

BEFORE THE
Federal Communications Commission
Washington, D.C. 20554

In the Matter of)
)
Additional Spectrum for Unlicensed Devices)
Below 900 MHz and in the 3 GHz Band) IB Docket No. 02-380
)
)

To: The Commission

COMMENTS OF SATELLITE INDUSTRY ASSOCIATION

The Satellite Industry Association (“SIA”) submits the following comments in response to the Notice of Inquiry (“*Notice*”) in the above-captioned proceeding.¹

SIA is a U.S.-based trade association representing the leading U.S. and international satellite manufacturers, service providers, and launch service companies. SIA serves as an advocate for the commercial satellite industry on regulatory and policy issues common to its members. With its member companies providing a broad range of manufactured products and services, SIA represents the unified voice of the commercial satellite industry.²

¹ *Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band*, Notice of Inquiry, ET Docket No. 02-380, FCC 02-328 (Dec. 20, 2002) (“*Notice*”).

² SIA’s membership includes Executive Members The Boeing Company; Globalstar, L.P.; Hughes Network Systems, Inc.; ICO Global Communications; Intelsat; Lockheed Martin Corp.; Loral Space & Communications Ltd.; Mobile Satellite Ventures; Northrop Grumman Corporation; PanAmSat Corporation and SES Americom, Inc. and Associate Members Inmarsat and New Skies Satellites Inc.

I. BACKGROUND

SIA's members have a strong interest in this proceeding. The 3650-3700 MHz band comprises part of what is known as the "extended C-band" and has long been allocated to the Fixed-Satellite Service ("FSS"). This 50 megahertz of spectrum currently is used by SIA member companies for intercontinental satellite communications downlinks in the United States. In addition, U.S. satellite companies also use the band for critical tracking, telemetry and control ("TT&C") operations. The adjacent (standard) C-band, 3700-4200 MHz, used for FSS downlinks, is the principle delivery vehicle for video in the United States. Disruption of these essential communications links could have devastating results on the provision of satellite communications services in the United States. Consequently, SIA and its member companies are extremely concerned about the possible proliferation of unlicensed transmitters in this portion of the extended C-band.

In an earlier proceeding involving the reallocation of the 3650-3700 MHz band from government to commercial use, the Commission allocated this spectrum on a co-primary basis for fixed and mobile (base stations only) terrestrial services, to be licensed by auction, and grandfathered certain FSS operations from interference from these terrestrial operations.³ In that proceeding, the FCC created a 200 km exclusion zone around each grandfathered earth station, encompassing large portions of the most populous regions of the United States, unless the earth station operator agreed to shorter spacing after coordination. FSS commenters generally supported the proposed 200 km coordination distance, but raised concern that this distance may

³ The Commission concurrently issued a second notice of proposed rulemaking to establish licensing and coordination rules in the band. *Amendment of the Commission's Rules with Regard to the 3650-3700 MHz Government Transfer Band*, First Report and Order and Second Notice of Proposed Rule Making, 15 FCC Rcd 20488 (2000) ("*First R&O and Second NPRM*").

provide insufficient protection from fixed systems aimed directly at a co-frequency earth station's boresight.⁴

In the *Notice*, despite the pendency of the *Second NPRM* to establish licensing and coordination rules in the 3650-3700 MHz band, the Commission proposes to add yet another use to the band: unlicensed devices. Such devices, transmitting at low power levels (typically 1 watt or less), are permitted to operate on a non-interference basis only in certain frequency bands shared with authorized services, pursuant to Part 15 of the Commission's Rules. Currently, however, unlicensed devices are not authorized to operate in bands allocated to FSS downlink operations, which are particularly sensitive to interference.

Without providing any relevant data, the *Notice* suggests that unlicensed devices could operate in the 3650-3700 MHz band without causing interference to incumbent FSS operations. The *Notice* seeks comment as to whether unlicensed devices can operate in the 3650-3700 MHz band at power levels even greater than one watt without causing interference into the FSS downlinks and other current and future users of the band. SIA's technical analysis demonstrates that unlicensed devices of one watt or higher operating in the 3650-3700 MHz band will be expected to cause harmful interference to grandfathered (and therefore primary) and secondary FSS downlinks absent relatively large exclusion zones that would effectively prohibit unlicensed operations in large portions of the country, and that unlicensed devices could share the 3650-3700 MHz band with the FSS without imposing large exclusion zones only if operating at extremely low and commercially unattractive power levels. Moreover, exclusion zones could

⁴ See, e.g., *Lockheed Martin Corp. Comments in the Matter of Amendment of the Commission's Rules with Regard to the 3650-3700 MHz Government Transfer Band*, ET Docket No. 98-237, RM-9411 (filed Dec. 18, 2000); *Inmarsat Comments in the Matter of Amendment of the Commission's Rules with Regard to the 3650-3700 MHz Government Transfer Band*, ET Docket No. 98-237, RM-9411 (filed Dec. 18, 2000).

not be used to protect FSS operations in the adjacent conventional C-band from out-of-band emissions. Accordingly, SIA opposes permitting unlicensed devices to operate in the 3650-3700 MHz band regardless of power level.

