Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C.

In the Matter of	)	
	)	
Revision of Part 15 of the Commission's	)	ET Docket 98-153
Rules Regarding Ultra-Wideband	)	
Transmission Systems	)	
	)	

COMMENTS OF SIRIUS SATELLITE RADIO INC.

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SUMMARY

Sirius Satellite Radio Inc. ("*Sirius*") is concerned that the Commission's proposals to allow for the deployment of devices using ultra-wideband technology ("*UWB*") will cause significant harmful interference to existing licensed services, including satellite digital audio radio services ("*SDARS*"). Although Sirius supports the Commission's desire to make UWB devices with important public safety benefits available, until the Commission has the information necessary to make a rational prediction about the full range of characteristics of potential UWB devices and the interference impacts that these devices may have on existing licensed systems, the Commission cannot, consistent with its obligations under the Communications Act, amend its rules to allow deployment of these undefined, undescribed and undeveloped UWB devices.

When Sirius begins operations later this year, Sirius will deliver 100 channels of programming to its listeners nationwide, including those listeners in under- and unserved communities. The launch of SDARS service will bring to fruition a decade of Commission effort to bring the many benefits of SDARS to U.S. consumers and to protect this service from harmful interference both domestically and internationally. The Commission should not undermine years of effort by permitting the deployment of UWB devices without careful and complete analysis of the new and unique interference potential posed by UWB devices.

The Commission's assumption in the NPRM that UWB devices can operate above 2.0 GHz without causing harmful interference to licensed systems is unsupported: the harmful interference concerns for the services that occupy the Part 15 restricted frequencies below 2.0 GHz that the Commission identifies in its NPRM also exist for the services that occupy the Part 15 restricted frequencies between 2.0 and 2.9 GHz. In order to protect all of

these licensed systems, therefore, a cut-off of at least 2.9 GHz is a more appropriate level above which to allow UWB operations. An exception to this cut-off may be appropriate for ground penetrating radar and through-wall imaging devices, however, so long as appropriate testing is done to ensure that these radar uses of UWB technology do not disrupt important, existing systems such as GPS and SDARS.

In order to deal most efficiently with the vast array of UWB applications potentially available, yet not unduly delay important uses of UWB technology, the Commission should proceed in stages and enact regulations that permit UWB technology to be used for specific applications as information on each specific application becomes available.

While insufficient information currently exists about UWB devices to allow for a meaningful and accurate response regarding the appropriate emission limits for UWB devices, Sirius notes that information about the emission limit necessary to protect the SDARS services from harmful interference is currently available to the Commission and has been thoroughly vetted, both by the Commission itself and internationally. This established limit of –154 $dBW/m^2/4kHz$ is appropriate for and should be applied to any new UWB device, whether operating inside or outside SDARS spectrum.

Regardless of the portion or portions of the spectrum in which the Commission eventually permits UWB devices to operate, a crucial first step is a definition of "UWB device" that allows existing services to predict and measure potential interference. Affected parties must have a specific quantitative definition of a UWB devices – based on specific UWB applications – in order to provide the Commission with any meaningful comments on the potential for harmful interference. Furthermore, the Commission's proposal to regulate UWB devices on an unlicensed basis under Part 15 makes the need for a workable definition of these devices even

more acute, as important safeguards normally present in the licensing process – the ability of potentially affected services to receive advance notice of the proposed use and to comments on such proposals – are absent in the Part 15 certification process. Given these concerns, a more appropriate approach to regulation of UWB devices is for the Commission to regulate most UWB devices on the basis of blanket licenses.

Regardless of the regulatory approach that the Commission ultimately adopts, the Commission must ensure that accurate measurement procedures are developed for each proposed UWB application. The measurement procedures currently proposed by the Commission in the NPRM, however, will likely not provide an accurate picture of the interfering character of the UWB signal.

Finally, the Commission has clearly and correctly recognized the need for, and importance of, thorough testing and analysis of UWB devices and their potential effects on other systems. Currently four such measurement efforts are underway to assess the potential for electromagnetic compatibility between proposed UWB devices and existing radiocommunications devices. The Commission must allow sufficient time for such testing and analysis to take place, and to allow interested parties to comment on the results. The Commission must also ensure that adequate tests are preformed to assess the impact of UWB devices on all existing systems, not just GPS. The burden is on the proponents of UWB technology, who propose to operate on a non-interference basis, to show that devices utilizing this new technology will not cause harmful interference with existing licensed services, and any Commission action to modify its rules to allow for the deployment of UWB devices must therefore wait until the proponents of specific UWB devices have met their burden.

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Sirius Satellite Radio Inc. ("*Sirius*") hereby submits the following comments in response to the Commission's Notice of Proposed Rulemaking ("*NPRM*") in the above-captioned proceeding. Satellite CD Radio, Inc., a wholly-owned subsidiary of Sirius, is the holder of a license awarded by the Commission to provide a satellite digital audio radio service in a portion of the S-band.

As the Commission is well aware, Sirius stands poised to initiate service to consumers in the new satellite digital audio radio service ("*satellite DARS*" or "*SDARS*") at the end of this year, well in advance of the milestones required by the Commission. With the launch later this Fall of Sirius-3, which will complete Sirius' three-satellite constellation, Sirius will begin broadcasting 100 channels of continuous, nationwide radio programming with digital-quality sound to consumers across the country, including rural and other underserved areas, where such audio-program diversity is currently unavailable. As a nascent service, Sirius has a special interest in the Commission's proposals in the NPRM to amend Part 15 of its rules to allow for the deployment of devices using ultra-wideband ("*UWB*") technology. Sirius has real concerns that the Commission's proposals will cause significant harmful interference to Sirius' licensed service, which depends on extremely sensitive, wideband receivers with omni-

directional antennas. Although Sirius supports the Commission's desire to make available devices with important public safety benefits, such as ground- and wall-penetrating radar, too many unknowns still surround other, undefined UWB devices, particularly those used for communications applications. Until the Commission has the information necessary to make a rational prediction about the full range of characteristics of potential UWB devices and the interference impacts that these devices may have on existing licensed systems, the Commission cannot, consistent with its obligations under the Communications Act, amend its rules to allow deployment of these undefined, undescribed and undeveloped UWB devices.

