. Delphi Automotive Systems Corporation ("Delphi")
2. James Page
3. Multispectral Solutions, Inc. ("MSSI")
4. Northrop Grumman Corporation and Raytheon Company ("Northrop Grumman and Raytheon")
5. Satellite Industry Association ("SIA")
6. Siemens VDO Automotive AG ("Siemens VDO")
7. XM Radio and Sirius Radio Inc. ("XM and Sirius")
8. XtremeSpectrum, Inc. ("XSI")

STATEMENT OF
CHAIRMAN MICHAEL K. POWELL

Re: Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems

This Commission has dedicated itself to incubating new technologies like ultra-wideband. Today we take additional steps to facilitate deployment of this groundbreaking and paradigm busting technology. Nearly two years ago we first adopted rules to permit several categories of ultra-wideband devices to operate under our Part 15 rules for use by consumers and non-Federal Government entities, including: imaging systems, vehicular radars, and indoor and outdoor communications systems.

Today, we amend our Part 15 non-UWB regulations to permit the use of peak emissions levels, similar to the levels applied to UWB devices. This will in turn provide greater flexibility for the introduction of new wide-bandwidth devices and systems. These new devices include radar systems to improve automotive safety and tracking systems for personnel location, such as hospital patients and emergency rescue crews, as well as for functions such as inventory control. Ultimately, this action will provide greater flexibility in the traditional Part 15 rules to facilitate the introduction of new equipment designs, a wider variety of products and increase consumer choices.