II. THE OPERATION OF UNLICENSED DEVICES IN THE 3650-3700 MHz BAND WOULD SUBJECT INCUMBENT FSS STATIONS TO HARMFUL INTERFERENCE THAT CANNOT PRACTICALLY BE PREVENTED

As the Commission recognized in the *Notice*, operation of an unlicensed device under Part 15 is subject to the conditions that the device not cause interference to authorized services, and that the device must accept any interference received.⁵ Accordingly, all FSS downlink operations in the 3650-3700 MHz band, including grandfathered primary earth stations sites and all existing and future FSS earth stations, must be fully protected from interference. As discussed below and in the attached Technical Appendix, however, the unlicensed devices proposed by the FCC, at the power levels contemplated by the Commission, can be expected to cause significant interference to FSS downlink operations, and thus cannot be authorized in the band.

A. Although it is Difficult To Model Accurately Interference from Unlicensed Devices, it is Clear that Unlicensed Operations Would Cause Substantial Interference Into FSS Downlinks in the 3650-3700 MHz Band

As an initial matter, there are a large number of unknown variables to be considered in evaluating the ability of unlicensed devices to operate co-frequency with FSS downlinks on a non-interference basis. Not only are the technical parameters of unlicensed devices proposed for the band unknown but—given their unlicensed nature—the potential number of devices deployed in a geographic region and their orientation vis-à-vis neighboring FSS earth stations

⁵ *Notice* at ¶ 2.

cannot be determined. Furthermore, FSS earth stations typically are licensed to communicate with multiple satellites at various locations, requiring them to be protected along their entire coordination arc rather than a single, permanent azimuth and elevation angle. Thus, any effort to model the interference scenario resulting from the Commission's proposal is fraught with uncertainty. Because unlicensed devices must operate on a non-interference basis, however, the Commission must make conservative assumptions and evaluate worst-case scenarios to protect incumbent FSS operations, particularly because FSS downlinks are extremely sensitive to interference.

Moreover, the interference calculations in this proceeding cannot be finalized absent a final determination of technical issues, such as permissible power levels and other operational parameters of fixed service ("FS") transmitters, in the Commission's other pending proceeding regarding the 3560-3700 MHz band.⁶ As numerous satellite licensees have noted, technical details of FS transmitters currently are insufficient to assess adequately the required separation distance from an FSS earth station.⁷ Thus, as with the analyses submitted in connection with that separate proceeding, SIA's comments and analysis herein are preliminary.

Further exacerbating the difficulty in analyzing the interference impact of unlicensed use of the extended C-band is the Commission's suggestion that unlicensed devices in this band might be able to employ power levels higher than the maximum permitted for unlicensed devices in other frequency bands (*i.e.*, greater than one watt), with only "minimal restrictions except

⁶ See generally *Second NPRM*.

⁷ See, e.g., *Lockheed Martin Corp. Comments in the Matter of Amendment of the Commission's Rules with Regard to the 3650-3700 MHz Government Transfer Band* (filed Dec. 18, 2000); *Inmarsat Comments in the Matter of Amendment of the Commission's Rules with Regard to the 3650-3700 MHz Government Transfer Band* (filed Dec. 18, 2000).

those necessary to avoid harmful interference to licensed users in the band.”⁸ The potential for unlicensed transmissions at increased power levels and with minimal operational restrictions is contrary to the requirement that Part 15 devices be operated on a non-interference basis only. Indeed, although the Commission does not suggest what restrictions might be eliminated or what power level may be considered for unlicensed operations, the attached Technical Annex establishes that the proliferation of unlicensed transmitting devices at other than the lowest power levels could cause grave harm to existing and future FSS operations.

B. Interference from Unlicensed Devices in the 3650-3700 MHz Band Would Be In Addition to that Caused By Existing and Future FS Transmitters

As described in the attached Technical Appendix, the operation of unlicensed devices in the 3650-3700 MHz band will cause significant interference into FSS downlinks. This interference would be in addition to that caused by existing FS transmitters, as well as those to be deployed in the band after the Commission concludes its separate rulemaking to establish licensing and coordination rules for other commercial use of the band.