I. INTRODUCTION

Satellite DARS technology offers high quality digital radio signals to subscribers through the use of satellites and terrestrial repeaters. The Sirius system is designed to provide seamless signal coverage throughout the contiguous United States, including previously under- and unserved areas of the nation, and clear reception in most areas despite variations in terrain, buildings, and other obstructions. Unlike current FM radio broadcasts, which have an average range of only approximately 30 miles, Sirius listeners will almost always be within its broadcast range.

The Commission first initiated its inquiry on satellite DARS nearly ten years ago.[1] Seven years later, in 1997, the Commission capped its efforts to set aside spectrum for satellite DARS by allocating the portion of the S-band located between 2320 MHz and 2345 MHz

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[1] *See Amendment of the Commission's Rules with Regard to the Establishment and Regulation of New Digital Audio Radio Services, Notice of Inquiry*, 5 FCC Rcd. 5237 (1990).

exclusively for satellite DARS.[2] The Commission made this domestic allocation in accordance with the international allocation that the Commission helped to secure at the 1992 World Administrative Radio Conference (WARC-92).[3] Also in 1997, the Commission opened the newly-allocated SDARS spectrum to competitive bidding and ultimately awarded two licenses to the winning bidders:[4] one to Sirius, through its subsidiary Satellite CD Radio, Inc., for $83.3 million,[5] and the other to XM Satellite Radio Inc. (then American Mobile Radio Corporation) for $89.8 million.[6]

Sirius' license authorizes it to construct, launch, and operate a satellite system providing satellite DARS to subscribers using 12.5 MHz of bandwidth in the 2320.0-2332.5 MHz band.[7] Although this license does not require Sirius to begin operation of its first satellite until October 2001, Sirius met this milestone in July 2000 and expects to initiate service with its full, three-satellite constellation at the end of this year. Sirius successfully launched the first two of its three planned in-orbit satellites on June 30 and September 5, 2000. Sirius' third satellite is scheduled for launch in Fall 2000, and a fourth on-ground spare satellite is scheduled for

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[2] *See Establishment of Rules and Policies for the Digital Audio Radio Satellite Service in the 2310-2360 MHz Frequency Band, Report and Order, Memorandum Opinion and Order and Further Notice of Proposed Rulemaking*, 12 FCC Rcd. 5754 (1997).

[3] *See* International Telecommunications Union, *Final Acts of the World Administrative Radio Conference* (Malaga-Torremolinos, 1992) ("*Final Acts*").

[4] *See FCC Announces Auction Winners for Digital Audio Radio Service, Public Notice*, 12 FCC Rcd. 18727 (1997).

[5] *See Satellite CD Radio, Inc., Application for Authority to Construct, Launch and Operate Two Satellites in the Satellite Digital Audio Radio Service, Order and Authorization*, 13 FCC Rcd. 7971 (1997) ("*Satellite CD Radio Authorization*").

[6] *See American Mobile Radio Corporation, Application for Authority to Construct, Launch and Operate Two Satellites in the Satellite Digital Audio Radio Service, Order and Authorization*, 13 FCC Rcd. 8829 (1997).

[7] *Satellite CD Radio Authorization*, 13 FCC Rcd 7971.

completion in 2001.[8] Thus, Sirius expects to be in full operation of its satellite system nearly three years ahead of the Commission-mandated milestone.[9]

Sirius has also completed the construction of its national broadcast studios, which are located in New York City. The national broadcast studios include twenty recording studios and two live performance studios, and have been designed to support the live transmission of video and audio performances in any medium. The national broadcast studios also house Sirius' corporate headquarters and music library, as well as tracking, telemetry, and control facilities for Sirius' satellites.

Currently, satellite DARS systems are designed primarily as a service for motorists. By the end of this year, consumers will be able to receive Sirius Radio by installing specially designed radio receivers in their existing vehicles. In addition, beginning in 2001, consumers purchasing new vehicles will be able to receive Sirius broadcasts through a new generation of radios factory-installed by Ford, DaimlerChrysler, BMW and other automobile manufacturers. Sirius will offer subscribers 50 commercial-free music channels and up to 50 additional channels of news, sports and entertainment programming.

In addition to the exciting news and entertainment services for consumers, the Commission has recognized on numerous occasions that satellite DARS will have public interest benefits as well. Satellite DARS will deliver programming to under- and unserved communities

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[8] Sirius has applied to the Commission to modify its constellation to three satellites in geosynchronous orbit. *See Satellite CD Radio, Inc., Application to Modify Authorization to Launch and Operate a Digital Audio Radio Satellite Services in the 2320.0 – 2332.5 MHz Frequency Band* (filed Dec. 11, 1998); *see also Satellite Policy Branch Information Applications Accepted for Filing, Public Notice*, Report No. SAT-00009 (Jan. 7, 1999) (accepting Satellite CD Radio, Inc.'s application for filing and assigning file number SAT-MOD-19981211-00099). Sirius anticipates that this pending request will be granted soon.

and will "reduce the proportional discrepancy in the geographic distribution of radio service."[10] Sirius will be able to provide its 100-channel lineup to the approximately 45 million underserved consumers in the United States, who live in areas that currently receive only a small number of FM stations.[11] The Commission has also noted that because the nationwide scope of SDARS allows it to reach small, nationally-dispersed listener groups that cannot otherwise be profitably served, SDARS providers such as Sirius will be able to offer niche programming in addition to more diverse program formats.[12] Indeed, among the 100 channels offered by Sirius will be niche and ethnic program formats, many of which are not currently available on AM or FM radio even in the largest markets.[13]

The Commission has expended considerable effort to bring the many benefits of satellite DARS to U.S. consumers. Domestically, the Commission conducted numerous proceedings to allocate and license SDARS spectrum in the United States and to establish rules for this new service. The Commission has also consistently sought to protect satellite DARS

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[9] *See Satellite CD Radio Authorization*, 13 FCC Rcd 7971, ¶ 62 (ordering Sirius to launch and begin operating at least one space station within four years, and/or be in full operation of its satellite system within six years of license grant).