Grandfathered extended C-band earth station operations already are degraded by the interference from FS operations in this part of the extended C-band. The out-of-band emissions of the FS operations falling within the adjacent conventional C-band, which is heavily used by FSS operators, also degrade primary FSS earth station operation. Permitting additional and potentially intense use of the 3650-3700 MHz band would further increase the noise floor of the FSS earth stations in both conventional and extended C-bands.

Yet, in the *Notice*, the Commission does not appear to recognize that interference into FSS downlinks resulting from unlicensed use of the 3650-3700 MHz band is additive to that

⁸ *Notice* at ¶ 20.

caused by the FS transmissions tentatively evaluated in its separate extended C-band rulemaking. However, if the Commission assumes in each docket that FSS operations could accept, for example, a 10 percent increase in the noise floor, the inevitable result will be a 20 percent increase in the noise floor, substantially diminishing satellite link margins.⁹ The Commission cannot avoid its public interest responsibility to prevent interference to licensed radio facilities from unlicensed devices by ignoring the issue of cumulative interference simply because the issue arises in two separate (but related) proceedings.¹⁰ As discussed herein however, even if the interference from future FS systems were discounted, the interference from all but extremely low power unlicensed devices would cause unacceptable degradation in C-band downlink receivers.

C. Unlicensed Operations in the 3650-3700 MHz Band at Commercially Practical Power Levels Would Cause Unacceptable Interference Into FSS Downlinks Operating in the Same Band

SIA's preliminary technical analysis demonstrates that it is not possible for unlicensed devices to operate in the 3650-3700 MHz band at commercially practical power levels without causing unacceptable interference to FSS downlink operations. Because unlicensed devices are permitted to operate on a non-interference basis only, the 3650-3700 MHz band should be eliminated from consideration as a candidate band for further unlicensed deployment.

Unlicensed devices operating at power levels of 1 watt would require large exclusion zones around all authorized FSS earth stations in the band to protect their operation (using worst-

⁹ This is particularly true because both proceedings have thus far ignored the increased potential for interference should a licensed or unlicensed fixed transmitter be located in the boresight of the victim FSS receiver.

¹⁰ *ITT World Communications, Inc. v. FCC*, 725 F.2d 732, 754 (D.C. Cir. 1984) (FCC may not “resolve some issues and ... defer the resolution of other issues when the issues decided were ... inextricably related to the issues deferred.); *id.* (“[A]n agency does not act rationally when it

case assumptions to protect licensed earth stations), and operation of unlicensed devices at a power higher than 1 watt would require even larger exclusion zones around these FSS earth stations. At these power levels, SIA calculates that exclusion zones at boresight might extend all the way to the radio horizon.¹¹ In this connection, it is important to note that FSS earth stations typically are licensed to communicate with a number of satellites at various orbital locations, rather than with a single azimuth and elevation angle. Thus, the relevant “boresight” of a given FSS earth station for interference protection purposes may actually be an arc defined by its authorized azimuths, rather than a single straight line. Given the number and geographical distribution of FSS earth station sites and the size of the exclusion zones required for power levels of 1 watt or more, such an approach effectively would render large parts of the United States (including many populated areas on the East and West coasts) unusable by unlicensed devices, undermining any hypothetical public interest benefits of the new allocation.

Enforcing any prohibition on unlicensed devices in such large areas would be very difficult, if not impossible, given that such devices would not be subject to site-by-site licensing or registration requirements. The FCC might consider requiring each emitter to have both an on-board GPS unit to determine its precise location and distance from licensed users and an automatic shut-down circuit. Although the incorporation of GPS into unlicensed devices possibly could be a means of restricting their transmissions to the areas outside of the exclusion zones, the reliability of such an approach is highly questionable, especially without mandating an automatic shut-down circuit. Moreover, even were unlicensed devices in the band required to include both GPS and automatic shutdown, such devices still could not determine if they were in

chooses and implements one policy and decides to consider the merits of a potentially inconsistent policy in the very near future.”).

a side or frontlobe of the FSS earth station antenna. Moreover, it is unclear whether including GPS into unlicensed devices would be financially feasible and commercially viable.

The unlicensed nature of the Commission's proposal also makes it impossible to monitor or regulate the number, location or orientation of such devices relative to licensed FSS earth stations. As a result, if an FSS earth station were to receive interference from one or more unlicensed devices, the earth station licensee would likely be unable to determine the source of the interference. Indeed, even though the possibility of "multiple entry" interference from several simultaneous interference sources is quite real, there is no practical way to derive the appropriate protection criteria because the sources of the interfering signals themselves will be unknown and randomly placed. The FSS operators should not be exposed to such a high risk, particularly from unlicensed devices that are supposed to operate only on a non-interference basis.

SIA understands that, in a perfect world, extremely low power devices might be able to share extended C-band FSS downlink spectrum in some areas of the country. As demonstrated in the Technical Analysis, however, unlicensed devices could not protect FSS downlink operations absent detailed, stringent and enforced limits on power, antenna gain, number, and antenna orientation, as well as a requirement to include accurate position determination and circuits that automatically cease transmissions when in any exclusion zone. Such theoretical restrictions are so at odds with current Part 15 policy that, as a practical matter, it is difficult to see how those restrictions could be safely applied and enforced.

¹¹ See Technical Exhibit, Table 2.

D. Out-of-Band Emissions from Unlicensed Operations in the 3650-3700 MHz Band at Commercially Practical Power Levels Would Interfere with FSS Downlinks Operating in the 3700-4200 MHz Band

In its *Notice*, the Commission recognized the risk that out-of band emissions from unlicensed 3650-3700 MHz devices operating with a power of one watt or more would interfere with satellite reception in the adjacent, conventional 3700-4200 MHz band.¹² That risk is of serious concern to SIA. FSS earth stations operating in the 3700-4200 MHz band, like those in the 3650-3700 MHz band, are particularly sensitive to interference, because they must receive transmissions from satellites located 22,300 miles away. Moreover, because the conventional C-band is the primary source of video downlinks in the United States, interference in the band would be devastating, impairing the distribution of news, weather, sports, and other essential programming that informs and entertains the public and on which life and safety can depend.

As explained in Section II.C above, unlicensed devices in the extended C-band will cause harmful interference to primary users of the band unless the unlicensed devices can accurately and reliably determine their location vis-à-vis earth stations that are operating in the band and can effectively be prevented from transmitting in any exclusion zone. As impractical as this “solution” is when it comes to preventing interference to 3650-3700 MHz downlinks, it is still more unrealistic in the case of downlinks in the adjacent 3700-4200 MHz band.

Unlike operations in the extended C-band, operations in the conventional C-band are not confined to a limited number of “fixed operations at known geographic coordinates.”¹³ Instead, conventional C-band receivers are widely used for video downlinks and increasingly being deployed for smaller dish “CSAT” services. In the case of many receive only C-band dishes

¹² *Notice* at ¶ 21.

¹³ *Notice* at ¶ 20.

operating on an unlicensed basis, there is not even a record identifying the earth station's location, making it impossible to program location information into an unlicensed wireless device or to specify the boundaries of an exclusion zone. Even if that information could be ascertained (and it cannot), the vast number of C-band receivers combined with the potentially large size of the exclusion zones effectively would prevent operation of unlicensed devices in major portions of the United States.

There is an additional layer of impracticality when it comes to avoiding interference to earth stations operating in the 3700-4200 MHz band. New conventional C-band earth stations continue to be deployed in significant numbers because, among other factors, this traditional FSS spectrum is allocated both domestically and internationally for FSS services on a primary basis and is free of the restrictions imposed on extended C-band operations. Consequently, even more than in the extended C-band, any solution to harmful interference that requires avoiding existing FSS earth stations that transmit in the standard C-band would be regularly outdated by the addition of new earth stations. In short, because the locations of FSS earth stations in the standard C-band are ubiquitous, unknown, and constantly changing, any interference solution that relies on exclusion zones to protect these stations is unworkable.¹⁴

¹⁴ The size of the exclusion zone for 3700-4200 MHz earth stations could be reduced if wireless devices in the adjacent band were required to use filtering to attenuate their out-of-band emissions. A smaller exclusion zone, however, would not eliminate the impracticality of avoiding a universe of stations that is large, changing, and not fully known. In any event, requiring filtering would raise its own set of issues. RF filtration would be prohibitively expensive, and IF filtration would impair efficiency, reducing the utility and marketability of the filtered devices and undercutting the Commission's stated goal of "increasing the operational range" of wireless devices. *Notice* at ¶ 21. These obstacles become increasingly severe as the power of the unlicensed wireless device increases. Moreover, the cumulative cost of attenuation requirements and the requirements necessary to protect in-band earth stations could tend to discourage, if not eliminate, production of conforming devices.