[10] *Establishment of Rules and Policies for the Digital Audio Radio Satellite Service in the 2310-2360 MHz Frequency Band, Report and Order, Memorandum Opinion and Order, and Further Notice of Proposed Rulemaking*, FCC 97-70, 12 FCC Rcd. 5754, ¶ 12 (1997) ("*DARS Order*").

[11] Of the more than 45 million people aged 12 and over who live in areas with limited radio station coverage, approximately 22 million people receive five or fewer FM stations, 1.6 million receive only one FM station, and at least one million people receive no FM stations.

[12] *DARS Order*, 12 FCC Rcd. 5754, ¶ 12-15 (observing that counties with smaller populations have fewer radio stations and that smaller markets have fewer radio formats).

[13] For example, Sirius Radio programming will include individual channels devoted exclusively to children's programming, soundtracks, world music, opera, sports, and Spanish-language music and news, as well as dozens of other niche and specialty programs.

from harmful interference from other FCC-licensed radio services.[14] Internationally, the Commission and the U.S. delegation to the ITU engaged in a contentious battle to allocate spectrum internationally for use by SDARS in the U.S. Also, the Commission recently participated in two years of difficult negotiations with Mexico to reach an agreement, similar to one previously negotiated with Canada, to coordinate the SDARS use of the allocated portion of the S-band in the U.S.[15] The Commission should not undermine years of domestic and international efforts by permitting the deployment of UWB devices without careful and complete analysis of the new and unique interference potential posed by UWB devices.

Sirius does not dispute that UWB technology shows promise for many devices with significant benefits for public safety, consumers, and businesses. Ground penetrating radar ("*GPR*") and through-wall imaging devices, which are highlighted in the NPRM, are examples of two such UWB devices that have the potential to increase public safety. Sirius supports the use of these imaging devices in conformance with appropriate Commission rules, and understands the Commission's desire to find a way to permit these UWB imaging devices to be deployed. The scope of the NPRM, however, goes well beyond these imaging devices,

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[14] *See, e.g., Amendment of the Commission's Rules to Establish Part 27, the Wireless Communications Services* ("WCS"), *Memorandum Opinion and Order*, FCC 97-112, 12 FCC Rcd. 3977, ¶ 27 (rel. Apr. 2, 1997) ("We also recognize that the 2320-2345 frequency band is the only spectrum specifically available for provision of Satellite DARS in the United States. Accordingly, if Satellite DARS in this spectrum is subject to excessive interference, the service will not be successful and the American public will not benefit from the service.").

[15] *See Agreement Between the Government of the United States of America and the Government of the United Mexican States Concerning the Use of the 2310-2360 MHz Band* (July 24, 2000) ("*U.S.-Mexico DARS Agreement*"); Letter from Michael Binder, Assistant Deputy Minister, Spectrum, Information Technologies and Telecommunications, Industry Canada to Ambassador Vonya B. McCann, U.S. Coordinator and Deputy Assistant Secretary, International Communications and Information Policy, U.S. Department of State (August 25, 1998); *see also United States and Canada Agree on Conditions for Implementation of U.S. Satellite Digital Audio Radio Services (DARS) and Canadian Terrestrial Digital Radio*

embracing unknown, undescribed and as yet undeveloped applications of UWB technology, particularly as regards communications-related applications. UWB technology is not fully defined – or even capable of accurate measurement – at this time, and a great deal of further testing and analysis is needed before the Commission and affected parties can fully understand the effects of the full range of UWB technology on existing, licensed services. Indeed, the Commission itself has observed as much in the NPRM.[16]

Sirius recognizes the challenge the Commission faces in attempting to balance its desire to make important new public safety devices available in a timely fashion with the need for careful planning to protect existing services – many of which have important public safety and public interest components of their own – from harmful interference. However, the Commission must nevertheless ensure that its desire to bring the public the benefits of this new technology does not effectively deny the public the benefits of previously licensed services. Until UWB technology is better understood, the rule changes proposed in this NPRM threaten to do just that.

II. THE COMMISSION SHOULD GENERALLY LIMIT UWB OPERATIONS TO SPECTRUM ABOVE 2.9 GHZ

A. THE COMMISSION'S ASSUMPTION THAT UWB DEVICES CAN OPERATE ABOVE 2.0 GHZ WITHOUT CAUSING INTERFERENCE IS INCORRECT; MOST UWB OPERATIONS CAN AND SHOULD BE RESTRICTED TO SPECTRUM ABOVE 2.9 GHZ

The Commission should limit all UWB operations except for certain ground- and wall-penetrating radar applications to spectrum above 2.9 GHz. In the NPRM, the Commission clearly voices its concern that the operation of UWB devices in the region of the spectrum below

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Broadcast Services (T-DRB) along the U.S./Canada Border Area, Report No. IN 98-50, *News Release* (September 3, 1998).

[16] NPRM at ¶ 1.

approximately 2.0 GHz will result in harmful interference with important communications and public safety operations, including GPS.[17] As part of the NPRM, the Commission sets forth three factors it believes should be considered in addressing which frequency bands should be made available for UWB devices: (1) protecting critical safety systems operating in the restricted frequency bands, including GPS operations, from interference, (2) a consideration of the unique spectrum attributes and requirements for each of the broad variety of potential UWB applications, and (3) the different propagation characteristics of the various regions of the spectrum.[18] An evaluation of these three factors indicates that a more appropriate cut-off frequency based on these factors is at least 2.9 GHz.

1. Protecting Critical Systems Operating in Restricted Bands

The Commission is fully cognizant of the importance of ensuring that critical safety systems operating in the restricted frequency bands, including GPS, be protected from interference.[19] However, the Commission should ensure that all systems operating in the Part 15 restricted bands receive protection from interference. It would be an unwise departure from current Commission rules to allow for the deployment of systems in bands in which Part 15 intentional transmissions are not currently allowed without a full understanding of the impact of UWB devices on the current operations in those bands. As the record in this proceeding indicates,[20] and the proponents of UWB have admitted,[21] UWB devices operating at lower

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[17] NPRM at ¶ 28.

[18] NPRM at ¶ 24.

[19] *Id.*

[20] NPRM at ¶ 23 & n. 55 (citing comments filed in *NOI* proceedings).

[21] *See, e.g.*, Comments of the Ultra-Wideband Working Group, ET Docket 98-153, at 10 (filed December 7, 1998) ("*UWB Working Group Comments*"); Comments of Time Domain Corp., ET Docket 98-153, at 37 (filed December 7, 1998) ("*Time Domain Comments*").

frequencies generally cannot avoid transmitting within the Commission's Part 15 restricted bands. The risk of harmful interference to systems operating in these bands, coupled with the apparent difficulty of using filters to limit emissions in restricted bands,[22] dictates that the restricted bands be kept clear of UWB operations until such time that the impact of UWB devices on the systems in the restricted bands can be fully understood.[23]

In addition, the aggregate effect of multiple UWB devices on victim systems is unknown at this time. The Commission has tentatively concluded that the cumulative impact of multiple UWB devices appears to be negligible and that only the closest transmitter placing an emission on the frequency of concern is of importance.[24] However, the aggregate impact cannot be fully realized at this time because of the lack of knowledge regarding the types of UWB devices that may used and their deployment. For example, a communications system using UWB technology would most likely consist of many devices located in close proximity to each other. The interference from multiple UWB devices will impact on receiving systems in two ways: (1) an overall increase in the noise floor, which is detrimental to noise-limited applications, such as SDARS, and (2) the addition of multiple high-powered pulses, each of which will not occur at the same time and may be on different frequencies, resulting in many high-powered pulses occurring continuously across much of the victim receiver's bandwidth.

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[22] *See* NPRM at ¶ 23 (noting Time Domain's opposition to the use of filters).

[23] *See* NTIA, *Ultra-Wideband Signals for Sensing and Communication: A Master Plan for Developing Measurement Methods, Characterizing the Signals and Estimating Their Effects on Existing Systems*, at 2, June 15, 2000 ("*NTIA Master Plan*") (noting that "the NTIA and the FCC need a comprehensive program that fully describes the UWB signals and determines their effects over a wide range of parameters in many potential victims" in order to "establish a policy that will allow UWB devices to operate without causing [harmful] interference to presently and futurely authorized and licensed systems").

[24] NPRM at ¶ 47.

While these considerations confirm the Commission's tentative conclusion that UWB operations should be prohibited from operating in the Part 15 restricted bands below 2.0 GHz, they also argue for a higher cut-off frequency than the 2.0 GHz proposed in the NPRM. A number of important services that are susceptible to interference from UWB devices operate above 2.0 GHz. NASA's Tracking and Data Relay Satellite Systems and the Air Force's Space Ground Link Subsystem both use the 2200-2290 MHz band for important satellite downlinks for space science and other government operations. NASA also uses the 2290-2300 MHz band as its primary Deep Space Network band for telemetry data from probes outside Earth's orbit. Of course, Sirius and the other SDARS licensee are licensed to use the 2320-2345 MHz band. Other sensitive services include the planetary research conducted at Arecibo Observatory in the 2380 MHz band, the space research (passive) uses at 2690-2700 MHz, and the airport surveillance radars and weather radars at 2700-2900.

With respect to Sirius' operations in the 2330 MHz band, the interference impact posed to Sirius from UWB devices is technically similar in many respects to the impact on GPS operations. The Commission recognizes in the NPRM that UWB devices, in general, pose a significant risk to GPS operations.[25] The Commission's concerns about GPS are valid; however, many of the same concerns that it has about UWB signals' effects on GPS systems are also true for Sirius' system. For example, Sirius' signals, like GPS signals, are satellite signals, which are, by nature, less powerful at the earth's surface than most terrestrial wireless applications. Therefore, both Sirius' system and GPS applications use extremely sensitive receivers to receive their satellite downlink signals. Similarly, both Sirius and GPS are mobile applications that use omni-directional antennas, which have less ability to reject interference than directional

[25] NPRM at ¶ 28.

antennas. Indeed, the Commission has recognized that GPS receivers are used in a multitude of mobile environments, including individuals, boats and motor vehicles, mobile radio E-911 services and airplanes.[26] Similarly, Sirius' services are highly mobile, extending throughout the entire contiguous United States ("*CONUS*"), and are intended to be used in a number of highly mobile applications – in cars, trucks, and other vehicles – while in motion. Furthermore, Sirius' system utilizes a wideband downlink carrier. This system configuration enables Sirius to provide the great breadth of services that it will offer across its CONUS footprint, but this wideband configuration is more susceptible to the interference that UWB applications may produce than many terrestrial wireless applications, which themselves are higher power, narrowband applications.

Thus, the harmful interference concerns that the Commission identified for the services that occupy the Part 15 restricted frequencies below 2.0 GHz also exist for the services that occupy the Part 15 restricted frequencies between 2.0 and 2.9 GHz.[27] Accordingly, a cut-off frequency of at least 2.9 GHz is a more appropriate level above which to allow UWB operations.

2. Unique Spectrum Attributes and Requirements for each UWB Application

The second factor that the Commission has indicated should be considered in making frequency bands available to UWB devices is the "broad variety of potential applications for UWB technology, each of which has unique spectrum attributes and requirements."[28] Certainly, the Commission should consider the unique attributes and requirements of each UWB application in order to make appropriate spectrum assignments. However, this factor highlights

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[26] NPRM at ¶ 28.

[27] The list of Part 15 restricted frequency bands, in which only spurious emissions are permitted, include a number of frequency bands between 2.0 and 2.9 GHz, including the 2200-2300 MHz, 2310-2390 MHz, 2483.5-2500 MHz, and 2655-2900 MHz bands.