III. THE 3650-3700 MHz BAND IS NOT NEEDED FOR UNLICENSED DEVICES

The central premise of the FCC's *Notice* is that additional spectrum is needed for wireless devices offering Wi-Fi-type services. The FCC proffers no evidence for this, nor does such evidence exist. In fact, this band is not the international standard band for Wi-Fi (the allocation will be domestic only, given the use by FSS earth stations in Regions 1 and 3). The standard bands for Wi-Fi are 2.4 GHz and 5 GHz. Substantial development in those bands is already underway and additional spectrum half-way between the two existing bands will not permit significant new Wi-Fi capabilities. As a result, SIA is not aware that there is any current manufacturing effort underway for unlicensed equipment in the extended C-band.

The FCC's *Notice* thus goes well beyond the needs of the Wi-Fi industry. Good and useful Wi-Fi equipment has been deployed at 2.4 GHz for only a few years, and is just being introduced at 5 GHz today; any possible expansion of Wi-Fi systems into the 3650-3700 MHz band logically should await higher loading in already-authorized spectrum. Thus, consideration of the extended C-band frequencies for Wi-Fi expansion is not only misplaced for the reasons outlined above, it is also wholly premature.

IV. CONCLUSION

SIA's technical analysis shows that the operation of unlicensed devices in the 3650-3700 MHz band at any commercially attractive power level poses an unacceptable risk of harmful interference to the longstanding operations of incumbent FSS operators absent significant limitations that would render their use impractical. The Commission's suggestion to allow such unlicensed operations, if adopted, would exacerbate the unfortunate effects of the Commission's reallocation of the extended C-band to the FS, which already has severely impeded the development of FSS satellite systems, stranded investment in in-orbit satellites and disrupted

services to existing customers. The public interest clearly would not be served by further hamstringing the operations of FSS operations in the band. For these reasons, SIA strongly opposes the Commission's suggestion to allow the use of unlicensed devices in the 3650-3700 MHz band.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "R DalBello". The signature is fluid and cursive, with the first name "Richard" and last name "DalBello" clearly distinguishable.

Richard DalBello, President
SATELLITE INDUSTRY ASSOCIATION

April 17, 2003

TECHNICAL ANNEX

The *Notice* seeks comment on a number of technical issues that would be raised by authorizing unlicensed devices in the 3650-3700 MHz band. SIA undertook a technical analysis to evaluate the potential impact of the operation of unlicensed devices on FSS downlinks in the band.

At present, the 3650-3700 MHz band is “restricted” and thus unavailable to unlicensed devices. Removing the 3650-3700 MHz block from the “restricted” band will increase the potential for interference into FSS earth stations in the band. By definition, unlicensed devices—which operate on an unprotected, non-interference basis only—should not be permitted to cause harmful interference to, nor harmfully degrade, licensed FSS services. This might be possible only if unlicensed devices radiate power levels not significantly higher than current spurious emission limits. Such low power levels, however, are not technically or commercially viable. With increased power (or antenna gain)—especially the one watt or greater systems discussed by the FCC—it would be impossible to prevent FSS downlinks from receiving debilitating interference from co-frequency unlicensed devices absent impractically large exclusion zones.

The FCC appears to suggest that FSS downlinks could tolerate some degradation in the noise floor caused by the introduction of unlicensed devices. But the Commission fails to acknowledge that further acceptable degradation can only be considered in the aggregate and apportioned for each interference source, whether licensed or unlicensed. It is impossible, however, to establish an accurate aggregate to single entry value at this time. The value could be from 10 – 1000 depending on the region (rural to urban) and on the density or uptake of these devices by the general public.

If limited in number and restricted to very low power (such as the current 500 $\mu\text{V}/\text{m}$ limit on spurious emissions from out-of-band transmitters), unlicensed fixed service might be able to share spectrum with FSS. The Commission appears, however, to be considering dramatically higher powers or antenna gains, with no coordination—meaning no restrictions on the concentration or orientation of the devices.

As stated above, the maximum interference level from such unlicensed devices has to be set to minimize the net increase in the noise floor of an FSS earth station from all the interferers within a specific distance of the earth station antenna. Two critical parameters in determining the exclusion zone distance from an earth station are the noise temperature of the Low Noise Amplifier receiver and the gain of the earth station antenna.

In standard sharing situations between the FSS earth station and terrestrial fixed line-of-sight station a coordination area¹ is calculated around the FSS earth station based on a very low probability (0.0017% of the time) of interference from the terrestrial station into the earth station. In the case of the unlicensed devices no coordination methodology is being proposed and it is assumed this zone would be an exclusion zone to ensure the probability of interference would be very small. The concept of exclusion zones around an FSS earth station for unlicensed operation is something new and no studies have been conducted to determine the allowable interference level for an appropriate percentage time. This percentage time would depend on the I/N protection ratio and should be consistent with the fact that unlicensed operation should not impair the operation of the existing FSS earth stations. However, in determining the exclusion zone for the purpose of this NOI, this study has assumed an interference degradation equivalent to 10% of the earth station noise floor, for a typical FSS earth station operating in the 3650-3700

¹ See ITU Radio Regulations, Appendix 7.