Sirius' concern that not enough information is currently known about UWB technology, its potential applications, and its expected deployment to enable the Commission to make appropriate decisions.

Of the "broad variety" of potential UWB applications that the Commission believes exists, only two such applications are discussed in any detail in the NPRM: GPR and through-wall imaging devices. While the NPRM mentions a multitude of other potential UWB devices, there is very little discussion in the NPRM about the specific spectrum attributes or requirements of these devices. What little discussion there is indicates that the technical characteristics of UWB devices vary wildly, depending upon the intended application.[29] In addition, as the NPRM makes clear, there is currently no settled definition as what qualifies as "UWB," nor can UWB transmissions or their effect on other systems currently be accurately measured.[30]

The Commission needs more complete information about UWB devices – both current and potential – and their effect on licensed systems in order to be able to enact regulations that will allow for the efficient introduction of UWB devices into the marketplace. However, in order not to unduly delay important uses of UWB technology, the Commission should proceed in stages – enacting regulations that permit UWB technology to be used for specific applications as information on each specific application become available. Such an approach is dictated by the fact that there is a "vast array"[31] of potential uses for UWB technology with varying characteristics, many of which have not currently been defined or even

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[28] NPRM at ¶ 24.

[29] See NPRM at ¶ 13 (discussing the general characteristics of UWB).

[30] See NTIA Master Plan at § 2.

[31] NPRM at ¶ 7.

conceived. The Commission should not delay regulation that would permit clearly defined applications of UWB technology with important public safety benefits, such as GPR and through-wall imaging devices, while attempting to find a one-size-fits-all standard for UWB devices that is appropriately protective of existing services across a wide band of spectrum or to analyze the potential aggregate effects of devices that are not even in existence yet.

Not only would attempting to fashion a single definition or standard for UWB devices delay the introduction of GPR and through-wall imaging devices, but such a unitary definition and standard – even if ultimately found – would likely be overly restrictive of GPR and through-wall imaging devices because of the need to account for other, more ubiquitous and less directional UWB applications. Thus, a staged approach to regulating the introduction of UWB devices, as their unique attributes and requirements become known, is prudent. Of course, it is easier for the Commission to authorize additional UWB applications as they become known than to try to mitigate interference from UWB devices that have been authorized after these devices are in widespread use.

3. Propagation Characteristics of Various Regions of the Spectrum

The Commission asserts in the NPRM that "UWB devices can generally operate in the region of spectrum above approximately 2 GHz without causing harmful interference to other radio services."[32] This conclusion is based on the assumption that UWB signals "will quickly fall off below the background noise because of high propagation losses at 2 GHz and above,"[33] and that radio services operating above 2 GHz use directional antennas that generally

[32] NPRM at ¶ 27.

[33] *Id.*

discriminate against the reception of undesired signals.[34] However, neither of these factors is applicable to SDARS operations at 2320-2345 MHz.

While the various regions of the spectrum have different propagation characteristics, as noted in the Commission's third factor, the propagation characteristics of the spectrum between 2.0-2.9 GHz do not vary markedly from that at 2.0 GHz. In fact, the propagation losses at 2.3 GHz, where Sirius' services are located, are only 1.2 dB higher than those at 2 GHz. This small additional path loss will not result in any significant reduction of interference to an SDARS system at 2.3 GHz in comparison with systems operating at 2.0 GHz.

In addition, the assumption that radio services above 2 GHz use directional antennas is unsupported. Sirius receivers employ antennas that are essentially omni-directional, rather than the directional antennas assumed by the Commission to be in use above 2 GHz,[35] and offer very little discrimination against the reception of undesired signals in the SDARS band.

Sirius' operations at 2.3 GHz depend on extremely sensitive, wideband receivers. Based on the similarity in propagation losses at 2.3 GHz and 2 GHz, and Sirius' need to use receivers with omni-directional antennas for its mobile service, the risk of interference from UWB devices into SDARS operations is substantially similar to that faced by systems at 2.0 GHz and below. Thus, the cut-off frequency proposed by the Commission should be raised to at least 2.9 GHz because the same concerns raised by the Commission with respect to operations below 2.0 GHz are also present in the 2.0 - 2.9 GHz frequency range.

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[34] *Id.*

[35] *Id.*

B. ANY EXCEPTION FOR GROUND- AND WALL-PENETRATING RADARS SHOULD ENSURE THAT THESE DEVICES ARE CLEARLY DEFINED AND OPERATE AT FREQUENCIES BELOW 2.0 GHZ

In the NPRM, the Commission tentatively proposes to allow GPR, and perhaps through-wall imaging devices, to operate at frequencies below 2 GHz. Unlike other UWB devices, the Commission proposes reasonably precise, workable definitions for both GPR and through-wall imaging devices, and the spectrum attributes and requirements for such systems.[36] However, appropriate testing must be done to ensure that these radar uses of UWB technology do not disrupt important, existing systems such as GPS and radio astronomy. Should such testing indicate that GPRs and through-wall imaging devices are, with appropriate limitations, compatible with currently licensed systems, Sirius agrees with the Commission's proposal to allow GPR and through-wall imaging devices to operate on frequencies below the cut-off frequency.

However, the NPRM contains a contradiction concerning the characteristics of GPR and through-wall devices. The Commission states that GPRs "must operate at frequencies in the region below 2 GHz" in order to be able to work effectively,[37] yet then proposes "to allow GPRs to operate in any part of the spectrum."[38] If GPRs and other radar devices, such as through-wall imaging devices, can only operate effectively at frequencies below 2 GHz, as the Commission suggests, then their operations should be restricted to those frequencies to reduce any potential impact on existing services in other frequency bands.

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[36] NPRM at ¶ 25

[37] *Id.*

[38] *Id.*

III. APPROPRIATE EMISSION LIMITS FOR UWB DEVICES

In the NPRM, the Commission seeks comments on the appropriate emission limits for UWB devices. However, information essential to answering that question is simply not available at this time. The basic question of how UWB transmissions are defined remains open and subject to much debate, and the NTIA has stated unequivocally that accurate and repeatable methods of measuring UWB transmissions and their effects on other systems have yet to be developed.[39] Until these basic issues are resolved, any attempt to respond definitively with a specific emission limit for all UWB applications is not practical or useful.

Nonetheless, information about the emission limits necessary to protect the Sirius Radio system from harmful interference is currently available to the Commission, and has been thoroughly vetted – not only by the Commission itself, but also internationally. The Commission has successfully negotiated with the Mexican and Canadian governments that the allowable interfering power flux density from their terrestrial microwave relays into Sirius and XM SDARS mobile receivers must not exceed –154 $dBW/m^2/4kHz$.[40] This is based on a single interferor increasing the noise floor of SDARS receivers by 10%. The noise floor of the SDARS receivers are approximately 160° K as detailed in Sirius' application to the Commission.[41] This established interference criterion is appropriate for and should be applied to any new UWB systems whether operating inside or outside the SDARS spectrum.

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[39] *See* NTIA Master Plan at § 3.

[40] *See* U.S.-Mexico DARS Agreement, Appendix I.

[41] *See Application of CD Radio, Inc. for an All-Digital CD Quality Satellite Sound Broadcasting System*, File Nos. 49-DDS-P/LA-90, 50-DDS-P/LA-90 (1990).

IV. THE COMMISSION MUST MORE PRECISELY DEFINE "UWB DEVICE"

A. THE PROPOSED DEFINITION OF UWB IS TOO VAGUE AND MAKES ACCURATE PREDICTION OF INTERFERENCE IMPOSSIBLE

The Commission proposes to define a UWB device as "any device where the fractional bandwidth is greater than 0.25 or occupies 1.5 GHz or more of spectrum."[42] This proposed definition places few actual limitations on the types of applications that could be used and does little to limit the potential interfering signals from UWB devices. Consequently, the proposed definition makes it impossible to predict the actual interference environment that could result from this definition.

Regardless of the portion or portions of the spectrum in which the Commission eventually permits UWB devices to operate, a crucial first step is a definition of "UWB device" that allows existing services to predict and measure potential interference, both from a UWB device's in-band emissions or from the device's out-of-band or spurious emissions. Among other parameter values, the modulated waveform and the emission levels or the radiated power flux densities both in-band and out-of-band must be specified. In order to provide the Commission with any meaningful comments on the potential for harmful interference, commenters must have a specific quantitative definition of a UWB device – based on specific UWB applications – on which to base their technical analyses.

The NTIA has acknowledged the importance of establishing a workable definition of UWB to predict the effect of UWB on other systems, in its *Ultra-Wideband Signals for*

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[42] NPRM at ¶ 21. According to the NPRM, the fractional bandwidth is calculated using the following formula: $2(f_H-f_L)/(f_H+f_L)$ where f_H is the upper frequency of the -10 dB emission point and f_L is the lower frequency of the -10 dB emission point. The center frequency of the transmissions will be defined as the average of the upper and lower -10 dB points. Further, it is proposed that the bandwidth be determined using the antenna that is designed to be used with the UWB device. *Id.*

Sensing and Communication: A Master Plan for Developing Measurement Methods, Characterizing the Signals and Estimating Their Effects on Existing Systems. Task 1 in this Master Plan requires the NTIA to "examine the stated characteristics [of] typical or known UWB systems to identify UWB parameters that need to be defined and measured for use in interference and spectrum analyses" and "[i]dentify the basic or common characteristics of UWB pulses or signals needed to perform interference analyses or measurements, and spectrum efficiency studies."[43] As the NTIA correctly observes, until the parameters unique to UWB devices are defined and can be measured, no meaningful analyses of these devices or their effect on other systems is possible.

The need for a workable definition for these devices is even more acute because the Commission proposes to regulate UWB devices on an unlicensed basis under Part 15 of its rules.[44] Part 15 devices are not individually licensed; instead they merely receive certification before proceeding to market.[45] This means that an important safeguard normally present in the licensing process – the ability of potentially affected services to receive advance notice of the proposed use and to comment on such proposals – is absent in the case of Part 15 devices.

This could have potentially disastrous results. If the Commission fails to precisely define "UWB device," it may find itself in the position of certifying devices that have the potential to disrupt seriously already existing services, many of which have important public safety or public interest benefits. The extent of the interference may not be immediately

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[43] NTIA Master Plan, Task 1.

[44] NPRM at ¶ 17.

[45] 47 C.F.R. § 15.1.

apparent, but as a particular UWB device begins to proliferate in the marketplace,[46] the amount of interference (both from an individual device and their aggregate) would increase. At that point, however, the Commission would be hard-pressed to put the "genie back in the bottle."

B. MULTIPLE DEFINITIONS BASED ON INDIVIDUAL APPLICATIONS MAY BE PREFERABLE TO A SINGLE, OVERARCHING DEFINITION

Sirius suggests that one solution to finding a workable definition of "UWB device" is to define individual UWB applications – such as the NPRM has proposed for GPRs – rather than attempting to develop a single definition that attempts to encompass all present and future UWB devices under its rubric.

The comments received in this proceeding to date make it clear that the term "UWB device" encompasses an enormous number of potential applications with a wide variety of technical characteristics. As described in the NPRM, UWB devices include GPRs, which operate over short distances intermittently and infrequently, at very low powers, at frequencies below 2 GHz, to higher power devices operating at longer ranges.[47] New UWB applications may demonstrate even greater variety. For example, the "communications applications" that the Commission references briefly in the NPRM are likely to have technical characteristics that differ greatly from those of "radar applications." It is more appropriate to define each application individually. Furthermore, a definition that attempts to encompass all UWB devices may prove inadequate in light of future applications and may open the door to the introduction of devices that interfere with licensed systems.