MHz band. It is further assumed that only a single unlicensed device is causing this 10% degradation in the earth station noise floor. However, depending on the deployment of such devices, the aggregate interference might be more appropriate. Three power levels for the unlicensed devices were assumed in order to calculate the required exclusion zone.

The three output power levels for unlicensed devices were assumed to be 500 uV/m at 3 meters, 50 mV/m at 3 meters, and 1 watt, specified over a 50 MHz bandwidth. If the Commission were to specify the above power levels over a smaller bandwidth the exclusion zones could be proportionally larger. Presently, spurious emissions in the C-band are limited to 500 uV/m at a distance of 3 meters, as specified in Part 15 of the FCC rules.² In other adjacent bands unlicensed devices are limited to a field strength of 50 mV/m at a distance of 3 meters, while spread spectrum systems in the 2483.5-2500 MHz (over one Gigahertz away) may transmit up to one watt (output power). Based on the above three power levels the separation distance was calculated that would be required to meet a -10 dB I/N ratio at the earth station receiver (a 10% increase in the noise floor).

Figure 1 shows the typical antenna gain towards the horizon for an FSS earth station operating at five degrees elevation. This is based on an antenna sidelobe gain pattern of $32-25\log(\Theta)$, which would apply to any earth station with a $D/\lambda > 50$. The other FSS earth station parameters are summarized in Table 1 below.

² See 47 CFR § 15.205.

Table 1: FSS earth station parameters

Typical FSS Link	Parameter
Antenna Diameter (m)	>4m
Systems Rx Noise Temp. (K)	100
Receiver bandwidth (MHz)	50
Satellite Link Noise floor (dBW)	-131.6
Aggregate Interf. Level (10%) (dBW)	-141.6

The required separation distance (exclusion zone) between an unlicensed device and an FSS earth station operating at an elevation angle of 5 degrees is shown in Figures 2 to 4. These distances are based on free space spreading loss and assuming a 10% increase of the noise floor of the FSS earth station. No attempt has been made to include any terrain blockage or surface roughness factor because the height of the earth station antenna could vary from 7.5m to 40m and the height of the unlicensed device could vary from 3m to 20m depending on the application. In addition, the exact terrain characteristics, urban, non-urban, rural, etc. are not known. The Commission has stated that “higher power limits and high gain antennas”³ might be used, which infers that such devices could be operated in fixed locations for distribution purposes. Based on these statements, the study only assumes free space loss at this time. Table 2 summarizes the minimum and maximum distances around any FSS earth station operating at 5, 10 and 20 degrees elevation, except no figures are given for the 10 and 20 degree elevation angles.

³ Notice at ¶ 21.

Table 2: Summary of exclusion zone distances for an ES at various elevation angles

EIRP of Unlicensed Device	ES @ 5 deg. Elev.		ES @ 10 deg. Elev		ES @ 20 deg. Elev	
	Min.Dist.	Max.Dist.	Min.Dist.	Max.Dist.	Min.Dist.	Max.Dist.
0.075 μ W (500 uV/m @ 3m)	6.8 m	114 m	6.8 m	48 m	6.8m	20.2 m
0.75mW (50 mV/m @ 3m)	0.7 km	11.4 km	0.7 km	4.8 km	0.7 km	2.0 km
1 Watt	24.7 km	416 km*	24.7 km	175 km*	24.7 km	73.6 km*

* Note: The minimum line-of-sight distance could be approximately 17 km if the antenna heights for the unlicensed device and the ES were assumed to be 2m and 7.5m respectively, or a maximum line-of-sight distance of approximately 22 km if the antenna heights were assumed to be 5m and 10m respectively. Harmful interference might still occur beyond these line-of-sight distances for short percentages of time.

Table 2 clearly shows that even for earth stations with elevation angles of 20 degrees very large separation distances would be required if unlicensed devices operated with 1 watt eirps. In response to the Commission’s request for comments on the use of higher power levels with higher antenna gain or directivity, this study clearly shows any such increase would result in even larger exclusion zone distances.