The Commission's definition of GPR demonstrates the type of application-specific definition that Sirius supports. In the NPRM, the Commission states that it proposes to

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[46] *See* Comments of Oak Ridge National Laboratory, ET Docket 98-153, at 3 (noting that "literally millions of UWB devices" may be expected to be deployed).

define a GPR "as a UWB device that is designed to operate only when in contact with, or in close proximity (i.e., 1 meter) to, the ground for the purpose of detecting or obtaining the images of buried objects."[48] The Commission further proposed that GPRs be required "to include a switch or other mechanism to ensure that operation occurs only when it is activated by an operator and the unit is aimed directly at the ground."[49]

Based on the information available in the NPRM, Sirius concurs in substantial part with this proposed definition. Sirius suggests, however, that the specific operating characteristics of GPR devices, including radiated in-band and out-of-band power and modulation of waveform, be included in this definition. Hence, instead of merely referencing "UWB device" in the definition of GPR, the specific technical parameters of GPRs should be incorporated into the definition.

V. THE COMMISSION SHOULD REQUIRE BLANKET LICENSES FOR MOST UWB DEVICES RATHER THAN REGULATE SUCH DEVICES UNDER PART 15 OF ITS RULES

A general rule, the Commission's proposal to place most "very low power" UWB devices under Part 15 is problematic; a more appropriate approach is for the Commission to regulate most UWB devices on a secondary, licensed basis under a new or alternative rule part.

The Commission's proposal for Part 15 regulation suffers from a number of problems. One significant stumbling block to this approach is the lack of a reliable definition for a UWB device and the lack of reliable, accurate procedures to measure the attributes of UWB signals, as discussed in more detail below. Even "very low power" UWB devices, however "low power" is ultimately defined, may have technical characteristics that vary greatly and whose

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[47] *See* NPRM at ¶¶ 13-16.

[48] NPRM at ¶ 25.

impacts on other services, therefore, are completely different. These differences strongly suggest that a licensing procedure, in which device manufacturers are required to submit a formal application outlining specific technical parameters, is more appropriate. Such a procedure would give existing, licensed systems enough information to determine whether the proposed device might interfere with their existing services before the device comes on the market, and allow affected parties to work out a mutually acceptable arrangement to avoid harmful interference before the UWB application disrupts the licensed service.

Part 15 certification is also inappropriate for UWB devices because they differ so greatly from any previously allowed Part 15 devices. Furthermore, current Part 15 devices are prohibited from radiating in the restricted bands; only spurious emissions not exceeding the general emission limits are permitted in the restricted bands. However, the extraordinarily wide bandwidths of UWB devices mean that they will radiate across many bands. And because the definition of UWB is so imprecise, it is currently difficult to define what emissions are "out-of-band" or "spurious" for UWB devices.

Nonetheless, a number of UWB device manufacturers argue that Part 15 is appropriate so long as the UWB devices in question can operate below the general emission limits currently set in Part 15.[50] Again, even ignoring the problems that currently exist in accurately measuring UWB signals, the unique characteristics of UWB make any such a comparison between UWB emissions and the emissions of current Part 15 devices inapposite. Based on the limited information available from the NPRM, it appears likely that – unlike existing Part 15 devices – certain UWB devices, such as communications applications, will

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[49] *Id.*

[50] *See, e.g.*, UWB Working Group Comments at 11; Time Domain Comments at 31; Comments of XtremeSpectrum, Inc., ET Docket 98-153, at 6 (filed December 7, 1998).

create harmful interference with Sirius' service, *even if operating below the Part 15 emission limits.*

VI. THE MEASUREMENT PROCEDURES PROPOSED BY THE COMMISSION ARE INADEQUATE

The Commission states in the NPRM that it is important to develop measurement procedures that are "simple and straightforward and can apply to a wide range of UWB devices."[51] Sirius agrees. Indeed, reliable measurement procedures are necessary not only to measure the characteristics of UWB devices themselves, but also to measure their effect on other systems. However, the measurement procedures that the Commission outlines in its NPRM will likely not provide an accurate picture of the interfering character of the UWB signal. For example, the Commission proposes in the NPRM to measure the peak emission level of UWB signals directly in the time domain.[52] Assuming that appropriate equipment is readily available for these measurements, this approach may be part of an effective measurement regime. However, the waveform characteristics of the UWB signal in the frequency domain will have a critical impact on the interference impacts felt by victim receivers and must be included in any scheme used to measure the interfering nature of a UWB signal.

In addition, it may be impossible to develop a single set of measurement procedures that can apply to the "wide range" of potential UWB devices because the best method for measuring UWB signals may depend on the nature of the specific UWB application. This is especially true of UWB communications applications, which are not defined in the NPRM and whose characteristics are currently unknown.

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[51] NPRM at ¶ 49.

[52] NPRM at ¶ 52.

The NTIA Master Plan acknowledges some of the difficulties involved in measuring both the UWB signal characteristics and their effect on other devices. It is extremely difficult to measure noise-like devices, and UWB signals have very narrow pulses that will require new measurement techniques and equipment to ensure signal characteristics are measured accurately. Furthermore, as the Master Plan correctly observes, neither the interference effects of very narrow pulses with high repetition rates nor the aggregate effects of multiple UWB devices are well understood.[53]

The Commission's NPRM does not address the fact that accurate methods for measuring UWB signals or their effect on other devices do not yet exist. While the NTIA's Master Plan seeks to address this problem, the NTIA is still in the very early stages of developing accurate, repeatable measurement methods. Thus, the Commission must identify adequate measurement procedures for each proposed UWB application before it permits a specific UWB device to operate.

VII. THOROUGH TESTING AND ANALYSIS IS ESSENTIAL BEFORE THE COMMISSION ENACTS REGULATION

The Commission should not adopt any proposal to amend its rules to allow UWB devices to operate until the Commission and industry complete thorough testing and analysis of UWB devices and their potential effects on other systems. The Commission clearly recognizes the need for, and importance of, such tests, stating in the first paragraph of the NPRM that "[f]urther testing and analysis is needed before the risks of interference [from UWB devices] are completely understood."[54] Sirius concurs with this statement, and emphasizes that unless such testing demonstrates that UWB devices can operate without causing harmful interference to

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[53] NTIA Master Plan at § 2.

[54] NPRM at ¶ 1.

already licensed services, the Commission must ensure that the potentially interfering UWB devices are not allowed to be placed in service. Testing to measure the effects of UWB devices on GPS systems seems to be well underway, but the Commission must allow sufficient time for such testing and analysis to take place, as well as ensure that adequate tests are performed to assess the impact of UWB devices on other, non-GPS systems. As it indicates in the NPRM,[55] the Commission must also provide interested parties a real opportunity to comment on the results of all such tests before modifying its rules to allow UWB devices to be deployed.

There are currently four measurement efforts underway to assess the potential for electromagnetic compatibility between proposed UWB devices and existing radiocommunications devices: (1) the NTIA's GPS/UWB Measurement Plan,[56] (2) the NTIA's ITS Ultrawideband Measurement Plan,[57] (3) the Department of Transportation (DOT)/Stanford University (SU) UWB-to-GPS Measurement Effort,[58] and (4) Ultrawideband Consortium/Applied Research Laboratories of the University of Texas at Austin Tests for Measuring UWB/GPS Compatibility Effects.[59] However, at this point, it is unclear as to when these tests will be completed. Although the Commission has encouraged parties to submit test results into the record by October 30, 2000, based on the NTIA's initial GPS/UWB Operational

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[55] NPRM at ¶ 31.

[56] NTIA, *Measurement Plan to Determine the Potential Interference Impact to Global Positioning System Receivers from Ultrawideband Transmission Systems*, August 8, 2000 (http://www.ntia.doc.gov/osmhome/uwbtestplan/gpsuwbtp.htm) ("*NTIA GPS/UWB Measurement Plan*").

[57] NTIA, *ITS Ultrawideband Measurement Plan*, June 14, 2000.

[58] Ming, Lous, Dennis Akos, Sam Pullen, Per Enge, Stanford University, *Potential Interference to GPS from UWB Transmitters: Test Plan – Version 4.5 Phase 1: Accuracy Test for Aviation Receivers and Reacquisition Time Test for Land Receivers*, May 1, 2000.

[59] Applied Research Laboratories, The University of Texas at Austin, *Test Plan for Measuring UWB/GPS Compatibility Effects*, July 21, 2000.

Scenarios meeting on September 7, 2000, this ambitious timetable may be difficult to meet. Because of the importance of these tests, it is essential that the Commission remain committed to its plan to allow ample time for interested parties, such as Sirius, to view the results of these tests and comment on them before reaching any final decisions in this proceeding.

Moreover, additional testing may be required. None of the four studies currently underway adequately addresses the issue of potential interference on commercial, non-GPS systems, such as SDARS receivers. Only one plan – the ITS Ultrawideband Measurement Plan – focuses on victim receivers other than GPS systems at all, and this measurement effort calls for testing of only three or four victim receivers and is focused on receivers used by the federal government.[60] While the limitation of this study to governmental receivers is logical in light of the NTIA's mission and the scope of the plan, because federal government users do not currently use the SDARS service, SDARS receivers were not considered for testing. The technical characteristics of SDARS receivers are unique, however, given their sensitivity and wideband nature (e.g., -140 dBW noise floor and 4.3 MHz bandwidth), and the testing proposed by NTIA will not accurately predict the interference potential of UWB devices on SDARS receivers.

Furthermore, the NTIA Master Plan calls for only two to four UWB devices to be tested.[61] This is understandable because there are no more than a handful of UWB devices available for testing at this time. However, given the wide range of potential UWB applications and the "unique spectrum attributes and requirements"[62] of each application, the testing of two to

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[60] NTIA Master Plan, Task 6.

[61] NTIA Master Plan, Task 2.

[62] NPRM at ¶ 24.

four UWB devices does not begin to cover the universe of potential devices.[63] The dearth of UWB devices available also means that there is a limit to the testing that can be performed to assess the potential for aggregate interference from UWB devices.[64] Yet such testing is crucial, as multiple UWB transmission systems, which might be individually tolerated by a receiver, may combine to create an aggregate interference level that could preclude the reliable reception of the signal.

The burden is on the proponents of UWB technology, who propose, of course, to operate on a non-interference basis, to show that devices utilizing this new technology will not cause harmful interference to existing licensed systems. Thus, any Commission action to modify its rules to allow for the deployment of UWB devices must therefore wait until sufficient testing and analysis has been completed to ensure that UWB proponents have met this burden. Therefore, the early stage at which UWB applications are in their development counsels for a conservative, staged approach to regulatory implementation of these devices. Such an approach would allow for adequate testing of each UWB device or class of UWB devices as they are developed to ensure that UWB devices do not interfere with existing services.

VIII. CONCLUSION

Sirius understands the Commission's desire to investigate potential new, additional uses for allocated and licensed spectrum. Such investigation is part of the Commission's mandate to regulate the efficient use of the electromagnetic spectrum, and Sirius

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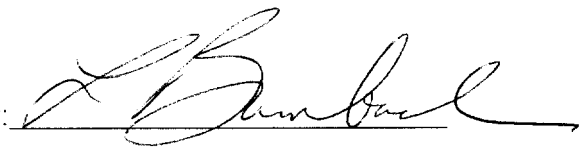
[63] The NTIA notes that "[i]deally, the range of UWB signal parameters should be representative of all anticipated UWB devices. However, because of the continuing development of the technologies involved in the design of UWB devices, a complete range of parameters is difficult to define and is nevertheless limited by the capability of the available UWB generators." NTIA GPS/UWB Measurement Plan.

[64] *See id.*

will not oppose new uses of its licensed spectrum that do not interfere with Sirius' current and future operations. However, the Commission's investigation must be full and thorough and allow ample opportunity for public notice and comment by affected spectrum licensees. In this proceeding, which involves a new technology wholly different in character than those previously permitted, the Commission must proceed conservatively, and perhaps in stages, as it considers permitting certain UWB applications to be deployed.

Respectfully submitted,

SIRIUS SATELLITE RADIO INC.

By: 

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