The attached Figure 5 shows the grandfathered FSS and Radiolocation sites in the 3650-3700 MHz band. This is an extract of Appendix G of the FCC’s *First R&O and Second NPRM*.⁴ The exclusion zone in Appendix G is 200km, which provides a good indication of the large areas throughout the United States which would have to be excluded if unlicensed devices were allowed in this band, especially with higher power levels and high gain antennas. Of course, in addition to protecting the grandfathered earth station sites indicated in Appendix G, unlicensed devices also would be required to protect subsequently licensed extended C-band earth station facilities, which are not depicted in the figure.

⁴ 15 FCC Rcd 20488 (2000).

Figure 1: FSS ES antenna gain pattern @ 5 degrees Elevation

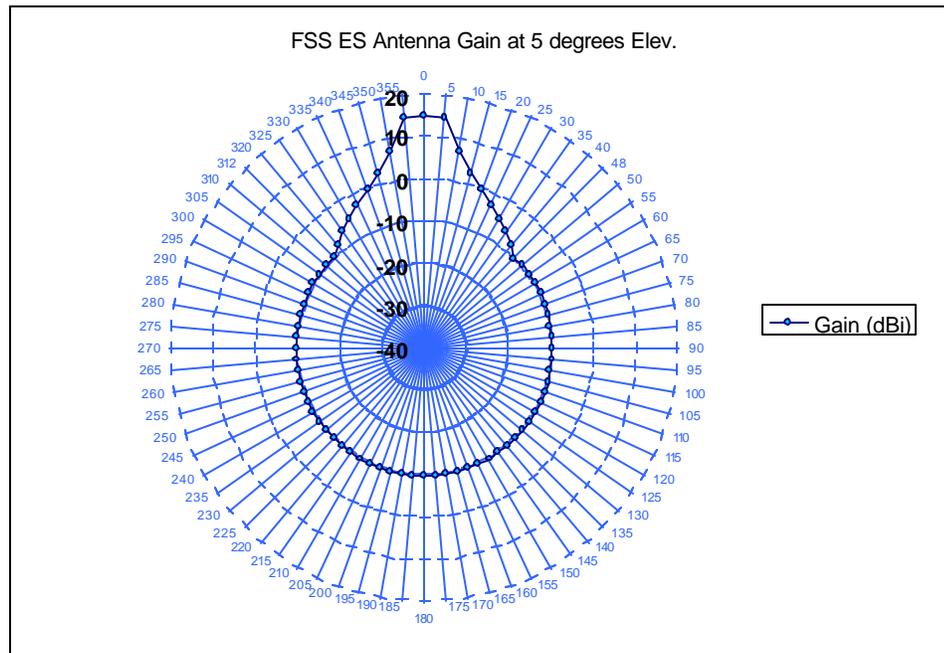


Figure 2: Exclusion Zone for a 500uV/m Unlicensed

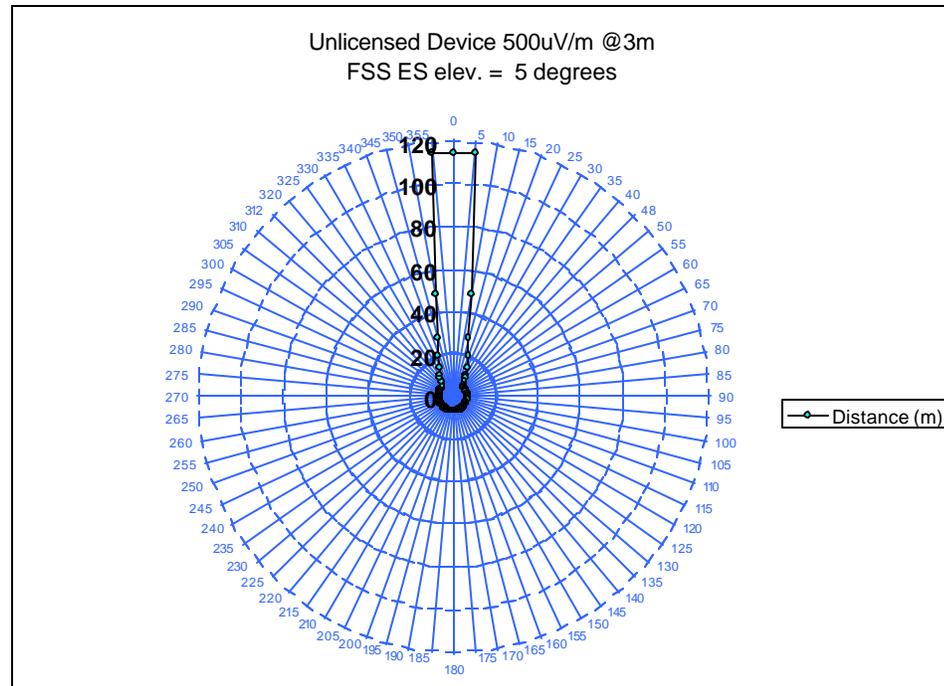


Figure 3: Exclusion Zone for a 50mV/m Unlicensed Device

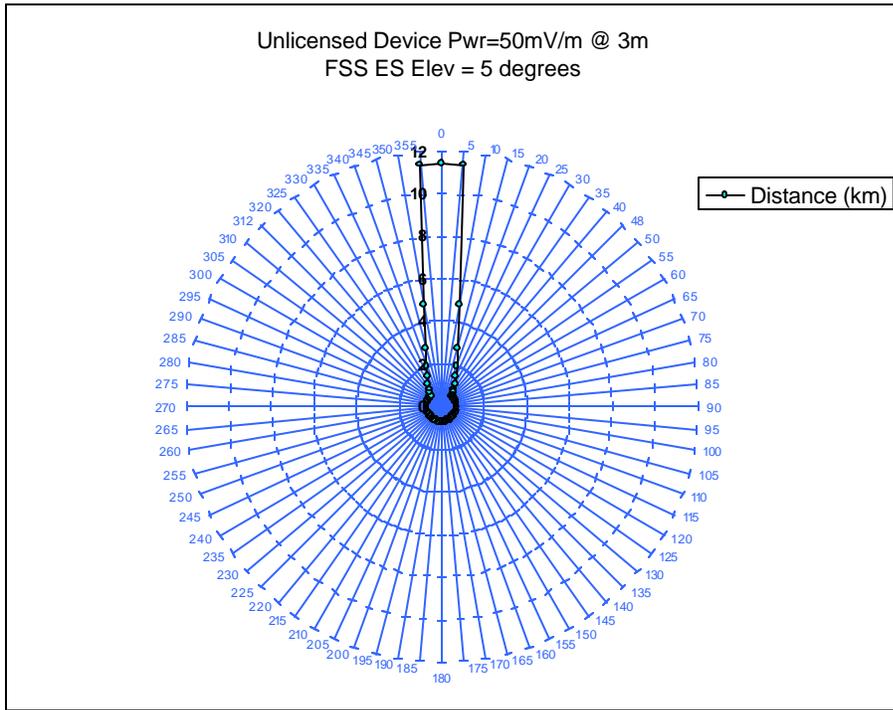


Figure 4: Exclusion Zone for a 1Watt Unlicensed Device

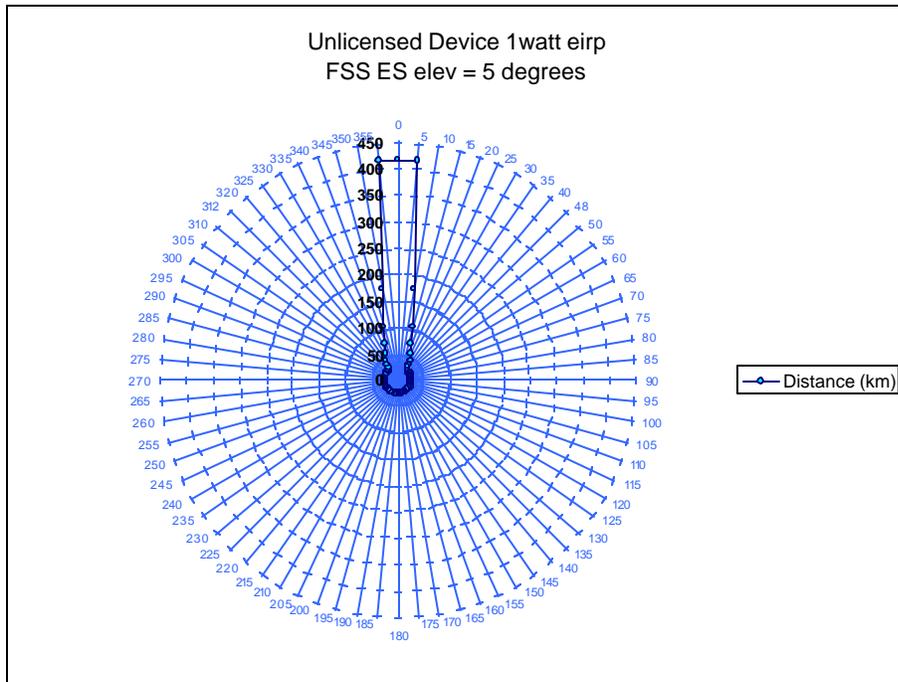


Figure 5

Extract of Appendix G, from FCC R&O 00-363 (October 24, 2000)

